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Austrian Society for Surveying and Geoinformation

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Geodetic Education at the "Politehnica" University of Timisoara – Romania

Carmen Grecea, Timisoara

1. Introduction

The paper describes the engineering programs and specific educational objectives in geodetic higher education from Politehnica University of Timisoara"; it offers a short presentation of the Romanian cadastral situation and aspects of the transition in the educational system.

2. Generals on the Romanian Cadastre

During its evolution in Romania, geodetic activity, especially cadastral works dealt with many economical and political changes and obstacles. That's why, nowadays, the most important task of the new cadastral policy is to assure the informatization of this activity, related to general and multipurpose cadastre, to provide a complete evidence of land and buildings in order to design the territory in a convenient way with environmental protection.

In time, it's role remained just the same, but the methods, technical tools and principles in organization changed a lot due to the progress in informatics and technology specific to geodetic work and also due to the inner conditions of the Romanian society.

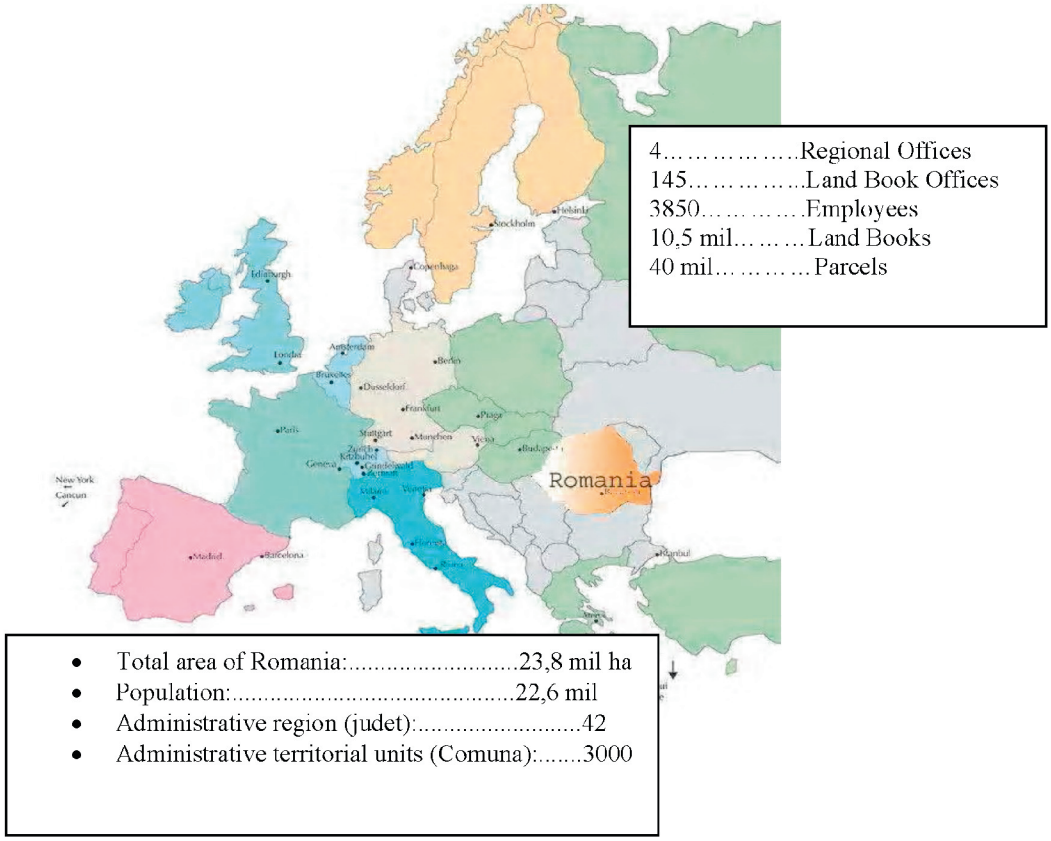


Fig. 1: RO - General context

Through cadastre work one can collect and store a big amount of technical, juridical or economical information and all this job can be efficient if the access to these documents is quick, convenient and reflects the reality. The main quality of a modern cadastre is represented by the use of digital data at any level of the process.

Transformation of the present informational system into database system supposes the organization of all information into separate files, which are closely, related one to another.

The primary data processing for computation of the land surfaces for a property is quite simple at this first level but it becomes very difficult due to the huge number of parcels and owners and also to the existence of a great amount of corrections in the adjustment of the territory (around 7 million owners and a total surface of about 9 million hectares, and if we take into consideration a medium number of 6 parcels/owner, it's necessary to create and determine by cadastral survey a number of about 40 million parcels – for Romania), fig.1.

This situation requires the elaboration of special, modern methods for data processing inside the local agencies for cadastre which offer the following possibilities:

- to collect the primary information using the electronic equipment which provides a convenient processing in addition;
- to collect by graphical tools the data which can be obtained by digitizing the parcels directly on the cadastral plans (this aspect implies the use of the existing data);
- to compute and evaluate specific elements useful for the preparation of the final cadastral registers in the form of individual files;
- to draw up the new cadastral plans or to update the old ones;
- to create the database of the general cadastre.

The new tendencies of automation in this research area impose the necessity of restoration the topographic and cadastral plans in the digital form.

3. Surveying and Cadastre Education in Romania

The education and training in Geodetic Engineering are at graduate and postgraduate levels. Graduates from the branch of *Terrestrial Measurements and Cadastre* can spatially locate and map natural and artificial configurations, develop control point networks, perform engineering and cadastral measurements. Graduates can also design and manage economic solutions for geodetic problems at a high engineering level. They can develop relevant technologies and perform scientific research.

The program taught in Romanian Universities (fig.2) follows a traditional European curriculum and leads to the Dipl.Ing.Degree, which is regarded as an equivalent to the M.Sc.Degree. The Romanian educational program operates with the credit system, the teaching period is four years long, in total 240 credits. The curriculum consists of compulsory subjects, optional and elective subjects, including in the eighth semester a period of 7 weeks which is reserved for preparing the diploma project. According to the strict requirements every student has to learn a foreign language and take a language exam of medium degree. Postgraduate or Ph.D. courses normally take three years to complete.

3.1 B.Sc. Degree

The first 3 semesters of B.Sc. feature a universal, fundamental education, while the subsequent semesters exclusively include the subjects of Geodetic Engineering and Cadastre. The students take 4 exams each semester and 4 colloquia.

In the first four semesters, students take a 27 hour/week block of compulsory subjects that provide fundamental education in the branch of study. During the other four semesters, they have 26 hour/week of compulsory, optional, and elective subjects in order to diversify and extend their knowledge. Part of the eighth semesters is reserved for planning diploma project (7 weeks), completed by another 7 weeks of teaching. On successful completion of the eight semesters, final exams and the diploma project, a student will be granted with B.Sc.Degree.

3.2 M.Sc.Degree

Students who already hold B.Sc. Degree, can pursue an M.Sc.Degree in the same field of study. They generally follow an approved curriculum, but elective subjects allow personal interests. Courses are run for small groups and the students are expected to work individually under the direction of a personal advisor.

A M.Sc. programme is 4 semesters, or 2 years in duration and consists of 14 hours (usually) of instruction per week and 4 examinations per semester (starting with academic year 2009/2010

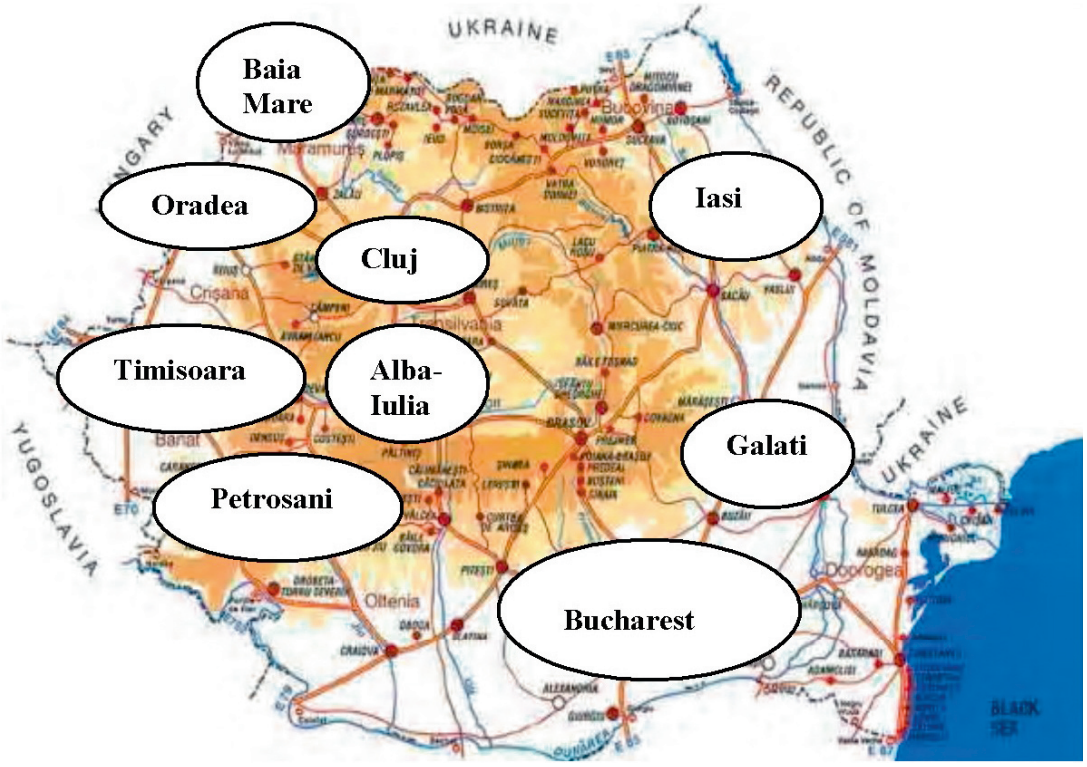


Fig. 2: Geodetic Educational Training in RO

for the Bologna program). A M.Sc. degree is granted on the successful completion of thesis and final exams.

Governmental Accreditation Committee and the Romanian Agency for Quality Assurance in Higher Education review the applications for each study program and each of its specializations for the given period. The assessment relates primarily to content of the program (specialization), number, quality and age of teachers, facilities of the given university. The accreditation is taken away from the university in case the requirements are not satisfied.

4. Educationin the "Polithenica" University of Timisoara

Timisoara is a large economic and cultural town in Banat region, in the west of the country.

It is also the capital of Timis county. The city is also called "Little Vienna", because it belonged for a very long time to the Habsburg Empire and the entire city center consists of buildings built in the Kaiser era, which is reminiscent of the old Vienna.

In recent years, Timisoara has enjoyed a significant economic boom as the number of foreign investments has risen constantly. It is considered to be the second most prosperous city in Romania (following Bucharest). Timisoara is an important university center with the emphasis on subjects like medicine, engineering, humanistic.

The "Politehnica" University is one of the largest and best-known technical universities in Central and Eastern Europe. For 80 years it has been an outstanding, modern university with a well-deserved reputation for excellence. This excellence is demonstrated by the academic programs, the research on which these programs are based, the support given to students, the employability and employment record of the students and the physical environment of the University. The "Politehnica" University of Timisoara has 10 faculties and several independent departments Ydelivering the academic programswhich are modern, relevant, intellectually stimulating and represent the highest quality in their respective disciplines. Being aware of the importance of the international collaborations,

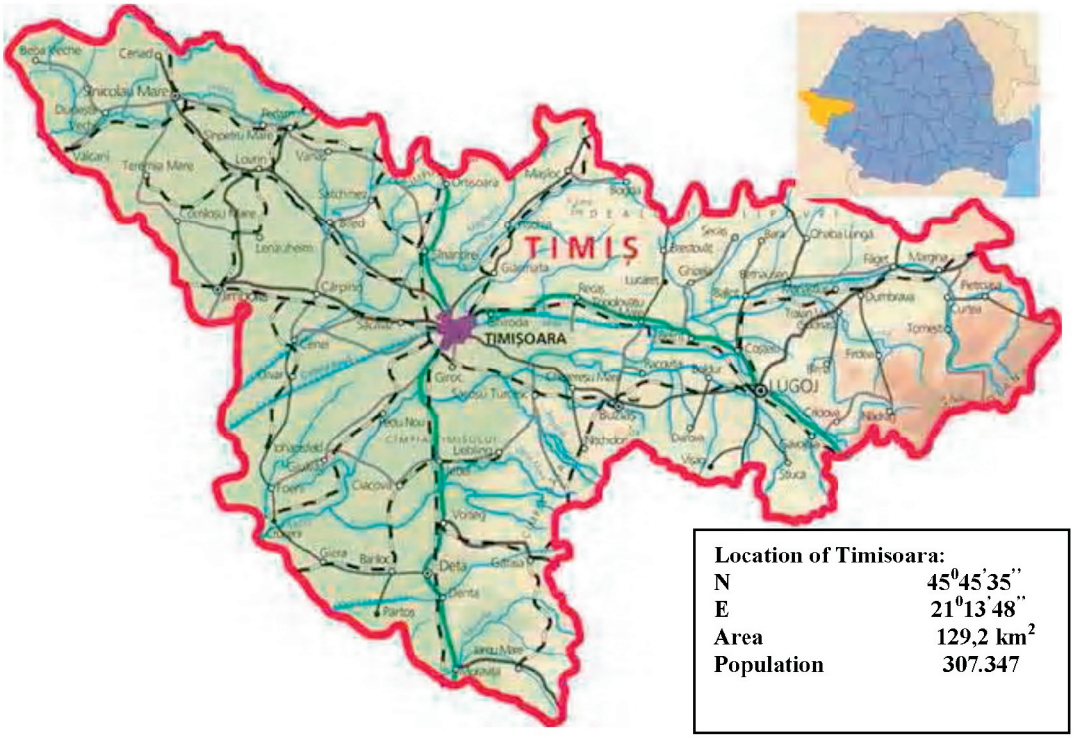


Fig. 3: Timisoara - Location

directly related to the mission and the objectives already stated, the "Politehnica" University of Timisoara has continuously extended and developed the relations with foreign partners through projects, programs and activities of learning and scientific research. The developing strategy for cooperation programs between the University and foreign partners is based on two coordinates:

- to take part in programs and projects financed by the European Union;
- to establish as many bilateral agreements as possible with universities from Europe and other continents.

The "Politehnica" University of Timisoara has focused on concluding agreements with universities from all over the world. Due to the agreements signed between the faculties, the departments have established mutual relations and facilities.

Speaking about the strategy of the management of international relations, in the "Politehnica" University of Timisoara was created the Department for International Programs and Relations. This department is directly coordinated by the Rector and the Scientific Secretary and it assures the coordination, the evidence and monitoring of the international programs. This department has the following functions:

- representation, protocol and public relations in the international agreements field;
- evidence and monitoring of the programs and activities of academic collaborations;
- initiates the international collaboration, gathers information and acquires it;
- keeps the evidence of the official trips;- offers advice for the use of the financial resources needed in collaborations.

Starting with academic year 2005/2006 the University adhered to the Bologna System with 3 levels for studies:

1. Bachelor's Program – **B.Sc. Degree,**
2. Master's Program – **M.Sc.Degree,**
3. Doctoral Program – **PhD,**

so that, in the current academic year four programs are part of the Bologna project (I-II-III-

IV years of study), and one program is part of the old project (Vth year of study).

The educational program at the "Politehnica" University of Timisoara is based on the credit system (ECTS). **The branch of Terrestrial Measurements and Cadastre** from the Faculty of Civil Engineering offers full-time degree programs in Romanian language only.

5. Program of terrestrial Measurements and Cadastre in Timisoara

Within the "*Politehnica*" University of Timisoara, Faculty of Civil Engineering this programme was founded in **1991**, being registered in the Romania's Official Monitor of 13 May 2002, in the section accredited specializations.

The development of the geodetic profile was imposed, both locally and nationally, out of the economic and scientific needs, i.e. the lack of experts in this field of activity.

This speciality belongs to the field of *Geodetic Engineering,* a distinct profile in the Romanian National Nomenclature of Specialities.

The structural changes, which occurred in our country after 1989, due to the development of the private properties and the passing to the market economy, also led to fundamental changes in the field of cadastre; both in what the record of the real assets and cadastral plans are concerned.

The update and the modernization of the cadastre, in order to make it multifunctional, require a large number of specialists and if at all possible a uniform national distribution.

At the University of Timisoara, from 1991-2008 more than 300 geodetic engineers were formed in the 12th series of graduates.

The curriculum is adapted for the open higher education system, and the syllabuses are correlated to similar national and international programs, in order to comply with the European Credit Transfer System.

In order to meet the required future objectives, the geodetic engineer needs a thorough training in the field of terrestrial measurements. This can only be ensured by the study of both fundamental courses (mathematics, physics, techniques of calculus, etc.) and speciality courses (Topography, Geodesy, Cartography, Photogrammetry, Cadastre, etc), Table 1,2.

Nr.	Discipline	Hours				Weight	ROregimentations
		C	S	L	TOTAL	%	
1	FUNDAMENTAL	308	168	126	602	18,59	min.18%
2	IN DOMAIN	518	–	767	1285	39,68	min.38%
3	SPECIALITATY	497	–	700	1197	36,97	min.25%
4	COMPLEMENTARY	14	140	–	154	4,76	max.8%
TOTAL		1337	308	1593	3238	100	100%

Table 1: Number of hours and distribution per discipline (1)

Nr.	Discipline	Hours				Weight	ROregimentations
		C	S	L	TOTAL	%	
1	COMPULSORY	994	308	1194	2496	77,08	60-80%
2	OPTIONAL	343	–	399	742	22,92	20-40%
Total: compulsory and optional		1337	308	1593	3238	100	100%
3	ELECTIVE	119	161	–	280	8,65	5 -10%

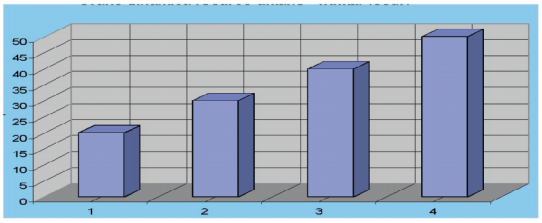
Table 2: Number of hours and distribution per discipline (2)

For the complex training of the future specialists, a substantial contribution is brought by disciplines belonging to the beneficiary fields of these activities, such as: Constructions, Urbanism, Transportation, Local and Regional Administration, etc. .

Nowadays, at the speciality of ***Terrestrial Measurements and Cadastre*** of Timisoara, 200 students are studying. Starting with the academic year 2005/2006 a new educational plan was introduced, structured on 4 years for the technical domain (licensed engineer) plus 2 years for the Master degree (diplomat engineer) – the Bologna Process.

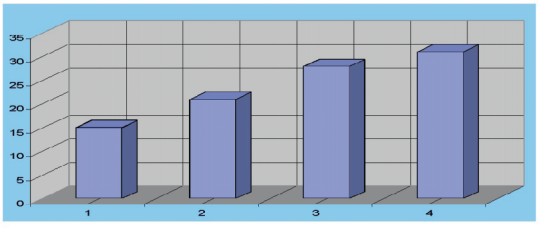
The Bachelor Program (**B.Sc. Degree**) was evaluated in 2008 by the Romanian Agency for Quality Assurance in Higher Education obtaining the accreditation in the Bologna system.

The second level of the educational training including the Master Program (**M.Sc.Degree**) will be evaluated until summer in Timisoara.



1 – period of time 1991-1995
2 – period of time 1996-2000
3 -period of time 2001-2004
4 – period of time 2004-2008

Graph 1: Dynamics of the human resources- number of places



1 –year 1996
2 – year 2000
3 – year 2004
4 – year 2008

Graph 2: Dynamics of the Human Resources- number of graduates

The only institution that offered until now Master Programmes in Surveying and Geodesy in the old system was the Faculty of Geodesy in Bucharest; it has been accredited also for new Master Programmes in Bologna system.

The specialization of Terrestrial Measurements and Cadastre in Timisoara has had an ascending evolution since its foundation, 18 years ago, justifying its existence completely (graph.1,2). The mission of training cadastre specialists includes not only the students but the teaching staff as well. The quantitative and the qualitative level of the students follows an ascending direction, being reflected in the increasing number of places (graph.1,), the increasing number of graduates (graph.2) and the marks obtained by the students. The students' evolution, since the admission until graduation, also reflects the interest and the preoccupation of the teaching staff in order to meet the requirements of the teaching process.

The speciality consolidation *strategy* envisages the following objectives:

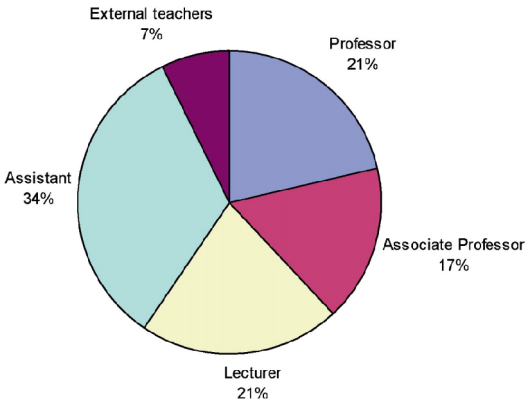
- Continuous development of the curriculum and of the syllabuses, in conformity with the evolution of the techniques in the domain of Geodesy, and in correlation with similar Romanian and European Union institutes;
- PhD development studies for the teaching staff and specialized training for external professors, i.e. people who work in the field of cadastre.
- The development of some current research fields in cadastre such as: informatization of the land register, land information systems, GIS, satellite technologies.

Since 1991, the well individualized speciality of Terrestrial Measurements and Cadastre part of the "Politehnica" University of Timisoara, has produced 12 series of alumni who have covered successfully the whole design and execution work in this field, mainly for the west part of the country.

The graduates, geodetic engineers, are employed by state institutions (offices of the National Agency for Cadastre and Land Registration, Local Councils, Design Institutes, Autonomous administrations, etc.) private companies (trading companies) specialized in cadastre or having related activities (constructions, urbanism) or, they are freelancers.

The University, and the faculty respectively, ensure the adequate material basis required by a qualitative education, teaching spaces, adequate laboratories, a specialized library, and obviously a

constant teaching staff and external professors, adequately trained.



Graph 3: Distribution of teaching personnel

All the teaching staff has been involved in scientific research. The various research themes in the field of geodesy engineering are made public either by the publication of scientific articles, in various speciality magazines, manuals, courses, laboratory works, or by presenting the findings at different national or international symposiums. The staff is also involved in research contracts with various companies. The teachers also belong to different professional associations such as: AGIR-the General Association of the Engineers in Romania, UGR-Romanian Geodesy Union, the Local Geodesy Association, the Romanian Society of Geotechnical Engineering and Foundations, the Romanian Road Society, etc.

5.1 Evolution and the perspective of the study programme

The speciality of Terrestrial Measurements and Cadastre was conceived as an interdisciplinary speciality, capable to train competent specialists and to provide efficient solutions for the design, realization and exploitation of works in the field of terrestrial measurements, for different purposes (topographic engineering works, cadastre works, systematization, urbanism, GIS, etc,)

6. Thematic Priorities in Research

The "Politehnica" University of Timisoara has a long term strategy and short and middle term programs which contain the objectives, the projects and the foreseen results of the research, as well as to the means of reaching them.

These are some of the main directions of the research team, formed from teachers and students, of the speciality of ***Terrestrial Measurements and Cadastre***.

- Topo-geodetic studies to monitor the tectonic processes in the western part of Romania;
- Topographic documentation to draw up the urban area plan projects in the western part of Romania;
- Technical solutions for ensuring the stability of certain industrial objectives with various destinations;
- Updating the data base of the Geographic Informatic System of Timisoara – the capital of the Timis County;
- Updating the database for urban cadastre ;
- Updating the road cadastre data base;
- Cemeteries Cadastre

The findings of the research are made know in different ways: they are published in different publications for didactic purposes or scientific publications; they are presented in doctoral theses, or are rendered profitable in university research contracts, since our department is accredited by the National Agency for Cadastre and Land Registration.

Man's wish and need for information has always been accompanied by new discoveries. Our field is not an exception. New wide perspectives are opened towards the understanding of the environment by the use of new technology and informatization.

In the field of terrestrial measurements, a constant concern of people, for more than two millenniums, to measure and study the shape and the form of our planet, new problems keep occurring, problems which have to be solved by the present and the future geodetic engineers.

This field of activity is of large perspective in Romania and its mission is to find adequate technical and technological solutions for various problems that the specialists in the field have to face, i.e. either topo.-geodetic works, cadastre and land register works, or setting up new appropriate information systems to monitor the specific engineering works, thus ensuring their stability in time.

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Can European graduates fulfil the expectations of Slovenian (private) enterprises?



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Abstract
Liberalization of services and international recognition of professional competences are a topical issue of the international agenda. In the European Union, an additional challenge is the EU market, which provides the framework for free trade in professional services within the EU member states. Consequently, the professional qualifications, which have to meet the labour market needs, have to be recognized on the international level. The competences of the graduates and whether these competences are in line with the demands of the employment areas (in particular of the private enterprises) are discussed in connection to the field of surveying in Slovenia. In addition, some main findings regarding the requirements of the European enterprises in the surveying profession are given, based on the research within the framework of the EEGECS (European Education in Geodetic Engineering, Cartography and Surveying). We try to emphasize the importance of collaboration between private/public sector and higher educational institutions in order to develop and/or adjust higher educational programmes to the technological and methodological development, and to the market needs, which would fulfil wide spectrum of the market needs.

Keywords: Surveying, geodesy, skills of graduates, private enterprises, Slovenia

1. Introduction

Each profession has to respond to the challenges of globalization, which dictates liberalization of trade in professional services. The international market pressures, including the regulations towards liberalization of trade stimulated by the World Trade Organization (WTO), and the EU free market within the EU member states, are reflected also in the surveying profession and surveying higher educational programmes throughout Europe. The rights of the EU citizens to provide services anywhere in the EU are fundamental principle of the EU law. However, the national regulations and in particular licensed professions, such as surveying is in several European countries, are serious obstacles to these fundamental rights.

Traditionally, the surveying profession predominantly operated in the niche markets, which were either local or national in character. These regulated markets are not conductive to mobility of professionals, due to the wide variety of procedures, laws, and functions performed by surveyors. However the non-regulated part of the surveying market is highly conductive to mobility. The European Commission has perceived the mutual recognition as a device for securing the free mobility of professionals within the single market place of the EU. Mutual recognition can be defined as a process which allows the qualifications gained in one country to be recognised in another country [1]. Although there are a number of barriers, which hinder mutual recognition at a world scale, such as language, national customs, culture etc., the free movement of professionals can be based on the definition of the qualifications required for professionals to practice in a profession or discipline. The European Ministers of Education made a joint declaration (Bologna agreement) in June 1999 to coordinate their policies to achieve the adoption of easily comparable higher educational degrees. Modernization of higher education in Europe is an ongoing process which tries to follow the main guidelines of Bologna declaration and market needs.

Establishment of the common European higher education area is very important from the perspective of globalization process and development of the European common market, which dictates high level of knowledge and comparable educational competences all over Europe. Private enterprises as well as public agencies (institutions) would like to get highly qualified graduates of surveying (geodesy) with as many competences as possible directly from the universities. However, not only the educational outcomes

(which have to adopt the needs of society as well), but general ability of the individual to apply knowledge and skills to produce a required outcome have to be defined in a standardized form, often mentioned as professional competency standards.

In this respect, the question arises: "How can higher education institutions and their graduates fulfil the expectations of the labour market?" The topic of establishing the equilibrium between the labour market needs and developing trends of the higher educational curriculum is illustrated on the case of Slovenian labour market in the field of surveying (geodesy), where a brief comparison with the European area is given as well. For this purpose, the results of analysis of questionnaires among employers and graduates in surveying profession in Slovenia are given. Furthermore, a brief overview of the EEGECS (European Education in Geodetic Engineering, Cartography and Surveying) research among employers on needed professional competences of graduates in surveying is given, which was done in 13 EU member states.

2. Slovenian labour market needs in the fields of surveying

Professional competences of a graduated surveyor, defined by the labour market, have been changing very rapidly in the course of the last decades. This is mainly the consequence of globalization trends, changing needs of society and technical development, which forced in particular private enterprises (as well as public sector in the fields of surveying) to take up a challenge and adjust their fields of work to the current and future needs.

The higher educational study programmes of surveying as well as professional competences of surveyors vary among the EU countries mainly due to historical reasons and regulatory framework of the profession. However, surveying has traditionally leaned strongly towards engineering. Nowadays, the need to shift to teaching management skills applicable to interdisciplinary work situations is obvious in almost all European countries. There have been several discussions on competences of surveying profession, based on the international comparison of higher educational curricula and professional competences, in order to support the international mobility and international trade in surveying services (see [2], [3]).

Comparable to other EU countries, globalization, interdisciplinary and technical development has forced many Slovenian private enterprises to change fields of work. This is the reason why they need different working profiles also in the field of surveying. The only higher educational programmes in surveying in Slovenia are performed at the University of Ljubljana, Faculty of Civil and Geodetic Engineering, Department of Geodesy. Although the higher educational programmes in surveying (geodesy) at the University of Ljubljana have tried to be flexible and adjusted the curricula to the needs of the profession (there was a considerable renovation of study programmes within the Phare-Tempus project (1996-1999)), the renovation of study programmes according to Bologna guidelines provided a new opportunity for important changes in the educational competences of surveying (geodetic) graduates.

For this purpose, the research was done by the University of Ljubljana, Faculty of Civil and Geodetic Engineering, Department of Geodesy in 2005 and 2006, which aimed to gather useful data from the Slovenian labour market in order to get information for development of the new Bologna programmes of geodesy (surveying, geoinformatics). The research of the surveying labour market in Slovenia was based on two questionnaires. The first one was the questionnaire for graduates about the study programmes of surveying (geodetic) engineering in Slovenia (see [4], [5]). The second questionnaire was completed by the employers who had to answer about study programmes of surveying (geodesy) in Slovenia and educational competences they expected from the graduate (see [4], [6]).

2.1 Employers' opinion of the Slovenian higher education in surveying

For the quality of renewal of the study programmes, the opinions of experts outside the university environment are appreciated. For this purpose, the analysis of employers' (whose main field of work is surveying profession and related disciplines) opinion of study programmes of surveying (geodetic) engineering at Faculty of Civil and Geodetic Engineering was performed in 2006 [6]. The main aim of the analysis was to find out the ratio between the expected and achieved abilities, skills and knowledge, which should be achieved by graduates in surveying (geodesy) during their study at university or higher professional degree. The questionnaire contained the following complexes of questions (see [4], [6]):

(a) general information about company/institution (name, field of activity, number of employees);

(b) general opinion of achieved graduates' level of knowledge and skills important for the employer;

(c) evaluation of expected and achieved abilities, skills and knowledge, which should be achieved by graduates of surveying (geodesy) during their higher education: (c1) the ability to apply knowledge in practice, (c2) the ability to develop the profession, (c3) the knowledge of management, (c4) the knowledge of legislation, (c5) the knowledge of standards, (c6) the knowledge of informatics and an ability to use new information technologies, (c7) the ability to communicate effectively, (c8) the ability to lead and coordinate the projects/organization, (c9) other abilities and skills (ethical loyalty, an ability to work in multidisciplinary teams etc.); and

(d) estimation of five most important abilities among seventeen suggested.

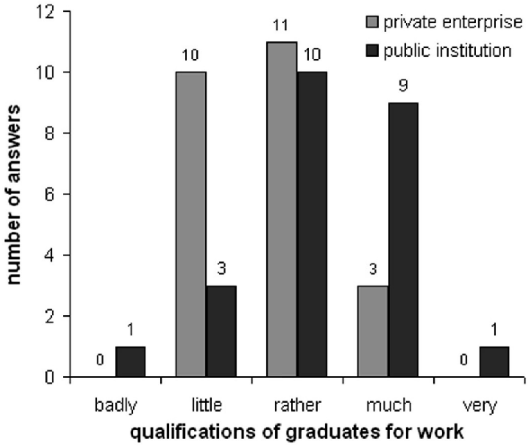

Fig. 1: Employers' opinion regarding the qualification of graduates in surveying (geodesy) at the Faculty of Civil and Geodetic Engineering, University of Ljubljana, to begin to work at their companies.

In the research, 50 different employers of surveying diploma engineers answered the questionnaire. The general opinion of Slovene employers in the fields of surveying (geodesy) is that (university) diploma engineers of surveying (geodetic) engineering are rather prepared for work in their company. But, employers in private companies are more critical regarding the qualification of geodetic graduates to begin to work at their companies. Their main subjects of critique are regarding graduates' ability to apply knowledge of business management techniques. Fig. 1 shows employers' opinion regarding the qualification of geodetic graduates.

Employers of geodetic graduates estimated also five most important abilities among seventeen suggested ones. There are some differences between public institutions and private enterprises. For public institutions the most important skills of the graduates are [4]:

- basic knowledge of surveying and geodesy,
- basic knowledge of profession (wider area of profession),
- the ability to apply knowledge to practice,
- the ability to accommodate oneself to a new situation, and
- the ability to acquire knowledge.

In contrast to the employers in public sector, the representatives of the private enterprises emphasized the skills of graduates in this order [4]:

- the ability to understand and communicate in foreign language,
- the ability to apply knowledge to practice,
- the basic knowledge of surveying and geodesy,
- the basic knowledge of profession (wider area of profession), and
- the ability to create and implement new ideas.

2.2 Graduates' opinion of the Slovenian higher education in surveying

In 2005, the analysis of graduates' opinion of study programmes of geodetic engineering at Faculty of Civil and Geodetic Engineering, University of Ljubljana, was performed [5]. Slovenian academic education of surveying (geodetic) engineering was based on German educational system. At the moment, the study programmes are in transition to the new programmes following the Bologna guidelines. However, at the time of the research, two programmes of the higher education in surveying (geodesy) were performed (diploma degree) [4]:

- University study programme of geodesy (9 semesters), which was comparable to the master's degree in countries using consecutive system of higher education.
- Higher professional study programme of geodesy (6 semesters), which was comparable to study programmes at Universities or Colleges of Applied Sciences.

The questionnaire for graduates contained the following complexes of questions:

(a) general information about (university) diploma engineer, his/her occupation and position, information about the institution and the field of work;

(b) evaluation of (b1) the volume of study courses in the time of his/her study; (b2) requirements of study courses; (b3) applicability of knowledge and skills obtained during the study; (b4) importance of knowledge and skills for the future;

(c) missing knowledge and skills, and

(d) suggestions for improvement of study programmes.

In the analysis, 50 university diploma engineers (university study programme) and 48 diploma engineers (higher professional study programme) answered the questionnaires.

The graduates in surveying (geodesy), who answered the questionnaire, did not have problems to find a job – they found job very quickly after they graduated, in less than one month. The fields of their work were from geodesy, land surveying, spatial data management, to land administration, land management, which is covered also by the newest definition of surveying profession (see [7]).

The main aim of the research was to find out the ratio between the knowledge and skills acquired during the study at the faculty, and actual applicability and utility in the praxis. In general, diploma engineers of both study programmes suggested that the volume of courses referring to the real estate registration and real estate management as well as courses in the fields of legislation, public administration and business economics could be enlarged. Both groups of questioned graduates agreed also that the importance of topics of real estate registration, real estate management, spatial informatics, legislation and business economics should be increased significantly in near future.

3 Permanent education in the (private) enterprises in some EU member states

Within the framework of European thematic network EEGECS (European Education in Geodetic Engineering, Cartography and Surveying), WG 4 – Public/ Private Enterprise, the needs of surveying (private) enterprises in some EU member were analysed based on a questionnaire for employers. The questionnaire was completed by representatives of 104 enterprises from 13 EU countries [8]. The results of the research gave an overview of the current situation of the surveying profession and employability of graduates in surveying in Europe, where following aspects were considered:

- Segmentation and main fields of activities of private/public enterprises;
- Number of graduates within the company;
- Main fields of activities of graduates within the companies;
- Skills of graduate staff expected by the enterprises;
- Continuous Lifelong Learning;
- Mobility across Europe.

The questionnaire was rather complex; we would like to emphasize in particular the needs of the employers regarding continuous lifelong learning.

3.1 EEGECS

The thematic network EEGECS (2002-2008) was the results of the vision for the Common European Area of Higher Education and was established within the Erasmus programme of the European Commission. As a part of the former European Socrates-Erasmus Programme, the thematic networks were launched officially in May 1996. The original purpose was to help higher education institutions to create forums with the aim to analyse and study the state of development of various education and training fields in Europe in order to encourage the European dimension and improve the quality of education and training. Generally speaking, a thematic network presents a co-operation between departments of higher education institutions and other partners (e.g. academic organisations or professional bodies). All countries participating in the Socrates-Erasmus programmes (EU, EFTA and Candidate Countries) had possibility to be involved in a thematic network. The main aim of the programme is to enhance quality and to develop a European dimension within a given academic discipline or study area [9].

The thematic network EEGECS, which was established in 2002 and later connected over 100 institutions from 27 European countries, aimed to facilitate trans-national access to educational resources in Europe. The EEGECS is a project originally created by Geodetic Engineering, Cartography and Surveying institutions whose main objective was to enhance collaboration and

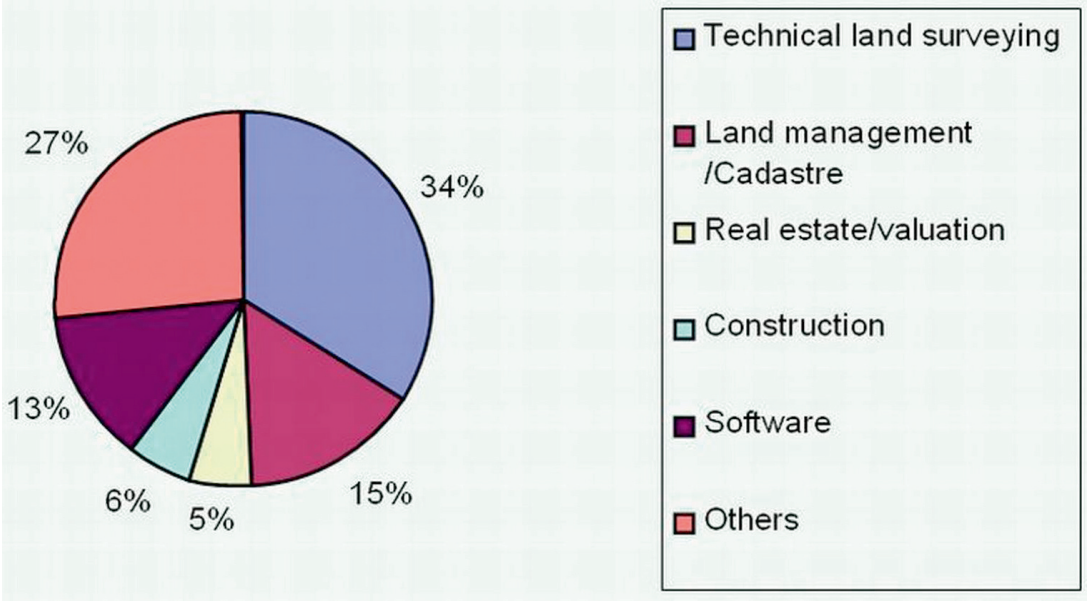

Fig. 2: Companies' main activities [8].

co-operation between the higher education institutions which offer these studies and studies from related fields [10]. The work was organised in six working groups. One of the focuses of the EEGECS was the research of labour market needs in surveying, geodesy, cartography and related fields, which was mainly studied in the WG 4 – Public/ Private Enterprises.

3.2 Some basic findings of the EEGECS research

Simple survey of the main fields of activities of the companies, that answered the questionnaire, showed that their field of work is focused on technical land surveying, which takes in average more than one third of the companies recourses, another 27% flows into other activities, mainly administration, marketing and promotion and management. Land management covers 15% of the company's activities, software development 13% and real estate economics and land valuation and construction are of minor relevance (Fig. 2, see also [8]).

The official academic education presents only a part of the professional competences - because of the fast developing technology and changing needs of society, each individual has to upgrade his/her knowledge and skills in the profession as well as in the other fields referring to his/her work, the analysis of lifelong learning practice in the companies was performed. The analyses of the questionnaires showed that more than 65% of the companies support life long learning activities of their graduate employees. Almost half of them cover the course costs and provide working time for training programs. The largest number of persons is getting training in the fields of management skills, communication skills and Information and Communications Technology (ICT) skills (Fig.3).

4. Market needs of enterprises in Slovenia in comparison to other EU countries

Based on the EEGECS research on skills of graduates required by European enterprises, we can say, that the European enterprises, working in the field of surveying and related fields, have similar demands for graduates. However, we can not directly compare the results of the analysis, performed by the Faculty of Civil and Geodetic Engineering, University of Ljubljana, and the EEGECS, because questions and structure of questionnaires was not the same. Nevertheless, we can get general idea about the needs and expectations of Slovenian and EU enterprises from graduates in the fields of surveying (geodesy).

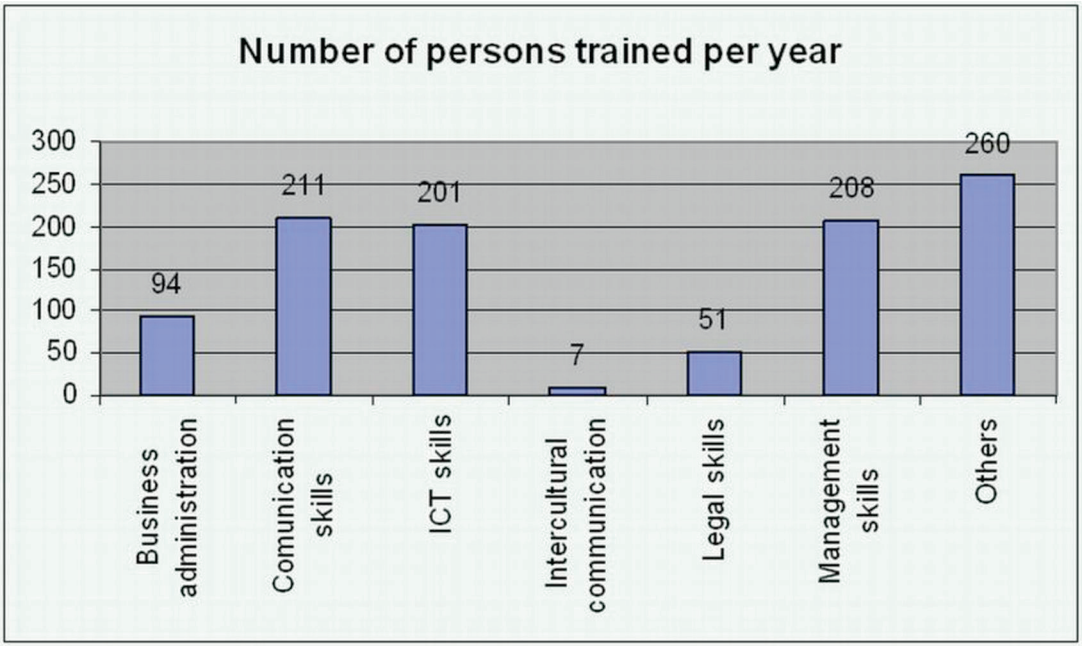

Fig. 3: Number of persons trained per year [8].

In general, we can say that (private) enterprises expect graduates from the university to have more skills and professional competences as they get it during the period of study. On the other hand, it is interesting, that in Slovenia, all graduates get work in one month after they finish their study (study from 2005, [5]). There are different kind of enterprises and different fields of work where graduates in Slovenia are employed. The employers' institutions can be classified considering different aspects:

- private – public;
- small – medium – big enterprise;
- mostly surveying field of work – partly surveying field of work – other field of work.

Expectations also vary according to the above mentioned groups because we can not for example compare small company (2 employees) with public institution (few hundreds employees). The small companies mostly work in the traditional fields of surveying (engineering surveying, geodetic surveying, real estate registration etc.) and they need graduates with a lot of professional practical knowledge. Bigger companies, which have more experts, can arrange their own education and introduction into the work and they do not expect that graduates will get enough knowledge for everyday work already during the study period. Generally private companies are more critical and expect more from graduates than public ones.

Referring to the needed skills of the graduates when applying for a job, it has to be emphasized, that in Slovenia as well as in other EU countries soft skills (project management, communication, time management, team work, economic, foreign language etc.) are more and more important, in particular in the private sector. These skills are necessary in all fields of work and sometimes they are even more important than professional knowledge. As an example, almost all of the work in the private enterprises is project oriented; without proper project management, communication skills, teamwork, there are no (expected) results. Basic knowledge of economics is needed in every project and foreign language is nowadays obligatory. The expectations of graduates as well as employers for the future development of surveying profession are further referring to the interdisciplinary work. We noticed that these expectations (already demands of society) are getting higher every day and it is very difficult for graduates and for the academic institutions to follow development of the labour market.

4.1 Graduates between studying programme and employers

Based on the presented researches on opinion of graduates and employers about the educational competences, we can say that graduates get enough of technical and expert knowledge but they do not get enough practice and soft skills. In Slovenia, only one month of practical work in the enterprise was obligatory during the study at the university level (and one semester at the higher professional level). However, we have to know that the educational competences are only part of the professional competences, which have to be developed lifelong. Students in Slovenia acquire practical and soft skills also by student work (summer job), which is widely supported also by the government. This may also be the reason for rather positive answer on graduates' skills from the employers in Slovenia. Nevertheless, the higher educational institutions have to follow the professional development on the international level and the needs of society.

4.2 Adjusting the study programmes to the needs of society

In the last few years almost all the higher educational institutions in Europe, that did not have the three tires higher educational system in the past, are being in the process of changing the study programmes according to the Bologna process. Bologna declaration forced higher educational institutions throughout EU to change their programmes, which has been also a great opportunity to adjust the programmes to the current guidelines of the profession and the needs of society. Fig.5 shows the triangle with important actors in the process of changing higher educational study programmes. In order to get as objective as possible overview of the current situation and the necessary changes it is necessary, that the higher educational institution (university, faculty) includes all levels of profession in discussion while renovating the study programme. In Slovenia, the Department of Geodesy, Faculty of Civil and Geodetic Engineering at the University of Ljubljana, did a lot of work to acquire the important information from main actors in the field of surveying before preparing the proposal and accepting the new programmes of surveying (geodesy) at the department. For this purpose, the Strategic Council was established, which was advisory body for the faculty in the process of changing the programme, considering the guidelines of Bologna declaration. The Strategic Council members were representatives of the Surveying and Mapping Authority of the Republic of Slovenia, Professional Surveying Association, Chamber of surveying engineers and private enterprises.

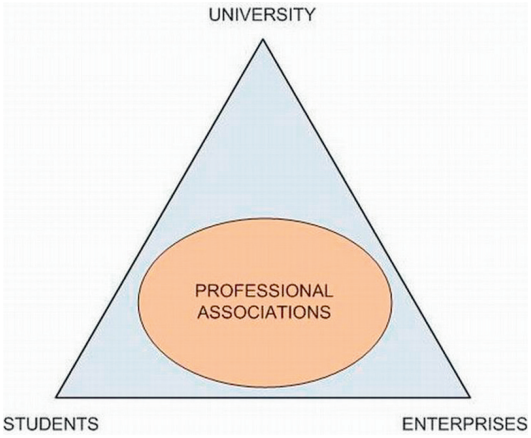

Fig. 4: Important actors for changing the programmes.

4.3 How can the enterprises influence the curriculum development

Cooperation between science (universities) and enterprises is an assurance for economy growth in all fields of work and surveying is not an exception. Because of this, enterprises should be actively involved in the process of changing the study programmes. Study programmes are not changing very often (however, the contents of each course are changing but this are not changes that influence on the study programmes as a whole) and every considerable change will not have immediate impact on labour market. This is the main reason, why every change is important for the long term development of the profession. In this aspect, a special support can be provided by the professional associations, which can coordinate the communication, support the exchange of ideas and following the ideas of all actors in the profession, prepare also some guidelines for the higher educational programmes in the future. In Slovenia, there are many possibilities for the enterprises to have direct or indirect influence on curriculum development; at least on the contents of the practical training programme within the framework of the higher education. The best way is a collaboration between professional association (for example in Slovenia we have Chamber of surveying engineers and Association of private enterprises) and the faculty.

Due to the fast development of the surveying profession and the extension of the surveying companies' fields of work, it is impossible to expect, that the higher education will ever "produce" graduates which will provide all the competences, needed in the enterprises. Sometimes the enterprises want to get some specific knowledge, which is a short term need, and the higher educational institutions should not response to such initiatives immediately by proposal of changing study programmes. Enterprises does not expect that either, because other approaches are much more appropriate for such needs such as life-long learning programmes, which are on the other side a challenge for the enterprises as well as for the higher educational institutions, who can organise the short training programmes for the particular topic. In Slovenia, there is still a wide space for developing this cooperation in the future, which can contribute to development of the professional skills of graduates by meeting demands of society.

5. Conclusions

In order to follow the needs of society, enterprises and graduates should play an important role in the process of changing higher educational study programmes in a certain field of profession. The higher educational institutions have to response to the market needs, not only with flexible study programmes but also with other kind of courses in the context of Lifelong Learning. The idea of establishing a Strategic Council for higher education in the field of surveying, where all the important actors (private, public, chamber) would take part in, is widely accepted in the Slovenian professional society, because of the advantages of such cooperation in the period of developing new study programmes in accordance with the Bologna declaration in the course of the last years.

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Interdisciplinary Knowledge Transfer within Surveying Higher Education

Guido Heinz, Jörg Klonowski, Hartmut Müller, Germany

Abstract

At Mainz University of Applied Sciences, Department of Geoinformatics and Surveying, a long experience is available in co-operation projects with partners from the humanities for the purpose of archaeological and cultural heritage documentation and preservation. This paper focuses on a subset of about 40 diploma thesis which were executed within archaeological and cultural heritage documentation projects outside Germany. Besides the location of the project area, another selection criterion was the overall importance of diploma work for the respective project. While conducting such work in close co-operation with students and professionals of other disciplines, surveying students gain valuable knowledge from those other fields. In such projects, students of all participating disciplines have the chance to augment their disciplinary knowledge with knowledge from other disciplines.

Keywords Higher Education, Surveying, Students work, Humanities

1. Introduction

Surveying as a discipline most often offers services to other natural or engineering sciences like architecture or mechanical engineering. However, a wide range of opportunities to establish fruitful co-operations is available in the humanities, too.

i3mainz , Institute for Spatial Information and Surveying Technology, has knowledge and experience in the fields of image processing, photogrammetry, remote sensing, surveying, 3D-visualization, internet applications development and software engineering. The institute is

Fig. 1: Recording of archaeological findings using tachaeometry

equipped with a wide range of devices for data recording and processing. Besides own software, it can rely on the leading software products for the above mentioned fields. Members of pi3mainzp have collected considerable experience with appropriate surveying methods ranging from simple hand surveys, tacheometry, satellite navigation systems up to aerial and close range photogrammetry, terrestrial and airborne scanners, remote sensing using satellite images in many cooperation projects with partners from the humanities. A large number of publications deal with surveying methods for archaeology and cultural heritage documentation ([1], [2], [3], [5], [8]).

The professors and scientific co-workers of the institute are involved in Surveying Higher Education, as well. In the last semester of their studies, students at the Department of Geoinformatics and Surveying usually prepare their diploma theses or their bachelor and master thesis, in the near future ([10]). Each diploma thesis is supervised by a member of the teaching staff. It must be finished within 6 months. About more than 10% of these theses on average are prepared outside Germany and some are written in English. A good overview of all the aspects of internationalization of education at the Department of Geoinformatics and Surveying in cooperation with i3mainz is given in [6].

Following the defined selection criteria, namely to present only projects from outside Germany, where students' work yielded an essential part of project deliverables, projects from the five countries China, Turkey, Yemen, Israel and Ukraine will be presented.

2. China since 1993

In Shaanxi province of People's Republic of China 18 Mausoleums of Tang Emperors covering up to more than 100 km* are located. Within an international research project at the Roman Germanic Central-Museum in Mainz, Germany, the tasks of geometric documentation of the sites and findings were performed at Mainz University of Applied Sciences. Documentation work started in 1993; besides the work of scientific collaborators up to now 10 diploma thesis with field work were executed. The measurement field work (see Figure 1) was carried out in close cooperation with archaeologists and additional local staff.

The area of the internal part of one single mausoleum covers more the 10 km*, which demands the application of modern techniques from geoinformatics and surveying. As the connection to the official reference system wasnot possible in the field, a local, user defined coordinate systems was established. Each complex is recorded in a rectangular coordinate system; the astronomical azimuth was measured for each of them. The single mausoleums are connected using total station and GPS measurements. At the precession ways more than life-sized sculptures of humans, animals and mythical creatures are present, at the corners the remains of towers are preserved.

Most important task for the documentation in the beginning of the project was the generation of topographic maps in various scales for the whole Mausoleums and special parts of them containing the positions of findings. Most of this work was done based on tacheometric measurements. Terrestrial photogrammetry was used for the

Fig. 2 and 3: Photogrammetric recording of a stone sculpture and line drawing of a mythical creature

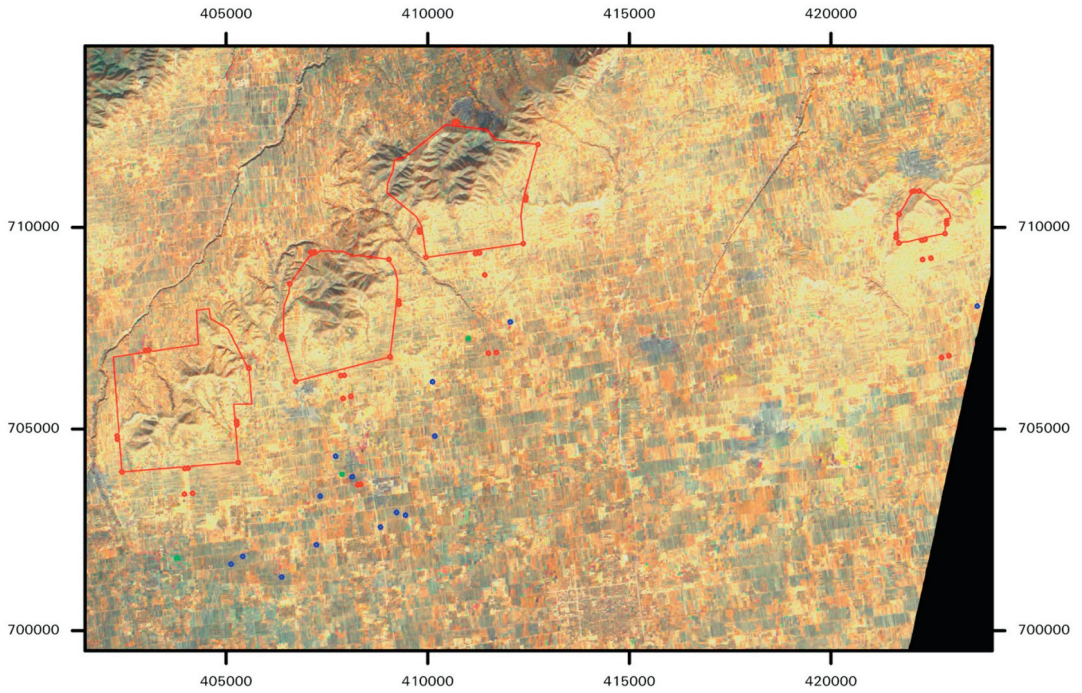

*Fig. 4: Image map with four mausoleums using satellite imagery (from [9]). Satellite images: * Space Imaging and CNES/Spot Image*

documentation of selected stone sculptures (see Figure 2 and Figure 3). All geometric data was processed in a CAD environment generating up to 40 maps in different scales from 1/5 up to 1/10.000 for each complex.

Due to the lack of aerial images to an increasing degree satellite images were used within the project. The usability of various systems with different geometric and radiometric resolution was evaluated. Landsat and SPOT data with 30 m respectively 10 m resolution was used especially for the generation of lower resolution elevation models and overview maps (see Figure 4). Over the years the geometric resolution of the available satellite image data increased enormously. With this imagery image maps and 3D-views could be generated in bigger scales. The information content of the plans was increased and the field work could be reduced with this new data source.

The interdisciplinary character of the project, the exotic environments in terms of area and features to record as well as the spectrum of techniques to use made this project interesting for the students and their diploma thesis.

3. Turkey since 1998

Documentation work in **Turkey**, Tavium, Central Anatolia started in 1998. Till now, 11 diploma thesis were executed there. Besides extensive large scale tacheometric surveys of the terrain surface animated 3D scenes of the landscape were generated from existing maps. An overall web presentation was developed to present the Tavium Research Project in much detail.

The ancient Galatian city of Tavium is located at the present-day village of Büyüknefes, 150 km east of Ankara, 20 km from the Hittite capital of Hattusha. The site being occupied from the 4th millennium BC had its flourishing phase during the Hittite period. In the 3rd century BC the Trocmii, a Celtic tribe from the Danube area occupied the site of Tavium ([15]). Since 1998 the area of the city has been surveyed by a team led by Karl Strobel of the University of Klagenfurt and supported by i3mainz, concentrating on the extensive Roman and Byzantine remains which are still available. Geophysical work has shown the citadel and lower city had a total extent of 150 hectares, pre-classical remains have been found at a number of places within the survey area ([16], [17], [18]).

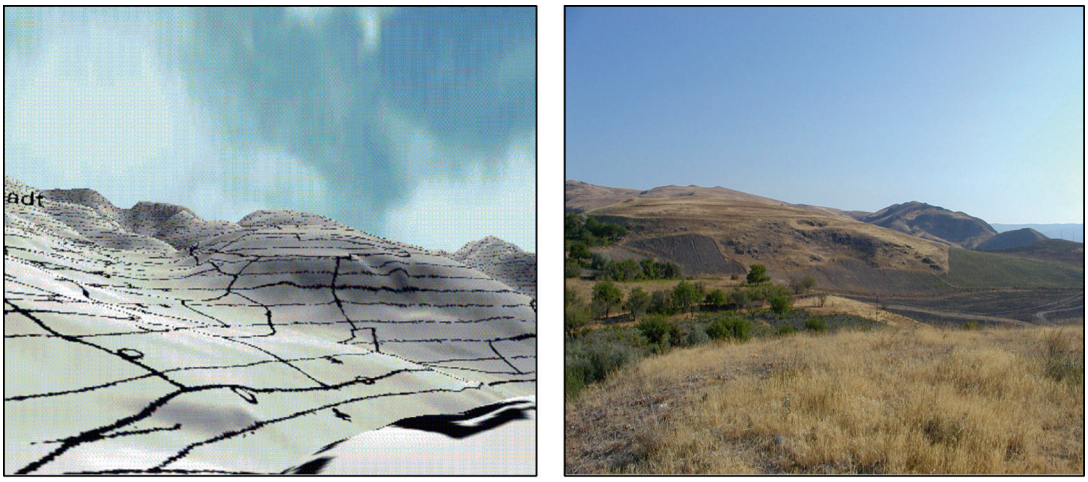

Fig. 5: Terrain representation generated from cadastral map and Digital Height Model (left) in comparison with the real life scenery (right).

Fig. 6: Web site of the Tavium Research Project.

i3mainz provides for the cartographic representation of the modern terrain surface at different scale. The produced digital spatial datasets are the geospatial base for the documentation of the location of archaeological findings. First field work was done in 1998. A spatial reference system had to be established, 1/500 large-scale documentation of wide areas was performed. Use of GPS technology yielded the base to introduce new methods and techniques into on site archaeological field survey. While 1/500 scale documentation concentrated on the core areas of archaeological interest, 1/5000 scale documentation of surroundings was achieved by using existing maps ([11]). Due to special properties of the analogue original map sheets considerable efforts were needed to convert the analogue maps into high-quality digital data sets. Once completed, many features of digital height model analysis like creation of perspective views of and virtual flights through the research area, calculation of cross sections could be used to support archaeologists' work substantially (see Figure 5).

To present the Tavium Research Project to the professional community as well as to the broad public an extensive project website was created (see Figure 6).

4. Yemen since 1998

In Yemen work started in 1998 with 13 diploma thesis since that time dealing with surveying and mapping of the antique City of Zhafar/Dhu Raydan, the ancient capital of the Himyarite Kingdom. Tacheometric acquisition of the terrain surface and of archaeological findings, generation of high quality digital height models, creation of digital orthophotos derived from satellite imagery, construction of animated 3D-scenes and reconstructions, pilot applications of geographic information systems were executed within diploma work.

Zafar lies some 130km south-south-west of the Yemenite capital, Sanaa in the mountain at 2800m altitude (see Figure 7). The ruined city Zafar, capital of the Himyar Empire (sovereignty 115 BCE – 525 CE) has a great historical meaning. Zafar was the capital of the tribal confederation known to the outside world as Himyar, which for some 250 years dominated the entire Arabian Peninsula politically and militarily. In the 6th century the 110 hectares large Zafar was one of the most important cities in the Near East.

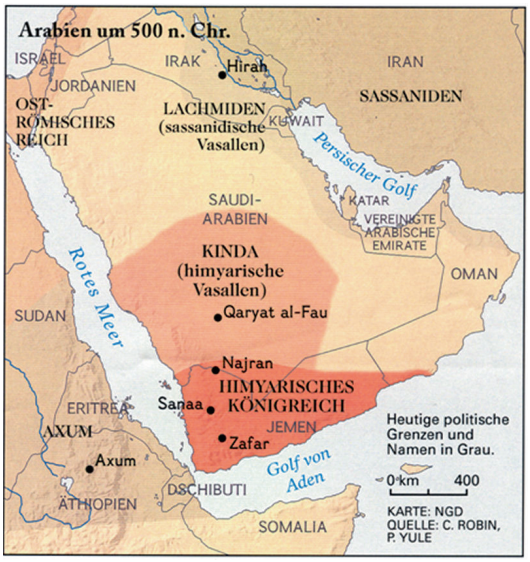

Fig. 7: Location of the ancient city Zafar.

Fig. 8: Workers at the excavation site.

In 1998, the Heidelberg University Expedition to Zafar, in the Yemenite Highlands, initiated a programme of excavation, mapping and training ([19], [20]). The mapping showed the ancient walled city with a core area comprising some 1000 x 1200 m. The core of Himyarite Zafar spreads over the southern and western slopes and the summit of the Husn Raydan, the fortified al-Gusr, and the present-day village. The ancient city extends eastward and southward outside the city walls. Till now some 1000 Himyarite inscriptions and relieves are being catalogued. They date predominantly to the 3rd – early 6th centuries. A late Himyarite cemetery on a mountain slope and a foundation at the southern foot of the Husn Raydan was excavated, the site museum was newly installed and all of the inscriptions were photographed. Other excavation started on the south-western flank of the Husn Raydan in what appears to be magazines; parts of a large limestone building came to light as well as a life-size king's sculpture (see Figure 8). Parts of the site were investigated by means of magnetometer survey.

As part of an interdisciplinary team i3mainz joined the field campaigns of the years 1998, 2000, 2002, 2003, 2005, 2006 und 2008. Documentation of the terrain surface and of archaeological findings was performed (see Figure 9 and Figure 10).

Fig. 9: Transport of measuring equipment.

Digital orthophotos, digital height models, virtual three-dimensional reconstructions were generated from satellite images (see Figure 11). A first prototype of a geoinformation system was developed.

5. Israel since 2004

Mainz University of Applied Sciences started its work in Israel in 2004 within the Kinneret Regional Project, a European expedition to the north-western shore of the Sea of Galilee in Israel (see Figure 12). The aim of the project is to explore the site of Tel Kinrot – ancient Kinneret – and its surroundings. The history of large excavations at this site started in 1982 after preliminary investigations ([13]). Despite several field campaigns of excavation only a fraction of the site is known so far. A detailed description of Kinneret Regional Project is given in [14] and in [12].

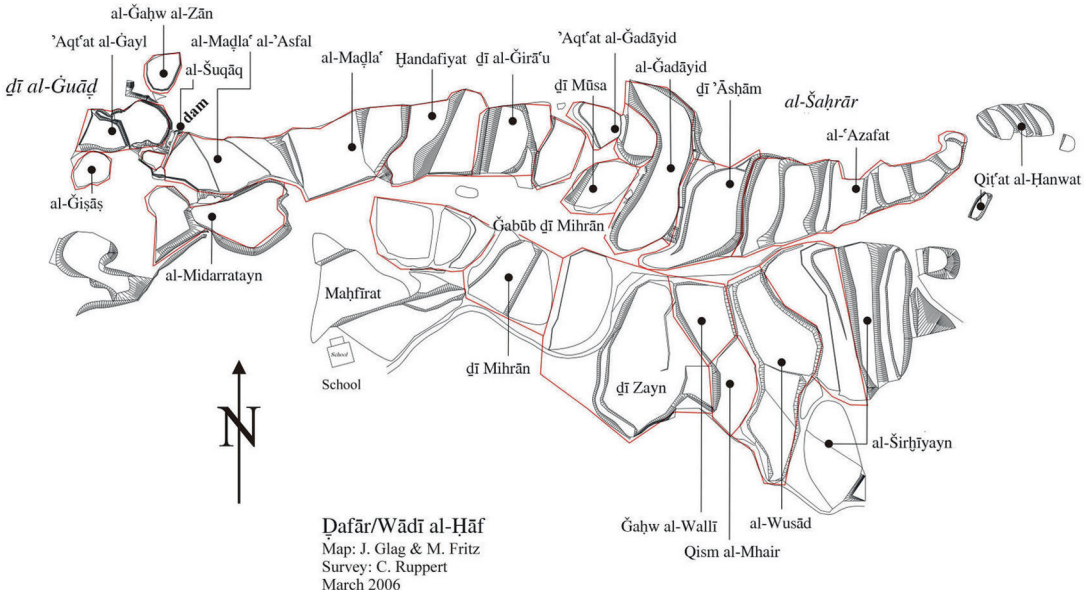

Fig. 10: True scale map of field names in Arabic language.

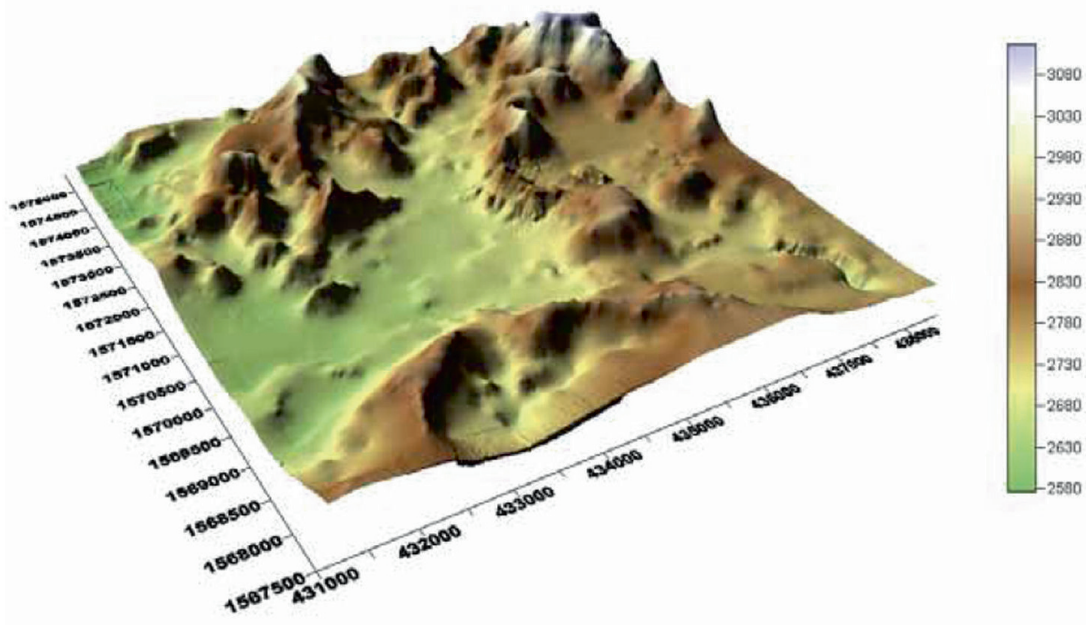

Fig. 11: 3D view of the surroundings of Zafar

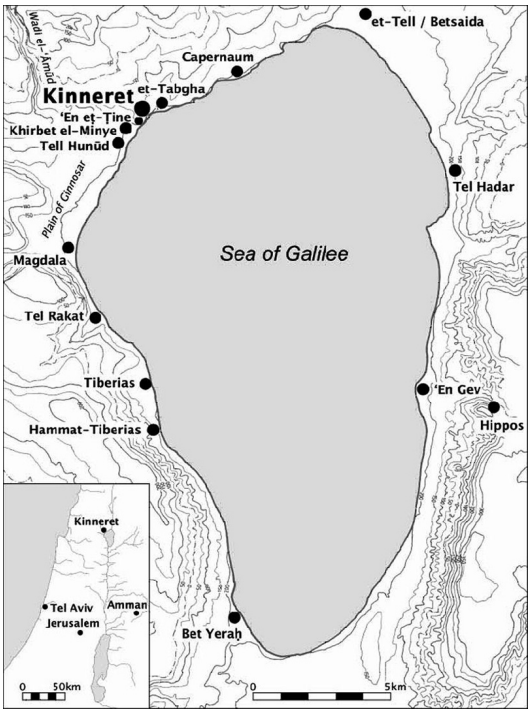

Fig. 12: Sea of Galilee with major sites (from [14]).

In the meantime 4 diploma thesis were completed in the context of this project. The goal of the first diploma thesis in 2004 was the establishment of a spatial reference system connected with the official Israel reference system. Thus, geo-referencing of local surveys made by the archaeologists in a common spatial context had become reality. In addition the site of Tel Kinrot with an expansion of 10.000 m* was completely re-surveyed using the latest surveying technology. This comprehensive survey resulted in a consistent spatial data base of the excavation site.

2005 two further diploma thesis started with a surveying campaign to complement and to expand the results of 2004. The collected data were the basis for a three dimensional precise geometric documentation of the excavation site in order to be able to derive 3D landscape models and longitudinal or cross profiles. The processing work took time until 2006.

Precise differential GPS was the clue to an acceleration of the work of the archaeologists in 2007. The fast and precise survey of findings and local excavation areas the archaeologists worked on antemeridian were processed noontime and offered to the archaeologists in the afternoon in their databases. This procedure led to an increased productivity because several of the former working steps could be omitted now.

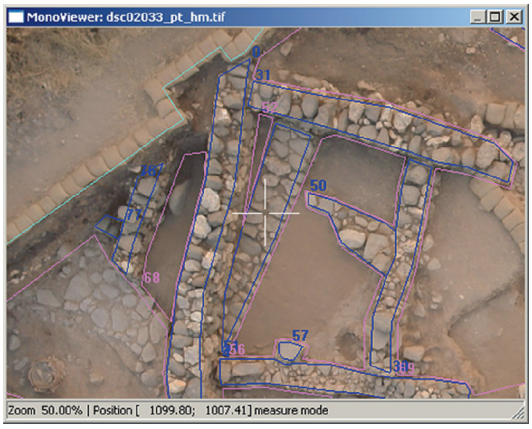

Fig. 13: DISTA with the representation of the coloured 3D objects with respect to the different thematic layers.

Another investigation for the development of an optimized work flow for both surveying and archaeological field work was done by using photogrammetric recordings. Aerial photos of the excavation site were taken by a consumer camera which was fixed to a small hot-air airship. Using DISTA (digital stereoscopic evaluation architecture ([4])) – a photogrammetric evaluation system used for the precise determination of 3D-coordinates from blocks of large metric images developed at i3mainz it was possible to build up stereo models and to register 3D objects described by points, lines, poly-lines and polygons. A thematic differentiation of the 3D object was done by the introduction of the layers “wall”, “floor” and “breakline” (see Figure 13).

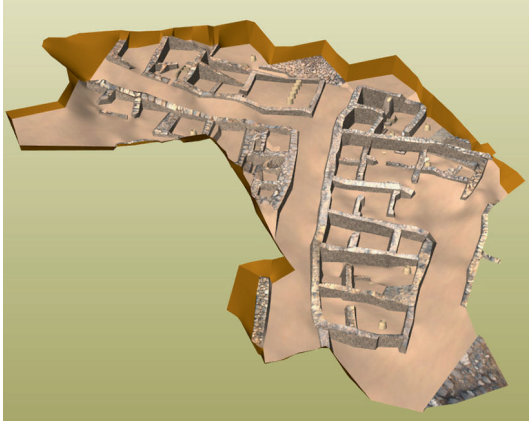

Fig. 14: Photo-realistic 3D model of the excavation site.

3D models of the excavation site using photo-realistic textures were derived based on these results (see Figure 14). An impressive visualization was generated by a walk and a flight through the virtual 3D model of the site.

In addition 3D archaeological objects like pillars, oven or door lintel were virtually reconstructed and implemented into the 3D scenes (see Figure 15).

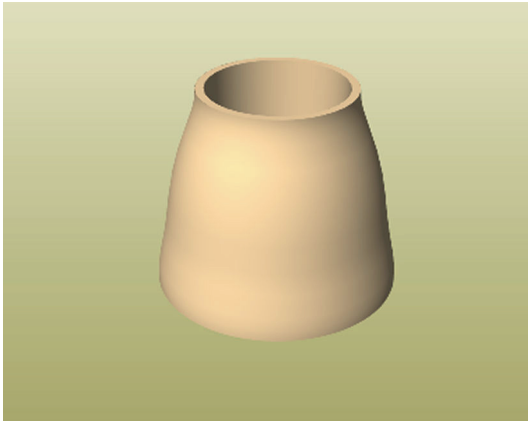

Fig. 15: Virtually reconstructed oven.

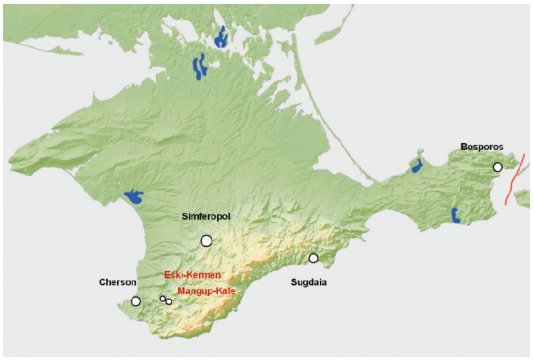

Fig. 16: Map of the Crimean peninsula with the two hill fortifications of Eski-Kermen and Mangup-Kale.

6. Ukraine since 2006

Starting from 2006 3D-documentation in archaeology is being applied in the Crimean highlands in Ukraine. The project is carried out within the cooperation of Mainz University of Applied Sciences with the Roman-Germanic Central Museum in Mainz. In the focus are two hill settlements, Eski-Kermen and Mangup-Kale (see Figure 16), with more than 600 artificial caves. Of main interest for the archaeologists in the project is the settlement-history which started in the 6th century AD.

Main tasks of the surveying work are the realization of a common reference system for all findings and the efficient use of methods for geometric documentation in archaeology. GPS, total station, close range photogrammetry and 3D-laserscanning are being used to meet the requirements.

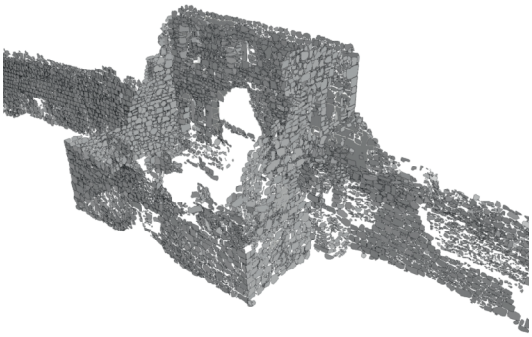

Fig. 17 and Fig. 18: Recording of the citadel and view of the 3D-model.

3 diploma thesis were completed so far within this project. Two of them deal with a comparative investigation and optimization of different measurement techniques for the documentation of antique constructions. For this purpose the ruin of a middle-aged citadel was recorded using analogue and digital close range photogrammetry and processed for each single stone in a 3D-CAD-model (see Figure 17 and 18). 3D-laserscanner data and an in-house solution for stereo imagery based on standard DSLR cameras were compared to this approach. Within another thesis, the 3D-recording of structures using reflectorless

total stations inside and outside artificial caves was optimized. The data is recorded using a simple point numbering system providing all information for the semi-automated generation of 3D-CAD data of the point and vector objects. Currently another thesis is prepared concentrating on the integration of old maps with the modern data and using old landscape marks in combination with the results of archaeological field surveys.

The spatial data is collected and processed in a common reference system as basis for a GIS-System. The GIS is used for storage, administration and analysis of all project data. The collection of attribute data is carried out in close cooperation with German and Ukrainian archaeologists. The data is used as well for generating maps in various scales, visualization and reconstruction tasks.

7. Conclusions and further work

Virtually all surveying students who decided to join an interdisciplinary team reported valuable experiences from their expeditions not to be missed, seen both from the personal and the professional view points. In that way, the well-established close link between institutional research and higher education at Mainz University of Applied Sciences proves to provide for a stable knowledge transfer base for different disciplines.

Special challenges exist in projects with partners from different professional cultures involved, like from different engineering sciences and, at the same time, from the humanities. Consequently, Mainz University of Applied Sciences, Department of Geoinformatics and Surveying, and Gutenberg University Mainz are cooperating to establish a new study programme in Archaeology (Master) with a special attention to spatial information and surveying technology and its application in archaeology ([7]).

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The Impact of Student Numbers on the Quality of Teachers – The Situation in Vienna and a Possible Way Out

Gerhard Navratil, Vienna

Abstract

For years the Vienna University of Technology has had problems attracting a sufficient number of surveying students. This leads to financial problems if the budget is based on student numbers. Another problem is that low student numbers lead to low graduate numbers and this limits the choice when looking for employees at universities. Then even less suited candidates have to be accepted. In the long run this will have an impact on the quality of the teachers. This can only be prevented if more students are attracted. The traditional fields are well covered. Thus we need to address new target groups. However, both, the curriculum and the job description must be attractive.

1. Introduction

Assessing and improving the quality of education is a standard problem (compare, for example, [1]). The curriculum is often used as a measure for the quality of the education. A specific field can only be taught if there are a certain number of classes with a minimum duration. The education is deemed poor if this requirement is not met. There are many examples for such curriculum descriptions [2-5]. However, the discussion of educational quality should not be restricted to the development of curricula and how to assess ECTS points to the various fields. The quality of education is based on several other factors, too. Some of them are

- monetary expenditure (for personnel, equipment, rooms, etc.),
- access to recent research results (projects, contacts, etc.),
- motivation of teachers, and
- quality of teachers.

Deficiencies in any of these areas can eliminate benefits from improved curricula. The discussion in this paper concentrates on the quality of teachers. The quality is influenced by several parameters including the ones listed above. What is usually ignored, however, is the fact that the number of students has an impact on the quality of teachers.

The remainder of the paper is structures as follows: Section 2 shows the impact of lacking monetary expenditure on the quality of the teachers. Section 3 shows the connection between student numbers and the quality of teachers. Some numbers and experiences from Austria show the effects. Raising the university budget is in Austria a political decision and thus we have almost no influence. Thus attracting more students is the only way to improve the quality of teachers. Section 4 thus provides some ideas to raise student numbers in Austria.

2. Impact of Tight Budgets on the Quality of Teachers

Monetary expenditure is a problem in times of tight budgets. High quality teachers demand adequate payment and if universities reduce salaries (as done in Austria) the quality of teachers will drop. Excursions and field training are expensive as is the acquisition of modern equipment. High quality teachers will try to guarantee that they have enough budgets to finance these activities and investments. Attracting internationally renowned experts as professors is thus connected to a guaranteed minimum budget. Lack of money has thus a direct influence on the attractiveness of the university for high quality teachers.

A typical way out of this problem is the acquisition of projects to bolster the budget. However, this has a disadvantage. Project proposals have to be written and, for accepted projects, the according work has to be done. Surveyors, as engineers, are usually successful in acquiring projects. But what is the impact on the teachers? They will have to help drafting the proposal and overlook the implementation of the project. This takes time and is usually missing somewhere else. Since administrative duties cannot be neglected, either teaching or independent scientific work will be affected. Scientific work is a major component for the development of new teaching material and thus excessive workload for project acquisition will have an impact on the quality of education.

The acquisition of projects usually requires ideas. Many ideas develop while reading texts or listening to presentations. The publishing channel must be accessible for reading. These channels are still mainly journals and books. Access to these kinds of publications is influenced by monetary expenditure. The access depends mainly on the budget of the university library. A shrinking library budget results in deteriorating working conditions because it is more difficult to access recent work of colleagues. Departments can try to keep the access by paying for the access themselves. The required money will, however, be missing somewhere else. Using project money may help but again leads to higher workload for the personnel. Thus the budget has not only a direct effect on the quality of teachers by limitation of wages, but also an indirect effect by deterioration of working conditions.

Time pressure and short budgets may also have an impact on the motivation of teachers. It is frustrating if there is not enough money available to implement excursions or student projects. This is not yet a pressing issue in surveying education in Austria (as most of my colleagues are highly motivated and budgets are still high enough to support teaching) but it may become one.

3. Impact of Student Numbers on the Quality of Teachers

We still have enough money and a number of excellent teachers in Vienna, but can we keep this level? The number of students is a crucial factor to keep a certain level: Smaller communities like surveyors have less influence than bigger ones (like, e.g., computer science or architecture) and receive smaller shares of the budget. Additionally, teachers have to be selected from the group of former students. It is therefore necessary to have a decent number of surveying students to guarantee the quality of future education.

Looking at the incoming student numbers for surveying studies in Austria shows a significant increase [6, 7]. Unfortunately, these numbers only tell half the truth since the number of graduates does not correlate with these numbers. One of the main problems is that ERASMUS students are included as starters, although they usually do not plan to finish their studies in Austria. Students who want to finish their studies in Vienna will usually take courses according to the proposed schedule. This can be used to separate ERASMUS students from regular students. In addition, there may be students who only need the inscription for access to social security system or who find out within the first weeks that surveying is not their main interest. These students can be eliminated when looking at the number of students participating in a course from the second or third semester. Figure 1 shows the difference between the incoming student numbers and students participating in the course adjustment computation in the third semester. Some of the missing students stopped studying. However, this cannot explain the different shape of the curves. Even if we eliminate the peak in 1997, the correlation between the lines is small. In 2003, for example, the number of students in the 3rd semester increased whereas the number of new students from the previous year shows a decrease.

The number of graduates is another important factor. Figure 2 shows a comparison of the student numbers in the 3rd semester with the numbers of graduating students four years later. The correlation between the numbers is 82% and thus the number of students in the 3rd semester seems to be a good indication for the available graduates four years later. Even better results can be obtained if removing the peak in 1992. This peak originates from the end of the old curriculum in 1996 (four years later). A large number of students wanted to avoid complications with the change of curriculum and this resulted in the high number of graduations. After removing this peak the correlation is even 94%.

A major problem from low numbers of graduates is employment at universities. Currently 71 researchers are employed at the three surveying departments at the Vienna University of Technology. This number rises to 74 if including currently open positions. Three other Austrian universities have surveying departments: Graz University of Technology (30 researchers), University of Applied Life Sciences (11 researchers), and University Innsbruck (6 researchers). Thus the universities alone must fill 120 research positions. Assuming an average work life of 40 years 3 graduates per year are necessary (the actual rate is even higher due to short-time contracts and migration to industry and administration). This is a quarter of the recent graduates. Vienna University of Technology and Graz University of Technology recently had problems finding suitable candidates for research positions. At least 4 to 5 candidates would be necessary to guarantee high quality of the personnel but at the two universities there were less than two applications per position. Thus even less qualified applicants have to be employed. Since these

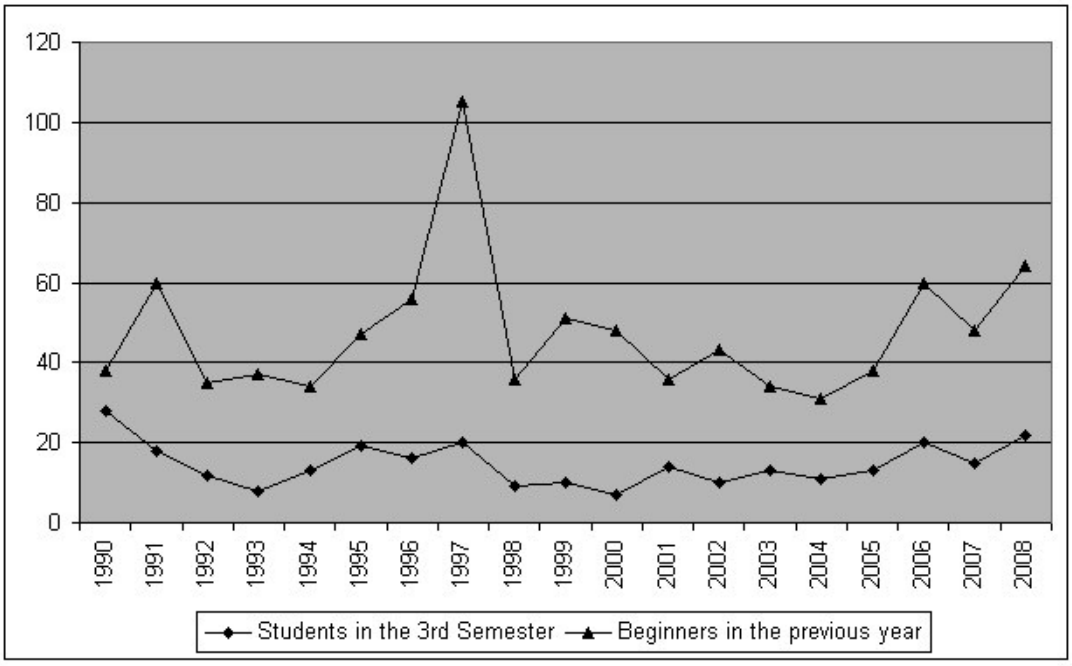

Fig. 1: Comparison of surveying students at the Vienna University of Technology: Newly registered students in the previous year vs. students in the 3rd semester.

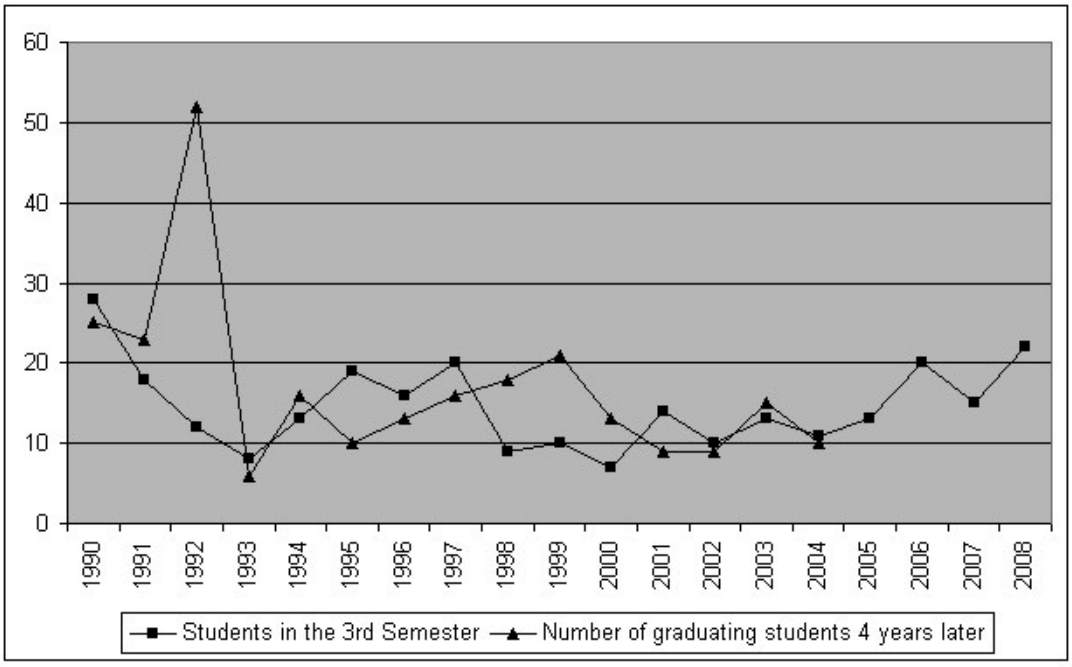

Fig. 2: Comparison of student numbers in the 3rd semester with the number of graduating students 4 years later

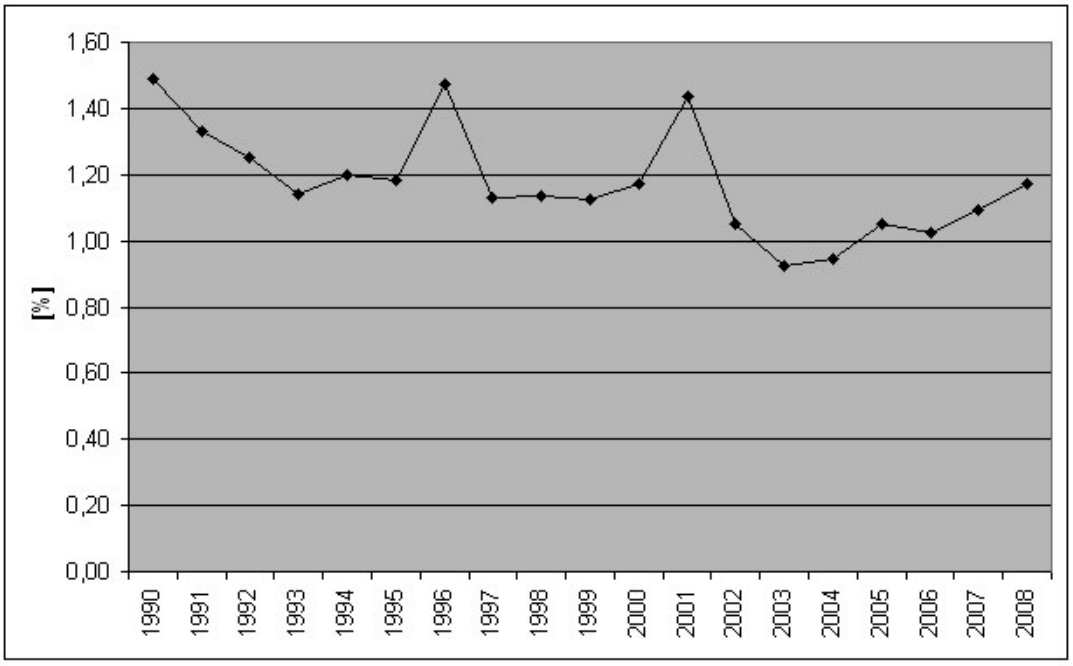

Fig. 3: Number of surveying students (without PhD-students) in percent of the total number of inscribed studies at the Vienna University of Technology

persons should also teach, the quality of the teaching will drop in the long run.

Whereas Figure 1 shows the absolute numbers, Figure 3 shows the relative importance of surveying at the Vienna University of Technology. The leaders of curricula with a large number of students will have a higher impact in organizational decisions than the leaders of small curricula. The relative number of surveying students decreased from 1990 (1.5% of the students in Vienna) to 2003 (0.9%). Since then surveying is regaining relative importance. This indicates that there is a positive trend but the relative importance is still at an unsatisfactory level. This problem even increases the monetary problems because everybody needs more money and the budget is at best at a constant level. Thus everybody tries to argue that his group is more important. Numbers of students and graduates are easy to count and are thus often used. Probably a side effect of this problem is the dropping number of places offering surveying education. In the last years, for example, Delft and Berlin closed their curriculums in surveying. Similar developments can also be found in other parts of the world (e.g., in Africa [8]).

4. How to Increase Student Numbers in Austria

A key factor to improve or even keep the educational quality is therefore raising the number of students in surveying. However, actions are only possible if the problem areas are known. Thus we should perform a thorough analysis of the interests of surveying students in Vienna. Based on this analysis we could then start focused marketing actions to increase the number of students [9]. I did not do such an analysis. I just want to show some observations I did in the recent ten years.

A large fraction of surveying students is formed by children of surveyors. Later in their academic career they either want to take over the office of their parents or at least work in a similar environment. They have a clear picture of the job and selected the studies because this is what they want to do. Marketing in this group of possible students is not necessary.

Other students had other contacts with surveying:

- summer work in a surveying office or with the Austrian Federal Office for Metrology and Surveying,

- presentations given by researchers at schools, or
- other promotion material.

Whereas the first two possibilities are obvious, the last one might be interesting. In Austria there is an annual exhibition where pupils can get information on a wide variety of jobs. The Austrian universities are also present at this exhibition and researchers explain to interested pupils the curriculum and chances in the job market. A study as done in Sweden [10] could be helpful to communicate the chances in the job market because good chances may increase the interest (compare [11]). Typically, some of these interested pupils become students of surveying. Other promotion material includes also folders (see Fig. 4) with information, which are sent directly to schools. As far as I know there are no reliable numbers of pupils who actually see and read the folder.

Fig. 4: Promotional folder

Typical students in surveying in Vienna are interested in mathematics and high precision of measurements. Undoubtedly, high precision measurements are necessary and interesting. For some fields, however, a different kind of students would be better suited. Surveying students in Austria, for example, seem not to be interested in thinking economically. However, this is a major requirement to become a licensed surveyor or create new information products. We esteem ourselves as the experts for geometrical and geographical data. This conflicts with successful products like Google Earth where the impact of surveyors seems to have been minimal. Otherwise it cannot be explained that the georeferencing was not done correctly. However, this technical flaw did not prevent a world-wide success of the service.

It seems that we fail to attract enough students who want to perform such creative development tasks. These students seem to study different fields like computer science, spatial development, or civil engineering. These graduates then move to companies and will pull colleagues into the company. Surveyors only rarely manage this step. A successful story is BMW where a small group of surveyors is employed. Still, it took large personal effort by colleagues from Munich to place the first one. The others just followed and even competitors saw the benefits of having surveyors in the company. Such an operation would be much simpler if surveyors were known for something else than just accuracy.

5. Conclusions

Student numbers are a problem for surveying curricula. The first guess is usually the financial aspect of the problem: A low number of students results in a low budget. However, there is a more indirect aspect of the problem, too. Since the majority of teachers should come from the group of surveying graduates, a low number of graduates limits the quality of the teaching. This again leads to lower quality of the education. Thus, attracting new students must be a priority goal. Changing the name from “geodesy” to “geomatics” does not help [9] and therefore we must start focused marketing. This, however, requires a clear idea which kind of students we want to attract and where they can find suitable jobs.

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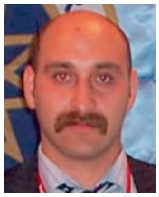

Final Situation in Surveying Education in Turkey, and its Contradictions

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Abstract

As around the world, also in Turkey, with the impact of the globalization, there have been important changes and developments in engineering education, particularly surveying engineering education, in a period of which free circulation has become widespread and intensive efforts for the membership of the European Union have been made. There is no doubt that products and reflections of the developing and varying technology has seen in Turkey, too. The first civilian survey education was begun in 1949 at Yildiz Technical University in Istanbul in Turkey. Over the past six decades, the number of active education training departments has risen to eleven. In addition, five new departments have been established, and they are still preparing for the active education training.

It is vital to select suitable models, which provide integration between the world and Turkey, and include certain standards with the aspect of survey engineering by the affect of both increasing number of departments and increasing enrolled and graduated student numbers. Therefore, redoubling the quality of the education, tracking the current curriculum, increasing the mobility in education, developing the e-learning system, adopting the European Credit Transfer System (ECTS), leading the national and international accreditation studies have been conducted as listed respectively in several considerable subtitles. Accreditation is a developed method of the quality assurance of the social services with a systematic approach in several countries and sectors. In this point, accreditation is a significant means of obtaining reliability and continuity for these services. Educational accreditation is a type of quality assurance process under which services and operations of an educational institution or program are evaluated by an external body to determine if applicable standards are met.

Accreditation studies conducted in national and international areas were completed in some of our departments and, became sustainable. The other departments are continuing the national and international accreditation studies rapidly. Beside international accreditation studies, like conducted by ABET (Accreditation Board for Engineering and Technology) and EUR-ACE (European System for Accreditation of Engineering Education), in national aspect MUDEK (Engineering Education Program Evaluation and Accreditation Association) conducts national accreditation studies. In this contrary, ITU (Istanbul Technical University) which is one of the university lectured surveying engineering education, has obtained the ABET accreditation, and the other two universities; YTU and University of Selçuk has obtained MUDEK accreditation. At the same time, MUDEK conducts accreditation studies with EUR-ACE (European Accreditation of Engineering Programs).

Although some surveying departments have finished or still conduct accreditation studies in Turkey, some of them have not started these facilities yet. Furthermore, serious differentiations between these departments have been affecting our country's surveying education. The differentials emanate from physical infrastructure, device and hardware capacity, lecturer staff, divisions, students' quota. There is no equal distribution on these listed issues in universities. So, one cannot wait to take an equally distributed education outputs (graduates) from these education system. This will finally affect the profession and sector outputs.

In addition to the problems as mentioned above, unbalanced growth in surveying profession will change the supply demand balance. In spite of positive developments in engineering education because of the ABET or MUDEK standards and criteria, new opened departments without determination survey sector needs of survey engineer would make difficulties in the near future for our profession and our country. Especially, in terms of criteria listed above, the serious differentiations between departments will affect the education quality and graduates in terms of well qualification and standardization throughout the country.

Therefore, in this paper, change and development process of survey engineering education in Turkey from onrush to today is examined. Moreover, studies about integration to the developed world are mentioned. Furthermore, in this process, affirmative contributions of the system and also contradictions and missing sides of the survey education in Turkey will be emphasized.

Keywords: Surveying education, accreditation studies, ABET, MÜDEK

1. Introduction

Surveying education at the degree level was started to be given for the first time in Turkey upon the Department, which was called as Survey and Cadastral Engineering in those days, was established in 1949 under administration of Yildiz Technical University due to the efforts of General Directorate of Land registration and Cadastre.

This was intended for graduating technical elements required for performing Turkey's cadastral affairs. The curriculum was intended for the targets of completion of cadastral works in the early years while it shifted due to increase in engineering projects such as dams, roads, bridges, tunnels etc, development and land agglomeration and large housing projects completed in the course of time in our nation. On the other hand, due to replacements of classic methods with electronic methods as a result of advances in technology and science, effective use of information and informatics technologies, increasing effects of space and satellite techniques on our profession, educational institutions have revised and rearranged their programs (curricula) for adapting to these changes occurred in the course of time in the light of these developments.

Rapid change and development process being experienced in the world and in Turkey has ensured that the curricula have been updated while our departments' names were changed as Geodesy and Photogrammetry Engineering through Higher Education Law Code published in 1981 in Turkey. Discusses on the name of the profession have continued in Turkey just like around the world until today since that date.

Today, Geodesy and Photogrammetry Engineering education is being done in the departments existing in 11 universities in Turkey. Some of these departments present master's and doctoral degree programs also. Geodesy and Photogrammetry Engineering departments were established in five universities beside the mentioned universities; however, they have not accepted students yet. These newly founded departments are making preparation works due to deficiencies in lecturers and also physical deficiencies. The list of universities to give active and passive education is seen in Table 1.

Also, institutions exist in 4 universities offering only graduate programs beside undergraduate programs. These exist in METU (ODTÜ), Bosporus University (Boğaziçi Üniversitesi), Gebze Advanced Technology Institution (Yüksek Teknoloji Enstitüsü) and Kültür University.

No	University	Department	City	State
1	Yıldız Technical University	Dept. of Geodesy and Photogrammetry	İstanbul	active
2	Karadeniz Technical University	Dept. of Geodesy and Photogrammetry	Trabzon	active
3	İstanbul Technical University	Dept. of Geodesy and Photogrammetry	İstanbul	active
4	Selçuk University	Dept. of Geodesy and Photogrammetry	Konya	active
5	Zonguldak Karaelmas University	Dept. of Geodesy and Photogrammetry	Zonguldak	active
6	Gümüşhane University	Dept. of Geodesy and Photogrammetry	Gümüşhane	active
7	Ondokuzmayıs University	Dept. of Geodesy and Photogrammetry	Samsun	active
8	Afyon Kocatepe University	Dept. of Geodesy and Photogrammetry	Afyonkarahisar	active
9	Erciyes University	Dept. of Geodesy and Photogrammetry	Kayseri	active
10	Kocaeli University	Dept. of Geodesy and Photogrammetry	Kocaeli	active
11	Aksaray University	Dept. of Geodesy and Photogrammetry	Aksaray	active
12	Cumhuriyet University	Dept. of Geodesy and Photogrammetry	Sivas	passive
13	Hacettepe University	Dept. of Geodesy and Photogrammetry	Ankara	passive
14	Niğde University	Dept. of Geodesy and Photogrammetry	Niğde	passive
15	Harran University	Dept. of Geodesy and Photogrammetry	ŞanlıUrfa	passive
16	Pamukkale University	Dept. of Geodesy and Photogrammetry	Denizli	passive

Table 1: Geodesy and Photogrammetry Engineering Departments in Turkey

Today, approximately 950 students obtain the right to study and are taught in Geodesy and Photogrammetry Engineering departments each year. The universities apply different curriculums. Although current professional developments are taken under consideration, these different lesson programs in different universities may be considered normal. However, deficiencies in lecturer and substructure are conspicuous at first sight in the newly founded departments. Different types of engineers are graduated with respect to quality in Turkey as a result of education given especially in the departments, which are not sufficient in physical substructure, instruments and equipments, laboratory and lecturers.

Therefore, in the recent years, especially the departments under administration of large and experienced universities have started accreditation efforts to increase quality of the education at the degree level in Geodesy and Photogrammetry Engineering, to follow current lesson programs, to increase mobility and to satisfy certain standards in education and they completed some of the accreditation works. In Table 2, number of the quotas of each university in Turkey can be seen. As mentioned and will be considered at the rest of the paper, the quotas of Geodesy and Photogrammetry engineering departments are very high in some of the universities, and it has affected directly to the quality of the graduated students. The higher number quota means the less quality education.

2. Current Situation in Geodesy Engineering Education in Turkey

Educational problems in geodesy sector should be taken under consideration within a wide range including the education in senior schools, the education in undergraduate department, training-on-job and certification programs. Under this context, these problems should be taken under examination seriously, planning should be done and the plans should be executed under coordination.

However, new departments and programs are being opened with an approach increasing the existing problems by ignoring demands for educated human resources in the sector. A review is required on curricula, educative staff and their competence, physical substructure in the educative units and also relation between the educative units and the institutions in geodesy sector. Especially the efforts spent on higher education area are highlighted among these subjects so that most of the advantages acquired by the geodesy sector within the process lasting from the rise of the geodesy sector until today have been obtained due to undergraduate and graduate programs being offered by the universities in our nation.

No	University	Overall Quota	
		1. Education	2. Education
1	Yıldız Technical University	100	100
2	Karadeniz Technical University	80	80
3	İstanbul Technical University	70	–
4	Selçuk University	80	80
5	Zonguldak Karaelmas University	60	–
6	Gümüşhane University	40	–
7	Ondokuzmayıs University	50	50
8	Afyon Kocatepe University	50	–
9	Erciyes University	40	–
10	Kocaeli University	30	–
11	Aksaray University	30	–
Total		630	310

Table 2: Year 2008 Quotas of Geodesy and Photogrammetry Engineering Departments in Turkey

2.1 Problems in Graduate Programs and Recommendations for Them

2.1.1 Quality and Accreditation

In this process in which globalization is affecting the whole of the world, quality and accreditation concepts, which is emphasized in engineering programs, also have high impact on geodesy programs. After both national and international accreditation principles and criteria were specified by different institutes and entities in different countries, our universities offering geodesy programs started to execute their works based on these principles and moreover, some of them have advanced significantly in this way.

Under this context, some universities are executing various works based on the accreditation programs of national "MÜDEK" and also international "ABET". Here, the important matter is to ensure that certain principles and criteria in education are fulfilled in our universities by executing these works in all departments offering geodesy programs in coordination.

The departments in Yildiz Technical University, Selçuk University and Karadeniz Technical University have started accreditation works of MÜDEK, which is a national accreditation program, as the first target to specify these principles and criteria. The department existing in YTU among these departments has acquired this national accreditation after passing many tests. The other two departments are still under assessment stage. On the other hand, Istanbul Technical University has fulfilled the international accreditation of ABET and made it sustainable. Various efforts are being spent for accreditation works in other departments also other than these departments.

2.1.2 Curricula

The lessons on the profession other than the basic engineering lessons enforced by YÖK (The Higher Education Board) are generally specified by the departments. We cannot say that, demands in the nation are considered sufficiently while specifying these lessons. It is seen that, curricula are produced according to the structures of the existing lecturers in the departments. However, basic science lessons, professional theoretical and practical lessons and social and cultural lessons required for a contemporary, scientific and qualified engineering program considering current conditions also should be taught sufficiently and at required levels.

In the recent years, program-producing efforts based on accreditation have become significant in the universities. Orientations of the universities in developed countries around the world are being followed in this process.

In our universities, mutual ECTS (European Credit Transfer and Accumulation System) credits were specified by making agreements with the universities existing in EU member states based on Socrates – Erasmus Program.

2.1.3 Lecturer Staff

Considering departments offering geodesy programs and accepting students in our country, some deficiencies and imbalances in lecturer staff are seen. Especially in the departments, which are newly founded and have just started education, academic staff is not sufficient from the point of view of number and serious assessments should be carried out about these departments. There is no doubt that, the subjects such as scientific research and development activities and becoming specialist on different topics are also very important beside educative efforts of the existing staff. Therefore, various measures should be taken today in these departments against potential problems, which would occur in the future.

The staff of the newly founded departments should be strengthened by providing encouraging conditions for research assistants, who acquired Ph.D. degrees. It will be an important resolution for the future and the quality of the profession that, students are not accepted to the insufficient departments from the point of view of academic staff and facilities.

2.1.4 Newly Founded Departments and Becoming a School

The number of the institutes offering Geodesy and Photogrammetry Engineering programs including the departments, which have just started education and those, which, have newly founded but not accepted students yet, has increased in the recent years in our nation. However, first national demands and then the demands in the geographic region in which the department will be founded for geodesy engineers should be considered while deciding about founding these departments. Therefore, the need for new departments offering undergraduate geodesy programs should be assessed in many aspects. The locations and location selections for the departments offering programs should be assessed seriously. Minimum technologic and physical

University	Academic Staff					Total
	Prof.Dr.	Assoc.-Prof.Dr.	Assist.-Prof.Dr.	Lecturer	Res. Asist.	
Yıldız Technical University	9	9	9	–	26	53
Karadeniz Technical University	7	3	6	–	16	32
İstanbul Technical University	15	11	5	–	22	53
Selçuk University	2	1	14	–	14	31
Zonguldak Karaelmas University	1	1	3	2	5	12
Gümüşhane University	–	–	2	1	2	5
Ondokuzmayıs University	1	–	5	1	2	9
Afyon Kocatepe University	–	–	4	1	3	8
Erciyes University	–	2	2	–	6	10
Kocaeli University	3	–	5	–	–	8
Aksaray University	–	–	5	–	2	7

Table 3: Academic staff in undergraduate education, 2008

substructure and lecturers required for the education should be determined.

The departments, which would be founded without providing the required substructure, equipment and instruments and also lecturer staff, would reduce the quality of the engineers to be graduated and also may cause irreversible damages our profession's interests and the future and also our nation.

Thus, the departments, which have been just founded and not started teaching yet, should be banned from accepting students until they complete their substructures and academic staffs. New departments should be opened and teaching should be performed based on principles and through a proper strategic planning for graduating qualified engineers.

3. The Result and Recommendations

There is no doubt that, the changed face of engineering profession, especially our profession, geodesy engineering due to the advances in science and technology is affecting geodesy programs in our nation in this process in which globalization is affecting the whole of the world. This developments and advances have positive effects on geodesy programs. However, some basic problems are becoming more significant in geodesy sector on teaching area. The most important problems are lack of coordination, insufficient cooperation, less participation processes and in sufficient substructure facilities.

The first thing to overcome these problems and to eliminate potential troubles in the future is to make strategic planning. A board including presidents of the departments offering Geodesy and Photogrammetry Engineering programs in the universities may be established. This board may be enlarged with the heads of the main scientific branch.

Because the fact that "*investments on education do not yield results in short-term*" is known, strategic thinking will be required for the steps to be taken in the future. Focusing on the next period including 15-20 years and orienting to establish educative substructure for the future based on contemporary values should be the basic initial point.

The steps to be taken for education will be an indicator for what kind of future we design. We can obtain the future by the steps to be taken today about education. The problem is important and vital.

Each engineer candidate should have the following qualifications as a result of the existing undergraduate programs along with all the plans, which should be realized:

- The graduated students should have good command of a foreign language.

- Practicing should be emphasized in professional trainings of our students.
- The graduated students should be able to use any current professional software at a good degree.
- The graduated students should have information on law relating to our profession beside measurement and assessment techniques.
- The students should be educated not only from the professional point of view but also social point of view and should have a vision that ensures to make them able to undertake administrative positions in the future.
- The graduated students should have professional ethic.
- Obstacles in front of the specialization should be eliminated in our profession and specialized engineers on certain subjects should be graduated.

Especially, the specialization and certification efforts triggered by Geodesy and Cadastral Engineers' Chamber should be supported for specialization in the profession. Growing specialist engineers on certain matters is important for our profession.

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TQM and Marketing Perspectives for Surveying Education and Training

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Abstract

This paper seeks to evaluate the arguments for the proposition that students in higher education are "customers" and should be treated as such, and investigate whether the adoption of the terminology, systems and processes of the "student-as-customer" leads to a degradation or improvement of the quality of education and level of service delivered to higher education students, especially focused on students enrollend in the field of surveying.

Keywords: TQM – Total Quality Management, QAA – Quality Assurance Agency

Focusing on the management function of the teaching and learning process these processes that can be managed like any other. One possibility for achieving goals for education lies in the application of the ideas of total quality management (TQM) to the teaching and learning process. TQM is defined here as the collaborative and holistic application of the ideas of the industrial TQM model to teaching and learning. This focuses attention on the management function that transforms teacher and student effort into learning. The power of a TQM teaching/ learning model lies in its ability to suggest hypotheses concerning teaching strategies that enhance learning and its emphasis on the quality of product, orientation to students, to teamwork, and a continuing desire to im- prove.

Deming has abridged his philosophy in a set of 14 principles for the transformation of an organization (Deming 1986, 23-24):

1. Create constancy of purpose for improvement of product and service.
2. Adopt the new philosophy. We are in a new economic age.
3. Cease dependence on inspection to achieve quality.... Build in quality in the first place.
4. End the practice of awarding business on the basis of price alone. Instead, mini- mize total cost
5. Improve constantly and forever [every process].
6. Institute training on the job.
7. Institute leadership. The aim of supervision should be to help people . . to do a better job.
8. Drive out fear.
9. Break down barriers between departments.
10. Eliminate slogans, exhortations, and targets ... for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low productivity belong to the system and thus lie beyond the power of the work force.
11. Eliminate work quotas, management by objective, management by numerical goals. Substitute leadership.
12. Remove barriers that rob people ... of pride of workmanship
13. Institute a vigorous program of education and self-improvement for everyone
14. Put everybody in the [organization] to work to accomplish the transformation.

Total Quality Management (TQM) is a „management approach to long-term success through customer satisfaction" (*American Society For Quality, Inc. (ASQ)*). In a TQM effort, all members of an organization participate in improving processes, products, services and the culture in which they work.

Implementation of TQM often entails forming cross-functional quality im- provement teams, drawn from different levels to work on major problems, and intradepartmental working groups sometimes called quality circles.

The quality teams employ a problem-solving process with four broad steps:

1. select a problem(s),
2. diagnose the problem(s),
3. suggest the solution(s),
4. and hold the gain(s).
5.

These generic steps are present in some form in all the various TQM models. For example, Coate espouses a 10-step problem-solving process that en- compasses the four generic steps and "begins with the customer, focuses on the root causes/barriers to improvement, and ensures that decisions and actions are based on real data. (Coate,1990a, pp. 16-17):

1. Identify and select the most important opportunities for improvement. Start with critical processes, especially those that support divisional goals, objectives, and breakthrough items. Select team members and empower them to make improve- ments.
2. Determine the key customers of the highlighted processes or services. Survey the customers, using a standard format, and analyze survey data using check sheets and Pareto diagrams.
3. Select the most important issue and write a clear issue statement
4. Identify and flowchart the key process or processes. This enables the team to more clearly recognize opportunities for improvement
5. Agree on which aspects of your performance you want to measure and, with your customers, set goals for continuous improvement in meeting or exceeding their expectations. To do this the teams must realistically evaluate current performance and set obtainable goals for improvement.
6. Begin to explore probable causes of the problems and barriers to improvement.
7. Gather data on the probable causes. The information collected gives the team a benchmark against which to measure its future progress.
8. Evaluate the data and show in "pictures"-charts and graphs.
9. Brainstorm and develop permanent solutions. Implement solutions; monitor their performance; adopt them if they work.
10. If the problem is solved, standardize the fixes as normal operating procedures.

The basic principles of TQM as applied to higher education are as follows (Lynne & Ross 2007):

Delight the customer: Delight means being best at what matters most to customers, and this changes over time. The aim is to prevent poor-quality services from being produced or delivered in the first place by focusing on processes and emphasising prevention rather than cure. Quality assurance involves ensuring fitness for purpose.

People-based management: Knowing what to do, how to do it, and getting feedback on performance is one way of encouraging people to take responsibility for the quality of their work.

Continuous improvement: Continuous improvement or incremental change, not major breakthroughs, is the aim of all who wish to move towards total quality. Quality enhancement is more transformative and it requires a deliberate change process – including teaching and learning – that is directly concerned with adding value, improving quality and implementing transformational change. For the individual lecturer, enhancement is about improving their students' work based on the premise that they want their students to do well.

Management by fact: Knowing the current performance levels of the products or services in the customers' hands and of all employees is the first stage of being able to improve. From this perspective academic quality is a „way of describing how well the learning opportunities available to students help them to achieve their award. It is about making sure that appropriate and effective teaching, support, assessment and learning opportunities are provided for them" (QAA, 2004, p. 1)

The application of the industrial quality model to the management of teaching and learning requires the translation of a number of key terms. The teacher plays the role of manager. But what role does the student play? Should teachers think of students as customers of the teaching and learning process whose needs should be satisfied; or should the teacher think of students as employees who should be empowered through teamwork?

There are undoubtedly different groups of students who may have both different objectives in studying and different perspectives of their role as customers, factors possibly under-recognised by academic and administrative staff. For example, there will be differences between students relatively new to university study who are seeking a qualification before entering the world of work, compared to a mature student with substantial work experience who is undertaking study as part of continual professional development. We focus primarily on the large body of

students who are in the first mentioned group, but note that there are differences between segments of this group, including substantial differences in objectives and in quality perceptions between students.

There is considerable debate in the literature regarding perceived positive and negative aspects of the "student as customer" concept, drawing upon both general argumentation and empirical studies. The principal arguments are shown in Table I.

However, the transaction by which students pay fees does not equate to a simple exchange of money in return for a product or service. Universities not only provide a range of services, but also regulate them and set standards; this includes not awarding qualifications to students who do fail to meet these standards (Sharrock, 2000). It seems to be necessary to ensure that students understand the implicit contract and the role of academic and administrative staff in facilitating the student's learning opportunities (Lammers et al., 2005). Education may mean that students are taught a specific occupational skill, where the content of their education by and large is determined by what is considered the knowledge vital for the conduct of the occupa tion. This is the kind of education that characterizes many institutions e.g. in engineering. However, education may also have as its purpose to teach students a specific academic discipline that is considered to provide no other direct occupational knowledge than teaching and research within the discipline itself thinking about the value of this kind of education on the labor market beyond the specific research and teaching qualifications it may provide, we often think of more general abilities that may be useful in a range of different occupations.

Students generally do not pay the full cost of their studies (*Halbesleben et al., 2003; Pitman, 2000).* Thus, even if it were accepted that students should be treated as customers because they contribute to the cost of their education, they are not the only customers; other groups who might be assumed to have entitlements include future employers, the government, families (who may assist with educational costs), and society in general, through the contribution of graduates to the economy and to issues of social equity and social mobility opportunities claimed to be afforded to graduates.(*Lynne and Brennan 2007).*

Students pay an increasing proportion of their education costs; they therefore should be treated in the same way as any other purchaser of goods or services	Bejou, 2005; Bennett, 2003 Halbesleben et al., 2003; Kanji and Tambi, 1999
Students do not know what combination of skills and knowledge will best equip them for the world of work; they may not appreciate the importance of a subject until they are in employment	Clayson and Haley, 2005; Adkins and Radtke, 2004; Driscoll and Wicks, 1998
Universities become focused on vocational training to the detriment of generic, transferable skills such as critical thinking analysis. This is coupled with reduced academic standards and rigour, together with grade inflation	Clayson and Haley, 2005; Ballard, 2004; Carlson and Fleisher, 2002; Rolfe, 2002; Scott, 1999
Students seek the easiest programmes and courses with soft assessments; conversely they may punish academically demanding staff through critical feedback. This may have a detrimental impact on future staff promotional prospects	Clayson and Haley, 2005; Yunker and Yunker, 2003; Chonko et al., 2002
Students transfer responsibility on to education providers rat her than taking responsibility for their own learning. This results in a reluctance to conduct independent study and greater demands for all material to be provided for students to learn as if education can be simply passively consumed	Clayson and Haley, 2005; Rolfe, 2002; Tam, 2002; Sharrock, 2000; Laskey, 1998

Table 1: Key arguments for and against the "student as customer" concept, synthetiszed by Lynne and Brennan 2007

Higher education is very largely a private good – the benefits of a university education are appropriated almost entirely by the student through enhanced life-time earnings. Accordingly, students increasingly are paying the costs of their university education. This makes the student *the customer* in the higher education process, and this turn education into an industry like any other, and the primary purpose of an industry is to satisfy its customers. Students are seeking the easiest way to obtain a qualification, and so expect pre-packaged learning delivered by happy, smiling service delivery staff. If the service delivery staff fail to smile sufficiently, or insist that learning demands time, concentration and effort, or give objective grades based on assessed performance, the student-customer will exercise their legitimate right as a consumer and will complain. „Accordingly, educators have come under pressure to reduce academic standards, to provide teaching materials in a style which not always reach an appropiate academic standards, and to give inflated grades for mediocre work. Students have happily relinquished responsibility for their learning to their educators, and believe that failure to achieve desired assessment outcomes should be blamed on the educator rather than the student" (Based on: Clayson and Haley, 2005), but little empirical evidence has been presented to support the claims made.

Marsh and Roche (2000) suggested that it is merely a popular myth. and, there is a positive association between student workload and student evaluation of teaching: students do not reward with high evaluation results those teachers who give them relatively light workloads. There is indeed a correlation between grades and student evaluations of teaching, this correlation can be explained by the fact that students who achieve higher grades believe that they have learned more, and accordingly are inclined to the view that they were better taught.

Conclusion

There is no simple model for educating land surveyors for the next century. Nobody can be certain that any educational model chosen is correct and appropriate. The student-as-customer concept would undermine the student's sense of responsibility for their own learning. There are clearly important public good aspects to higher education, both those associated with the contribution of graduates to the wider community, which depend upon learning and information for competitive advantage it is necessary to have a highly educated workforce to sustain prosperity. While students are paying an increasing proportion of the costs of higher education in several countries, higher education is still very largely funded by governments out of general taxation. Students are neither the sole consumers in the higher education system, nor are they the sole customers, therefore higher education institutions must not seek to serve only the interests of students to the exclusion of other stakeholder groups.

There is little evidence that students are sufficiently short-sighted as to prefer a university education that is built around easily-won qualifications and a cheerful approach to customer service. The evidence suggests that students have a reasonably discerning approach to higher education, believe that hard work is necessary to achieve worthwhile results, and do not penalise (through poor student evaluation reports) educators who insist on hard work and objective assessment of performance. Additionally, the rights and responsibilities of both the student and the institution in all parts of the education process need to be clearly stated

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Solving the Surveying and Geoinformatics undergraduate Student Enrolment Problem: The University of Lagos Experience



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Abstract

The first Survey School in Nigeria was established in 1908 as a Departmental post-secondary school, to cater for the education of the country's youth who could not proceed overseas for further training. But it was not until 1962 that the first Department of Surveying in a Nigerian University was established at the University of Nigeria, Enugu Campus. In 1970 the University of Lagos (UNILAG) also began the training of Surveyors by establishing a Sub-Department of Surveying in her Department of Civil Engineering. The sub-department became a full fledged department in 1973. About the same time survey training started in UNILAG, another Department of Surveying was established at the Ahmadu Bello University in Zaria, in the northern part of the country. All these departments were domiciled in the Faculty of Engineering. At present, there are eleven Universities in Nigeria, offering courses in Surveying and Geoinformatics leading to the award of Bachelor's and other degrees.

One common and major problem faced by all the Universities is in recruiting interested and qualified candidates as students in their respective departments. This problem is aggravated by the large number of Universities struggling to recruit limited number of available qualified candidates. Other factors contributing to this problem include the following: the very low regard and poor publicity for Surveying profession in Nigeria, perception of poor career prospects for graduates in Surveying, poor financial yield for Surveying professionals, centralized admission process in the University and the stringent uniform requirements for all courses in the Faculty of domicile, and the physically demanding, and sometimes boring nature of some aspects of the training of Surveyors.

The Department of Surveying and Geoinformatics, University of Lagos, has taken some steps to solve the problem of recruiting qualified candidates into the department. These include: organizing career talks in Secondary Schools, making admission requirements more relevant, encouraging and engineering positive publicity for the profession, and undertaking a review of the curricula, to make the course more interesting and attractive to young school leavers.

The result of the efforts made at University of Lagos has generated a lot of interest in the profession amongst the students. By the 2008/2009, the Department had been able to fill its admission quota with qualified candidates, almost exclusively from those who indicated Surveying and Geoinformatics as their first choice course, in the central admission system.

Introduction

Surveying is one of the oldest professions in Nigeria (Atilola, 1999). The Nigerian Surveyor was among the first professional man to be exposed to formal training locally. The first Survey School in Nigeria was established in 1908 as a Departmental post-secondary school, to cater for the education of the country's youth who could not proceed overseas for further training. That school was later moved to Ibadan in 1927, from where it finally moved to Oyo in 1935. When the Yaba College of Technology was established around 1932 as the highest institution in Nigeria, a provision was made for prospective surveyors to undergo basic educational studies in the institution for two years, followed by two years of training at the Survey School, Oyo. Successful candidates were subsequently awarded diploma of the College. The first exposure to university education came in 1947 with the establishment of the University College of Ibadan. There, provision was made for the training of professional surveyors for the country. The programme was later discontinued following a change in the policy of the colonial administration (Fajemirokun, 2008).

In 1962, the Nigerian College of Technology, Enugu became part of the then two year old University of Nigeria, Nsukka and the Nigerian Surveyor was again exposed to university education. The first set of 5 students of surveying from the University graduated in 1966, 58 years after the first Survey school was opened in Lagos (Fajemirokun, 1976).

In 1970, the University of Lagos (UNILAG) also began the training of Surveyors by establishing a Sub-Department of Surveying in her Department of Civil Engineering. The Sub-Department became a full fledged department in 1973. The initial programme of the sub-department at the time was a two-year postgraduate course of studies and research leading to the M.Sc. (Surveying) degree. Graduates in fields cognate to surveying were admitted into the programme (Department of Surveying and Geoinformatics Unilag, 1999). Prior to all these, the Faculty of Engineering of the University of Lagos in 1967 arranged for a few students who were surveying undergraduates of the University of Nigeria, Enugu Campus and who were displaced by the Civil War, to complete their degree programmes in the Faculty, and earn a degree of the University. About the time survey training started in Lagos, another Department of Surveying was established at the Ahmadu Bello University in Zaria, in the northern part of the country. All these three departments were domiciled in the Faculty of Engineering at the time of their establishments.

At the beginning of the 1974/75 session, the first set of five students was admitted to Unilag to pursue a three year B.Sc. programme in Surveying, after obtaining A' Level papers in relevant courses or having completed a one year preliminary programme in Engineering in the Faculty of Science. In addition, a postgraduate diploma programme for graduates with relevant degrees was introduced (Department of Surveying Unilag, 1981). The three-year undergraduate programme was later changed to a four-year programme to allow for enough practical experience before graduating. Presently, the Department runs a five-year undergraduate programme.

University training in surveying in Nigeria is also offered at the Enugu State University, Enugu, Federal University of Technology Minna, Rivers State University of Science and Technology Port-Harcourt, Abubakar Tafawa Balewa University Bauchi, Imo State University Owerri, University of Uyo Uyo, Nnamdi Azikiwe University, Awka, and the Federal University of Technology Yola.

The duration of university training programme in Nigeria is five years for candidates entering through the University Matriculation Examination (UME), four years for candidates entering with National Diploma certificate (ND) and three years for holders of Higher National Diploma Certificate (HND). Postgraduate programmes in Surveying and Geoinformatics at M.Sc. and Ph.D. levels also exist in a few of these Universities.

The minimum entry requirement for Surveying and Geoinformatics courses in Nigerian Polytechnics is four credits (in W.A.E.C and NECO) at not more than two sittings in Mathematics, Physics, English, and Chemistry or Geography. Candidates are also required to sit and get above the cut-off marks in the Polytechnic JAMB Examination.

At the university level the minimum entry requirement is five credits at not more than two sittings in Mathematics, Physics, English, Chemistry or Geography and one other subject. The minimum entry requirement in University of Lagos for Surveying and Geoinformatics is five credits in Further Mathematics, Mathematics, Physics, English, Chemistry or Geography at one sitting.

Candidates seeking University admission are required to sit and pass the JAMB examination and the Post JAMB test. The JAMB and Post JAMB test subjects for Surveying and Geoinformatics are Mathematics, Physics, English, Chemistry or Geography.

2. Dearth of Qualified Candidates for Surveying and Geoinformatics Programme

One common and major problem faced by all the Universities is in recruiting qualified and interested candidates in adequate numbers as students. This problem is aggravated by the large number of Universities struggling to recruit from the limited number of available qualified candidates. While the number of Universities offering Surveying increased from one in 1962 to three in 1970, the position remained the same till the mid '80s. Within the next 15 years, the number had increased to eleven. Table 2.1 shows Surveying and Geoinformatics students' enrolment statistics at the University of Lagos between 1998 and 2009.

S/N	Session	No of UME Applicants	No of UME Admitted		No of DE Applicants	No of DE Admitted		No of Applicants for Change of Course
			Merit	Supplementary		Merit	Supplementary	
1	1998/1999	*na	26	105		10		
2	1999/2000	64	28	27		13		
3	2000/2001	*na	11	65	23	25		
4	2001/2002	*na	14	147		44		301
5	2002/2003	*na	28	27		20	30	54
6	2003/2004	42	23	*na		28	1	
7	2004/2005							
8	2005/2006	52	39	17	62+	32		
9	2006/2007	36	13	45		18	2	102
10	2007/2008	36	19	23	16+	7		
11	2008/2009	59	26	2	15+	9		

*na — not available

Table 2.1: Students Enrolment Statistics in University of Lagos Between 1998 and 2009

From table 2.1, most of the candidates coming into the department through the University Matriculation Examination (UME) are mostly through supplementary admission, which picks from candidates crossing from other departments because they could not be admitted for their first choice courses. The situation is different in the current session, as almost all admitted students were on merit. It is hoped this trend will continue.

Most of the candidates coming in through direct entry (into year two and three) got admitted by merit. This is the case because many candidates with National Diploma (ND) and Higher National Diploma from polytechnics were able to come in between 1998 and 2002. However, when the entry qualification was changed from Upper Credit to Distinction in 2003, many of them could no longer come in. Most of the candidates coming into the department through direct entry at present are candidates from the University Diploma programme.

From table 2.1, it is clear that we have candidates enrolment problem into Surveying and Geoinformatics programme. Many factors are responsible for the dearth of qualified and available candidates for recruitment into the Surveying and Geoinformatics programmes in Nigerian's Universities, these factors include:

i. Very low regard and poor publicity for the Profession of Surveying in the country.

ii. The centralized process of admission of students into the various University programmes.

iii. The perception of poor career prospects for graduates in Surveying.

iv. The physically demanding (and sometimes dangerous) nature of the practical aspects of the training of Surveyors

v. Poor financial yield for qualified professionals in Surveying in comparison to others

vi. The stringent entry requirements into the course, which is the same for other courses within the Faculty of domicile, while some of these courses are considered 'better' than surveying

vii. Perception of students that surveying as a course is not only difficult, but also boring.

2.1 Very Low Regard and Poor Publicity for the Profession of Surveying in the Country

The poor enrolment rate in the profession of surveying can be largely attributed to the low regard people have for the profession. Majority of the public erroneously think that all surveyors do is to carry poles and theodolites, and enter the bush to demarcate landed properties. Many young school leavers want courses or professions like engineering, law and medicine that will make them popular and give high financial yields. We live in a community where people worship titles and like to be called doctors, lawyers or engineers. This low regard for the profession is however changing as more people get enlightened. The impact of recent advances in Information Technology, coupled with the emergence of GIS, has made many enlightened people to know the power of GIS and surveying in managing spatial data.

Poor publicity for the profession has also contributed to the enrolment problem. For instance, ethics of the profession as practiced in the country does not permit self advertisements. As a body, the profession also shies away from aggressive publicity of its activities and capabilities. It is also our opinion that established professionals have also not done enough to attract and encourage young ones, through personal contacts, print and electronic media to join the profession. It is however interesting to note that some of our professional colleagues have succeeded in getting their children to join the profession. Many of them did this because of the wealth that the profession has brought to them, while others did so because of the love they have for the profession.

2.2 The Centralized Process of Admission of Students Into the Various University Programmes

Admission of students into university programmes in Nigeria is through the Joint Admissions and Matriculation Board (JAMB). JAMB stipulates the minimum entry requirements into all university programmes. For the University of Lagos, candidates are expected to score at least 200 out of 400 in the JAMB exams before they could be given any consideration into any degree programme. In addition, the cut off marks are usually high because of the large number of candidates seeking admission into the university. The JAMB examination is written at the same time by all the candidates; because of this, candidates usually prefer to choose popular courses, to the detriment of the other ones like Surveying. The eleven universities offering surveying and geoinformatics programmes are left to struggle to attract the very few school leavers, who are genuinely interested in the course, and who have applied to JAMB for the course.

Within the university, admission is handled on faculty basis. Invariably, there is uniformity in admission requirements within the faculty, and this works to the detriment of the less popular courses like surveying. The department, often times, is forced to make do with candidates who were unable to get admission into there first choice course. The problems associated with the centralized process of admission have made enrolment into surveying programmes difficult.

2.3 The Perception of Poor Career Prospects for Graduates in Surveying

There is a general belief by the general public in Nigeria that there are little or no career prospects for graduates in the surveying programme in the country. Many people still see surveyors as people who work only in the bush. This impression is however changing slowly, due to education and public enlightenment.

2.4 The Physically Demanding Nature of the Practical Aspects of the Training of Surveyors

One of the reasons for the low enrolment of candidates into surveying and Geoinformatics programmes is the fact that some aspects of work in the profession is physically demanding. Though with modern instrumentation like GPS and remote sensing, the physically demanding part has been reduced, people still have the old mentality of surveyors always carrying poles and traditional instruments about in the bush. In any case, the physical nature of aspects of the surveyors' work cannot be totally eliminated.

2.5 Poor Financial Yield for Qualified Professionals in Surveying in Comparison to Other Professions

The poor financial yield in the profession as compared with some other professions where charges are based on percentage of the cost of project has discouraged quite a number of intending entrants. Despite the fact that efforts are made by the profession to see that surveyors are adequately remunerated, we still have a lot to contend with in this regard. Most survey projects

are not given directly to members of the profession, but are awarded to Engineers, Architects and even lawyers, who only give the survey components of the job out to surveyors at ridiculous fees.

2.6 The Stringent Entry Requirements into the Course

The stringent entry requirement in some universities and especially University of Lagos has discouraged many candidates from seeking admission into Surveying and Geoinformatics. University of Lagos demands that all candidates must pass all the required subjects in the Ordinary School Certificate level at one sitting for all courses in the university. In addition, Faculty of Engineering, where the Department of Surveying and Geoinformatics is domiciled, also requires a credit pass in further mathematics for any degree programme in the Faculty. The Faculty also requires distinction from candidates with polytechnic diplomas for direct entry admission. The situation in the past used to be Upper Credit for candidates coming in through the polytechnics. Since most of the candidates seeking admission into the department through direct entry have upper credit, they are therefore unqualified for admission.

2.7 Perception of the Students that Surveying is Difficult and Boring

Many students in the profession believe that surveying as a course is not only difficult, but also boring. Most of those complaining are those who are ill advised to choose the course instead of some other courses that are not so much mathematically oriented. Also, some students admitted after effecting a change of course, or during supplementary admission, find it difficult to move along with other students in the class.

3. Measures taken to solve Students' Enrolment Problem

The following steps have been taken by the Department of Surveying and Geoinformatics, UNILAG to encourage students' enrolment into the department:

- Organising career talks in Secondary Schools
- Reviewing admission requirements, and making it more relevant to the course
- Encouraging and engineering more, and positive publicity for the profession
- Reviewing the curricula, to make the course more interesting and attractive to young school leavers.

3.1 Career Talks and Positive Publicity

Public campaign to get qualified candidates into the profession has been stepped up in recent times. Career talks have been given to secondary school students. The 'GIS Day', a day set apart to popularize GIS, has also been exploited to give career talks and sensitize candidates on the profession. Secondary school students are being invited to the department to see some of the facilities, and also get acquainted with what they stand to gain by joining the profession. The department of Surveying and Geoinformatics, Unilag, has used some of the pubic enlightenment campaign and career talks to identify areas of job opportunities for graduates in Surveying and Geoinformatics. The department also publishes, regularly, students' prospectus for undergraduate and graduate programmes. The prospectuses, among other things, list several job opportunities that await graduates of this profession. Some of the places where graduates of this profession could be employed in the country include, but are not limited to:

1. Telecommunication Industry like MTN, ZAIN, GLO MOBILE and, STARCOMMS
2. Military (i.e. Nigerian Army, Navy, Airforce and Police)
3. Oil Companies (i.e. Shell, NNPC, Exxon-Mobil, Chevron, Department of Petroleum Research (DPR))
4. National Space Research and Development Agency (NASRDA)
5. Federal Airport Authority of Nigeria (FAAN), Nigerian Airways Management Authority (NAMA)
6. Federal and State Survey Departments
7. Federal and State Universities and Polytechnics
8. Federal and State Ministry of Solid Minerals
9. Federal and State Ministry of Water Works
10. Federal Capital Development Authority (FCDA) Abuja
11. Banks and Insurance Companies
12. Institutes of Agriculture and Forestry
13. Nigerian Ports Authority (NPA)

14. National Institute of Marine and Oceanography Research Department (NIOMR)
15. Nigerian Institute of Waterways Authority (NIWA)
16. Federal and State Environmental Protection Agencies
17. Dredging Companies like Dredging International
18. Engineering Construction Firms (i.e. Julius Berger)
19. Survey and GIS Companies and organisations
20. Personal Survey Practices.

The poor perception by the public concerning career prospects for graduates in the profession is fast changing because of the high rate of general unemployment in the country. People have now come to know that it is easier and more lucrative to own a private Surveying and Geoinformatics company than to build a hospital or set up an engineering firm. In addition, many of our graduates are working in telecommunication firms, oil companies, and federal and state government establishments.

The Lagos State government in July 2007, through the office of the Surveyor General, embarked on a public forum to sensitize the citizens on the benefit of the Lagos State Mapping project to the general public. Through this forum, which was chaired by the Deputy Governor of the State, many people including prospective students have come to know more about surveying and geoinformatics. The Nigerian Institution of Surveyors has also, in recent times, been aggressively promoting the publicity of the profession. The President and other officers take every opportunity that comes their way to publicize the profession and its valuable and key contributions to the society

Besides career talks and publicity, many efforts are being made to counsel students who find the course difficult and boring, and majority of them have come to love the course, especially as they get to higher levels where they are introduced to GIS and modern instrumentation in surveying.

3.2 Reviewing Admission Requirements

It is worthy to note that University of Lagos pioneered efforts to reduce some of the problems associated with the centralized admission by conducting post JAMB examination for candidates who chose the university as their first choice and scored more than 200 in JAMB examination. This laudable step was initially rebuffed by JAMB, but as more universities aligned with University of Lagos' position, the post JAMB examination has come to stay and it is now being conducted by all the universities in Nigeria. The post JAMB examinations have succeeded in getting qualified candidates into the Nigerian universities.

The Department of Surveying and Geoinformatics, University of Lagos is also planning to move out of the Faculty of Engineering to the Faculty of Environmental Science, where the department actually belongs, and it is most likely that the admission requirements there will be more favourable to prospective students. These steps, when taken, will further improve students' enrolment into the department.

3.3 Curricula Review and Change of Name

In line with the development in Colleges of Education and Polytechnics, the National Universities Commission (NUC) directed all institutions offering surveying to modernise their curricula. Due to recent advances in Information Technology and its effect on the profession, the Department of Surveying and Geoinformatics, University of Lagos recently reviewed its various degree programmes and came out with new structures, whose curricula tended to address the shortcomings of the past (Fajemirokun and Nwilo, 2000). Some of the new courses introduced at the undergraduate level include Computer Applications in Surveying, Principles of Geoinformation, Digital Mapping, Coastal Mapping and Management and GIS Tools and Applications. At the Graduate level, some of the new courses introduced are Data Acquisition Systems, Advanced Concepts in Geoinformatics, Spatial Data Structures, GIS Implementation Strategies, Spatial Statistics, Policy Issues in GIS Implementation and Digital Cartography.

Advancement in technology coupled with the changing trends in the surveying profession led to a worldwide debate on the appropriate name for the profession. A number of training institutions and establishments after the debates changed their names. Some of the new names adopted include Geomatics, Surveying and Geoinformatics, and Geodesy and Geomatics Engineering. The global wind of change in name of the profession also blew across Nigeria.

The Department of Surveying and Geoinformatics, University of Lagos formerly known as the

Department of Surveying University of Lagos led the campaign for the change in name of the profession in Nigeria. The campaign for the change in name was cushioned with a workshop on Surveying and Spatial Information Technology in July 1999 organised by the Department. The objectives of the workshop were to determine the appropriate name and direction for the profession in the Department as well as in the country (Nwilo *et al*, 2000). Experts in the profession across the country from tertiary institutions, oil companies, government agencies and other key management leaders participated in the workshop. Papers were delivered by some of the experts in the profession. At the end of the workshop, the Department adopted the name "Surveying and Geoinformatics'. The new name had since been approved by the University Authority.

The modernization of the curriculum and change in the name of the department has attracted more people into the profession. There are many graduate students from other fields coming to do professional Masters in Geoinformatics in the department. In recent times many of the former graduates have been coming back to do M.Sc. programme in the department. The department graduated two Ph.D. students in surveying and Geoinformatics this year, and has close to ten registered Ph.D. students presently.

3.4 Improved Financial Yield for Professionals

The Federal Government has taken some steps to correct this anomaly by moving the Office of the Surveyor General of the Federation (OSGoF) from the Ministry of Works to the Presidency. Notably, some State governments have recently awarded GIS and mapping projects directly to surveyors. These efforts by both Federal and State governments have rekindled hope in the profession.

4. Conclusion and Recommendation

4.1 Conclusion

Recruiting qualified and interested candidates into Surveying and Geoinformatics programme has been a huge problem. Many factors like the large number of Universities competing for limited number of candidates, poor publicity for the profession, centralized process of admission of students into the various University programmes coupled with stringent entry requirements into the course have contributed to the inability to recruit interested and qualified students into the programmes in adequate numbers.

The Department of Surveying and Geoinformatics, University of Lagos, had been concerned and has been in the forefront of the vanguard to solve the problem of the dearth of qualified candidates for the Surveying and Geoinformatics programme. The Department paid attention to the very narrow interpretation given to "surveying" by the general public, and the need to reflect the tremendous impact that the advances in technology and modern techniques have had on the profession of surveying. In 1998, the Department, in conformity with the reviewed programme changed its name from 'Department of Surveying' to the Department of Surveying and Geoinformatics, to portray a discipline that deals with acquisition, analysis, storage, distribution, management and application of spatially-referenced data.

Public campaign to get qualified candidates into the profession has been stepped up in recent times. Career talks have been made to secondary school students. The GIS Day has also been exploited to give career talks and sensitive candidates for the profession.

It is worth noting that University of Lagos pioneered efforts to reduce some of the problems associated with the centralized admission by conducting post JAMB examination for candidates who chose the university as their first choice and scored more than 200 in JAMB examination. The Department of Surveying and Geoinformatics, University of Lagos is also planning to move out of the Faculty of Engineering to the Faculty of Environmental Sciences, and to review the entry requirements for prospective students.

The efforts made at the University of Lagos have generated a lot of interests in the profession amongst students and prospective students. By the 2008/2009, the Department had been able to fill its admission quota with qualified candidates, almost exclusively from those who indicated Surveying and Geoinformatics as their first choice course, in the central admission system. There are also many graduates from other fields coming to do professional Masters in Geoinformatics in the department. In recent times many former graduates have been coming back for the M.Sc. programme in the department. The department also graduated two Ph.D. students in Surveying and Geoinformatics this year, and has close to ten registered Ph.D. students currently.

4.2 Recommendation

The following recommendations if carefully implemented will go a long way in attracting qualified candidates to join the Surveying and Geoinformatics profession.

1. More career talks and public enlightenment campaigns on surveying and geoinformatics should be made in secondary schools, electronic and print media.
2. The Federal and State governments should award survey projects directly to competent and qualified professionals in their respective fields.
3. All impediments like stringent admission requirements that are counter productive should be removed.
4. Surveying and Geoinformatics curricula should be reviewed and modified from time to time in line with advances in information technology and instrumentation.
5. The Nigerian Institution of Surveyors and the Surveyors' Council of Nigeria should work closely with professionals in Higher Institutions, Public Service and in private practice to modernize professional practice in Nigeria, and promote the well being of the profession.

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Surveyors at the Faculty of Geo-informatics before and after the introduction of the credit system

Tamas Jancso, Peter Engler and Andras Szepes, Hungary

1. Introduction, short history

At the Faculty of Geoinformatics, University of West Hungary, the professionals are mainly educated in the field of land surveying and management, GIS and mapping. In the 50's there was more and more demand for specialists at the existing organizations of the National Survey, at the surveying firms and at the big designing institutions. To meet this demand, with the aim of providing an up-to-date university education for experts the precursor of the college was established in 1962 under the name of Land Surveying Technical High School.

The next considerable change was in 1972, when the development of educational and scientific activity reached that level, where the technical training was replaced by the academic training of production engineers, later on general engineers. Within the meaning of the decision land surveying and land management education began in 1972 and 1975 resp. in Szekesfehervar in the College of Land Surveying and Land Management, Sopron University.

The new college-form of organization created favourable conditions for solving practical geodetic tasks. The relative self-independence of the College ensured the continuous enforcement of the claims of the land surveying branch, while taking over the useful educational and researching experiences of the ancient parent establishment.

2. The educational system and the effecting marketing issues [Engler 2008]

In the last period our name was changed to Faculty of Geoinformatics. Our faculty successfully kept the dominant role in the land management and surveying education. In 2005 because of the structural changes in the higher education we introduced the BSc education in land management and surveying. After the 7 semester education the graduated engineers will be capable to deal with the new technologies in geoinformatics, land development, land and property management, land valuation and qualification. The diploma gives also authority to work in the field of photogrammetry, remote sensing and spatial informatics.

To deal with tasks in property and land mainly juridical knowledge is necessary. To offer well educated professional in this field we founded in 2000 the land registry management, and in 2006 the public administration management courses.

We believe that from marketing point of view it is very important to follow up the improvements and changes in the technology. The curricula have been renewed and revised continuously. Our direct highest authority was the Ministry of Agriculture until 1993. In terms of the law about university education LXXX, 1993, all Hungarian universities and colleges are directed by the Educational Ministry, but for us the Ministry of Agriculture and Rural Development remained the professional director.

In the Hungarian higher education besides the marks the main measuring unit is the credit which indicates the fulfilment of the curricula subjects. The introduction of the credit system was ordered by a governmental decree in 2000. This system especially uses the ECTS (European Credit Transfer System) as a tool. Our faculty introduced this system in the 2002/2003 academic year and designated credits to the subjects, where the total amount of credits is 210 at the BSc level. In our curricula the subjects are sorted in three groups: compulsory subjects (A), compulsory optional subjects (B) and optional subjects (C).

The credit system has many advantages, but – we should admit – disadvantages as well. The advantages are formulated in a nice way in those materials, which propagate them. That's fine. The problem is that the practical introduction often doesn't prove the theoretical expectations or the fulfilment of the conditions is difficult.

The credit system makes easier the earlier rigorous conditions. It gives possibility to the student to choose subjects in different ways. Practically it means that the student can plan his academic years in flexible way considering of course the curricula requirements, especially the

pre-requisites. The students don't have to repeat the full-semester if they fail in one or more subjects. They can choose other subjects and they can continue their studies. The new system gave a tool to continue the studies in other institutions, admitting some certain subjects carried from the previous schools, etc. .

This methodology requires more caution and punctuality from the students when they plan their semester. Many students are not prepared for that. They receive of course advice and aid from the tutors and the students learning in higher courses, but despite of this there are many repeated subjects, the pre-requisites are not fulfilled, etc.. We consider as an advantage that that one subject can be repeated three times, but on the other hand it makes the students irresponsible.

Also it is considered as an advantage that the completed subjects from other institutions can be accepted. This tool was available before the credit system with similar conditions as well. This possibility is very useful at those professions which are educated in some different institutions, but there are many professions which are taught only in one institution. Our faculty belongs to this category, which means that we are not able to accept many subjects, especially the core subjects, which are very special and accredited only at our faculty. This fact decreases the student mobility.

The introduction of the credit system didn't affect the entry system. It can be proved by the statistics. At our faculty usually the number of applicants is twice more than the available capacity. Among the earlier recruiting methods (open day, carrier choosing exhibitions, EDUCATIO exhibition, visits at the middle professional schools) we had to introduce new "tools" in the marketing process. Besides of the television and radio ads, we published ads in those newspapers, periodicals which are popular amongst the younger. The impact of the Internet facilities has grown largely. Last year as a trial, we organized a series of road shows in eight different cities, but the surveying statistics showed us that most people use the Internet to get more knowledge about a certain institution.

The main reason for the intensive propaganda is that the number of entry students is less and less, and the financing is based on the number of students. So, (more or less) the constant number of students is a crucial issue at the universities. The other reason is that in 2007 the entry application system was changed. It means that there is no certain amount of students designated to a certain university, instead a contingent is determined for one professional field. In their entry application the students indicate the institutions in an order of importance, and it means that the large universities can gain more profit from it, since mostly the students indicate them at the first place. In 2007 except of two-three big universities, most of the higher education institutions found themselves in a disadvantageous situation. In 2008 this system was fixed considering those special institutions where the given profession is educated only there. Also an important marketing issue is that our faculty can provide an MSc course from the next academic year and two years ago we started our PhD program in Geoinformatics.

3. Financial issues

The education is financed basically by the government. It was regulated earlier with the tool of the „base budget", which meant that each year the budget was increased with a multiplier factor calculated by centralized principles at the beginning of each year. The governmental budget principles have been changed radically and it has brought big changes in the financing of the higher education sector. Recently the institutional budget is composed from two sources: governmental subsidy and own incomes.

The subsidy contains a fixed and a variable part. The calculation of the fixed part is depending basically on the number of students, the educational staff and on the ratio of the tutors having academic degrees (PhD, professors, etc.), also the fixed part contains expenses for the maintenance of the infrastructure. Since 2007 the variable part has been based on quality improvement pledges planned by central regulation principles. Hereafter the amount of the variable part depends on the fulfilment of the undertaken quality improvement pledges.

Besides of this subsidy the important issue is the own income. The governmental subsidy is calculated only by the centrally regulated quantity of the students. It means that the educational staff is financed by the government only partly with some ratio considering the number of students financed by the government. The expenses of the remaining staff should be financed, covered by own incomes.

The sources of income can be different. In the first place there is the income coming from the tuition fee of BSc courses. The tuition fee should cover all the expenses related to these BSc

courses. To achieve this goal the first condition is that the tuition fee should reach the level of the governmental student subsidy. At our faculty this condition is not met yet. The tuition fee should be calculated according to marketing principles, mainly by the student market demands and needs. Important factor is the parental salary. Examining the composition of students, if we expect that the parents are not able to pay the desired tuition fee, then the consideration is a difficult issue. If we remain at a lower tuition fee we can expect higher number of students. On the other hand if we raise the tuition fee then the number of students can be decreased largely with the same educational staff. This problem needs an optimization. Recently we consider that the number of students is appropriate thanks to our successful education, the reputation and the good chances of the graduated students to get job on the market.

The student hostel plays an important role in our expenditure and income. We receive governmental subsidy to this facility, but it's not enough for the maintenance. To get more income we offer the empty rooms on the market. Recently it shows a raising tendency at our faculty.

4. Role of the postgraduate courses [Markus, Szepes, Engler 2007]

A special part in our educational program is the palette of the postgraduate courses. We take care of it from the beginning. We have a multilayer postgraduate system. Before describing them in detail, here are some thoughts about the role of the postgraduate courses.

The engineers of our profession have inner and outer challenges to gain an updated or new knowledge. Several institutions are capable to educate them, but for us as the Alma Mater it is very important that our graduated engineers return for further studies. We organized an ALUMNI movement. Belonging to it is a honour. The alumni support their Alma Mater morally and financially. The alumni bring new students to the BSc and postgraduate courses. The alumni are proud of the togetherness, and he/she becomes one of the most effective advertisement booster. If he/she says that this faculty is a good institute then it carries an authority. If he/she suggests changes among the subjects, than it carries an authority. He/she has goodwill, because he/she as an employer wants to have engineers with up-to-date knowledge.

Our first task was to give engineering diploma to the technicians graduated from our school. This education lasted many years, hundreds of technicians become engineers.

After this period there was a demand to the professional postgraduate courses. In Hungary we call it the "education of professional engineers". The topics of these courses always fit the market needs, the actual professional tasks, he new technologies. The topics of data processing, engineering geodesy, photogrammetry covered the first 15 years of the operation period

In the 1990s in our profession we encountered deep changes. The Spatial Informatics grasped more areas and it directed us to other paths. From the Data Processing a new course was developed. In the same time we joined the UNIGIS initiative. We received learning material and methodology. Our task was the adaptation. Now we are a Distance Education Centre in our field of profession.

We just began this new way of teaching, when we started a TEMPUS project together with English, Belgian and Austrian partners and as a result we prepared learning materials and methodology for Land Offices. The project was called as OLLO (Open Learning for Land Offices). Later on we founded a few postgraduate course. Recently our offer is: Geoinformatics, Engineering Geodesy, Real Estate and Land Developer and Soil Mapper and Qualifier.

All these courses are organized by Distance Learning, only an introductory 2-days workshop is held at the beginning and then the students start to work with the teaching material at home. We have a special educational portal to maintain the courses (www.vgeo.hu). The portal was developed by the Moodle system (www.moodle.org).

The important part in our postgraduate course are the so called "short courses". By these courses we try to react on the new challenges, technologies and needs.

5. International issues

To have more effective training in educational, cooperational and financial aspects our faculty has the following possibilities:

1. Join international professional networks; The faculty is member of the following professional network organizations: FIG, AGILE, UNIGIS, EuroPACE, EDEN.

2. Development of teaching materials in international co-operation.
3. Join student and teacher mobility networks, initiatives; Our faculty is part of the ERASMUS and CEEPUS network.
4. Sign contracts for scientific-research and educational co-operation.
5. Co-operate with foreign universities in organization of common courses.
6. Submit jointly EU and other international applications.
7. Offer the PhD schools for the international partners.

All these activities play an important role in the utilization of international experiences, but from the listing the educational projects have bigger emphasis in the faculty's life. To give an impression about these projects here is a short list of some typical projects:

a) Open Learning for Land Offices (OLLO) TEMPUS Joint European Project (1995-98):

The main objective of the OLLO project was the development of open learning materials and course infrastructure in Land Information Management within CSLM at professional and postgraduate level. The short term development of short cycle professional and practically oriented courses in Land Information Management.

b) Distance Learning in GIS – MULTY-COUNTRY PHARE Project (1996-97):

Aims of the DLG project were the following the development of a distance learning professional degree course in Geoinformatics at CSLM. The wide target group consists of professionals in the Geoinformation and related industries (national mapping organizations, application oriented organizations – cadastre, local authorities, utilities companies or private Geoinformation production companies).

c) SDiLA – Staff Development in Land Administration – a TEMPUS project (1999-2001):

There are three SDiLA project objectives. First, the creation of a program of education for continuing professional development for Land Administration in Hungary based on existing programs developed under the OLLO TEMPUS Project and other projects in Hungary and the EU. In seeking to achieve these objectives, the project will develop a core base of knowledge in land administration matters, the Knowledge Pool, which can be used in a flexible manner as a part of staff development program tailored to individual's requirements. Second, the creation of a delivery system for continuing professional development based on a management system and education technology, both CD and Web, with a comprehensive credit system. Third, the creation of a network of EU centers and education providers with the objective of participating fully in EU activities in Land Administration and the EU professional community.

d) LIME – Land Information Management for Executives – a LEONARDO project (1999-2001):

One successful EU founded project (Land Information Management for Executives – LIME) proposal was prepared in co-operation with other UNIGIS sites and GISIG on Issues of EU harmonization and Knowledge pool developments. The project was started in December 1999. The 18-month project will produce a new course for a new profession called Assistant in Land Information Management.

e) GI-INDEED – Geo-Information in the Implementation of Net-based Distance Education for Environmental Decision-making (2006-2007):

GI-INDEED is a EU training project that aims at improving life-long learning and continuous training in the field of geo- and environmental information, to tune data according in particular to the proposed new INSPIRE Directive. In such a context, the realisation of modules of pilot training are foreseen on:

1. environmental web services
2. tuning of data and Spatial Data Infrastructures (SDI)
3. use of SDI for protected areas
4. use of SDI for coastal areas

f) eduGI – Reuse and sharing of e-Learning courses in GI Science education (2006-2007) [Jancso, Markus 2008]:

Many European GI institutes have digital teaching material available. Some already have introduced e-Learning. The project idea is to (re)use existing resources by the exchange of e-Learning courses via the internet. Our faculty has developed the "Data Acquisition and Integration" learning module.

5. Summary, conclusions

In Hungary the Faculty of Geoinformatics started to educate Surveyors in 1972 as a College for Surveyors and Land Managers. Gradually in the last five years the attraction and enrolment of new students has become more end more important. The faculty should be involved deeply in the marketing including the advertisement in different media, organization of road shows throughout the country. The atmosphere and the goals of usual educational exhibitions have changed as well. With the introduction of the credit system the budget planning and the economy with the human resources and infrastructure require a new philosophy and approach. The other important marketing issue is that – besides the BSc level education – the faculty understood the importance of other forms including the MSc, PhD and postgraduate courses. For these courses the main source of students is coming from the alumni. To attract them for the continuation of their studies is an important task. The credit system brought the necessity of the credit transfer between the European universities. The faculty is member of several associations and mobility networks. Although there are some obstacles because of the specific Hungarian accreditation system.

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Where is Surveying Heading – Issues in Educating the Public?




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Summary

It has been clear for some time, at least from the evidence presented at a number of FIG events, that the profession is changing with a huge number of recognised competencies. This raises fundamental questions for the global surveying profession that include: what core subjects should be encompassed in educational curricula; how can we attract and educate new recruits into the profession; how should we market the core surveying competencies; and how can we address the demographics of an aging profession?

Different parts of the world report a range of major challenges, including low student numbers, closure of surveying courses, an aging teaching profession, inadequate job opportunities in some locations with an insufficient supply of graduates to fill the vacancies in others.

Overarching these is the lack of any clear international recognition of definition of the profession of "surveyors" for the 21st century. Thus we risk failure to promote, at a global level, the full range of surveying skills to both our clients and to the broader public, thereby constricting both the supply of and demand for surveyors.

This paper argues that there is need for a review of the core competencies that one might expect of a surveyor and the establishment of a focused marketing programme that influences national and international agencies and overcomes the relative ignorance about the nature, structure, education and regulation in the profession in different countries. This paper identifies and discusses these issues, and challenges the whole of FIG to contribute to developing a range of global solutions to ensure the survival and future of our profession.

1. Introduction

In 2007 the authors presented a paper at the FIG Conference in Hong Kong, SAR, China, Mahoney et al. (2007) suggesting that the surveying profession faced critical future issues. The rapid deterioration in the economic climate in many countries since then has made the imperative to address them greater. This paper sets out to explore some of the fundamental challenges facing the surveying profession.

New technologies and new opportunities have enabled surveyors to broaden their skills and competencies, and as a result they may be involved in such diverse activities as estate management, digital image processing, boundary demarcation, engineering design, and satellite orbit analysis. The number of competencies that surveyors claim now number over 200. This might suggest that that surveyors have become multi-talented professionals, or specialist generalists but it may also point towards a profession that has difficulty in defining its core expertise. This is further confused by the fact that a competency regarded as part of the surveying profession in one jurisdiction may be part of an entirely different profession in another jurisdiction. The general perception may be that surveyors are 'opportunists' rather than 'pragmatists'. This has implications, for the way the profession defines, educates and markets itself.

The global recession being experienced in many countries is reported to be having a profound effect on the surveying profession as a whole. Some members with professional skills currently encompassed with the "surveying" domain will see a dramatic decline in workloads, while others are likely to find a major increase in workloads.

In addition, there has been a fundamental shift in the role of 'professionals'. Threats and challenges emerge in the form of an increasingly litigious and consumer-aware society; a few years ago professional knowledge was required for the interpretation of complex data, but this is now no longer the case. The traditional values of integrity upheld by the professions have succumbed to commercial pressures. This is reflected too in the evolution of the professional skills required of surveyors, who are increasingly delivering more commercial advice. (RICS, 2004) This leads to a number of critical questions being raised:

- What will constitute the core skills of professional surveyors in the medium to long term?
- What does the profession need to do not only to retain its position of expertise within the professional community and in society but also to enhance it?
- Have some areas become too niche?
- Are surveyors too generalist?
- Should measurement be the focus of the profession?
- Is valuation really a form of technical accounting?
- How should education develop to meet the challenges of a changing profession?
- Is the drive for niche courses driven by the educational institutions need to attract more students?

To ignore these questions or to leave these questions unanswered potentially threatens the survival of the surveying profession.

2. Supply and Demand

During the last decade, surveyors faced crucial supply and demand problems. The promise of massive injections of capital into infrastructural projects suggests that those involved in associated engineering surveying activities, may well be largely immune from these problems. It remains to be seen if this is a temporary manifestation or a long term permanent change.

The absence of a protected market in the UK allows the unqualified to compete with the professionally qualified. This is exacerbated by the fact that RICS does not recognise the academic qualifications gained from the majority of UK universities, thereby limiting the market for quality recruits. In some countries, in particular, the UK and New Zealand there is a general lack of surveying technicians.

Another issue is how to attract the highest calibre students into the profession. The public perception of surveyors is varied, and the reality is that we have an extremely low public profile when compared to other professions, except in a very few surveying specialisms. Having attracted students, the challenge then becomes one of providing an educational programme that not only retains the interest of Generation Y[1)], but also encourages them to become skilled and resourceful professional practitioners. For over a decade, almost every surveying degree programme in Australia has struggled to attract its full quota of students. Anecdotal evidence now suggests that students are leaving more 'arts based courses' and looking for academic qualifications that give them much more value for their student fee. Is this an opportunity that the surveying profession can exploit?

Mills et al. (2005) suggest that attracting students has been a problem in the UK. There is a demographic time bomb in the profession which means that a large number of surveyors will retire in the next ten years – where will their replacements come from? This is also a particular problem within academia, where an aging teaching profession is a very visible barrier to attracting young people into University surveying education.

3. A Fundamental Problem

The profession has developed in isolation in different jurisdictions to reflect the needs of their markets, what may be considered to be the field of expertise of a surveyor in one country may be considered to be the expertise of some other professional or technical specialism in another country. Plimmer (2001) demonstrated the variations of competencies (based on the FIG definition of "surveyor") which comprises the profession of "surveying" in 16 European countries. Unless the current economic climate brings about radical change there is no evidence of an external driver to force commonality within the profession. According to Williamson, (1997) over ten years ago, "*The surveying profession is currently struggling for an identity in both the developed and developing worlds.*" The profession requires a clear, coherent and relevant identity.

3.1 National and Regional Variations

This issue of 'identity' is interesting, but perhaps it needs be asked if individual surveyors are concerned with status or identity? A cynical view might suggest that part of the problem may be the senior members of the profession who are resisting change, in order to maintain their own position and status rather than equipping the profession for the future.

In the wider Australasian context, surveyors are typically defined as specialists in spatial measurement and boundary demarcation. Land sur-

1) defined in www.dictionary.com as "The generation following Generation x, especially people born in the United States and Canada from the early 1980s to the late 1990s."

veyors are not estate agents or realtors, they are not specialists in building construction nor are they land valuers – these are all distinctly different industry groups, typically with a lower level of education and skills such that they would not meet the membership requirements of the local surveying profession. However, the Royal Institution of Chartered Surveyors (RICS) argues that a much wider range of specialisms constitute the surveying profession and embraces other groups of specialists into the profession.

While all parties to the reciprocal agreement between all the Australian states and New Zealand, consider land law, spatial measurement and the definition of cadastral boundaries to be the essential body of knowledge for a surveyor, surveyors in New South Wales and New Zealand tend to place added emphasis on municipal engineering. In these particular jurisdictions, the surveyor has traditionally been the designer of urban subdivisions, including all its engineering services. By way of contrast, in the United States municipal engineering is strictly the domain of the professional engineer and certainly not that of the surveyor. There, the surveyor tends to specialises in spatial measurement and land boundary definition.

There are also issues affecting divisions between surveyors and professional practice in some jurisdictions. For example, some of the specialisms of building surveyors are the sole preserve of architects within certain countries of the European Union. Similarly, the functions undertaken by quantity surveyors are not practised in some EU countries – professional valuers in the UK often combine the roles of valuation advice and estate agency, but this is traditionally unacceptable to professional valuers in some EU countries. (Gronow &Plimmer, 1992)

3.2 International Perception

At the other end of the spectrum, within the international community, there are documents which categorise the range of occupational and activity-based data often used to appoint appropriate people or organisations to undertake work. Two of these documents that show how surveyors and their professional skills are represented to the international community are two UN documents – The International Standard Classification of Occupations (ISCO) and the International Standard Industrial Classification (ISIC Rev. 3).

ISCO provides a system for classifying and aggregating occupational information obtained by means of statistical surveys and is one of the standards of international labour statistics. Within ISCO-88, ten separate classifications for "surveyors" are listed, which do not cover the range of competencies recognised by FIG. Thus, "surveyors" are shown as having a fragmented and disparate range of activities with no cohesion, focus or single identity. These classifications were agreed in 1988 and the profession has developed significantly since then.

ISIC is a basic tool for fostering international comparability of data and for promoting the development of sound national statistical systems. ISIC is used in a wide range of statistics, including demographic and social statistics for labour and employment analysis, which need detailed data classified by the kind of activity involved. It is hard to identify clearly those categories in which the activities of surveyors should most appropriately appear. Since all of these "economic activities" require the use of land and buildings, it could be argued that surveying should underpin them all.

It is vital for the future of the profession that its expertise is appropriately presented at this level. Failure to achieve this will result in the surveying profession being seen as increasingly irrelevant to the major issues facing society; its expertise will be overlooked at an international level and, unless it is protected within national legislation, surveying work could be awarded to professions with inappropriate expertise. It is also likely tat the profession's role as influencers of policy will be eroded and the risks of significant and damaging errors hugely increased.

The surveying profession has, therefore, a major identity crisis – at least as far as the rest of the world is concerned, because, when viewed from a global perspective, the surveying profession not only has a wide range of competencies, but also significant variations both in how these specialisms are grouped as a profession and within professional practice. It could be argued that the current FIG definition of a "surveyor", if taken in its totality, is probably not appropriate in any one country. On top of this, we tend not to exploit our ability to act as 'professional facilitators'. Ultimately our success lies in our ability to exploit our professional abilities and secure their recognition on the national and international stage.

If this is the case, how can the profession possibly present the globally coherent marketing message necessary to attract international clients

and also young people into an increasingly aged and apparently fragmented profession?

Indeed, its failure to do just this, may be the root cause of a number of other problems such as, poor public recognition, poor student numbers, poor understanding of the surveyor's skills and expertise and, in some cases poor remuneration, resulting in a vicious circle of decline. While there may be international standards in professional practice, national professional associations that regulate professional education and qualifications operate largely in isolation from one another, or achieve a limited degree of co-operation at regional level, though it can be argued that it is only through the global influence of an organisation such as FIG that the forum to discuss and share ideas and experience can be effective.

4. Societal Changes

The traditional professional whose position in society was secured by the implicit integrity and trust no longer exists. The increase in general education and consumer legislation, mandatory Professional Indemnity Insurance (PII) cover and an increasing litigious culture are combining to erode the traditional status of the professional. (Dabson, et al. 2007)

Professionals are emerging into facilitators who rely not only on their own knowledge base, but also on the expert in-put from clients, who in their turn rely on the expert evaluation of the surveyor (Matzdorf et al., 1996). Until recently much of the surveying profession was based broadly upon high-end technology. Today, many in the profession are essentially working as part of the knowledge society, where careers are made through the provision of value added services.

Knowledge workers access their employment, specialism and social position through formal education, combining this with high manual skills. Different knowledge work will require different levels and kinds of formal knowledge, the source of which is institutional learning. Thus, the quality of traditional teaching and learning is fundamental. Increasingly new knowledge will be acquired later in life, through continuing life-long learning

According to Druker (1994) *'Knowledge workers . . . give the emerging knowledge society its character, its leadership, its central challenges and its social profile.*

A number of major changes within engineering, land administration, cadastral systems, GIS, and marine projects are occurring. Multi-professional groupings are being created to generate holistic complete life cycles solutions, of which the surveying profession can form an integral component. Land, marine and valuation surveyors have been freed by technology to provide value-added service. The surveying profession as a whole must embrace these opportunities. Collaborative working practices with other professions for the provision of value-added services need to become the norm or professional commercial competitors will take over

5. Possible Solutions

If, indeed, the surveying profession is to thrive, what solutions might exist?

5.1 Reviewing the Definition of "Surveyor"

FIG (1991) recognizes a range of skills as being within the competence of a 'surveyor'. In the UK, there are recognized educational and qualification routes for different surveying specialisms. In other countries, certain specialisms are considered to be separate professional activities. Is the complexity of the profession an advantage or a hindrance, both to the recruitment of students into universities and the public's perception what a surveyors does? Clearly a review is long overdue.

As a starting point for discussion, a set of core competencies might perhaps be:

- spatial measurement- land, engineering, buildings and marine
- geospatial information – remote sensing, GIS imagery, presentation
- Valuation
- land administration, – boundary demarcation, cadastre, land tenure arrangements
- planning and development
- project management and professional studies – ethics, basic business practice, multi-professional projects

This core should be defined as soon as possible to enable the profession to change its marketing strategy. Whatever core competencies are identified, it then becomes important to decide whether, regardless of history, this is an appropriate competency or set of competencies for the future. Within individual countries, the surveyors' expertise would then be defined by these core competencies plus any other necessary competencies that might be country or region specific.

5.2 Identifying Successes and Failures

Within the FIG surveying community, some have taken initiatives which have led to real success in gaining public recognition, in attracting students, in improving incomes. Equally, some initiatives have proven to be failures. The following observations can be made.

5.2.1 Changing Names is not a Solution

In the early-1990s it became fashionable to change names, for example from "surveying" to "Geomatics", in an attempt to provide a more integrating title for a profession that was subject to significant technological change. It was to be a new name that reflected the breadth of subject matter encompassed in the profession, that had greater appeal than the old word "surveying" and that would attract students into a profession whose new vision had become one of producing and managing spatial data (Gagnon and Bedard, 1996).

"Geomatics" has had a chequered history for such a young term. In Australia, in recent years, at least one major university programme has dropped the name, "Geomatics", in favour of a return to "surveying". In China, the central mapping and surveying institutions have changed their English translation to "Geomatics". In the UK, Geomatics gains some ground but mainly at corporate level. Individuals tend to call themselves Land or Hydrographic Surveyors, not geometricians!

5.2.2 Focused Marketing is Essential

Anecdotal evidence from the UK indicates that a relatively high proportion of surveying students are encouraged into the profession by personal contact with a practising surveyor who is either a member of the family or a close family friend. Hannah (2006) opines that the primary culprit responsible for the skills crisis facing the surveying profession in Australia is the lack of public profile associated with the surveying profession. In reviewing the success of the surveying programme at the University of Otago in attracting students, versus the difficulties experienced by the Australian universities, he concludes firstly, that it is essential to build marketing momentum; secondly, that a simple and attractive marketing message is essential; thirdly, that it is important to use good communication tools; and, finally, that target audiences must be identified and reached. Surveying recruitment needs to be more focused in both its message and its target audience, and professional associations need to respond by ensuring that the very best students are attracted to professional membership.

5.2.3 Coordinated Marketing is Essential

Typically, when it comes to marketing the profession, there are at least two major interest groups, i.e., the professional bodies and the educational institutions. In the first instance, it is in the interest of the professional bodies to raise their profile thus attracting both work and members. They need an ongoing inflow of members to survive. Equally, the educational institutions need students if they are to survive. In the longer term, the aim should be for graduates to join the professional body.

The New Zealand experience is instructive. Prior to 2002, all Registered Surveyors were required by law to be members of the NZ Institute of Surveyors (NZIS). The links between the tertiary education courses and the NZIS were close, with a high level of coordination and shared marketing. New legislation passed in 2002 eliminated the name "Registered Surveyor" and introduced the new name, "Licensed Cadastral Surveyor" for those with appropriate education and experience. At the same time membership of the NZIS became voluntary. Immediately, a small splinter group of former NZIS members (less than 5%) formed a new Institute known as the Institute of Licensed Cadastral Surveyors (ILCS). Effective marketing can only be done through a strong professional organizations and structures.

The recent careers brochures from RICS demonstrated a new approach to a more integrated careers drive. The Land Group has recently designed and produced five new brochures, similar in brand, format and layout which highlight the areas of:

- Environment;
- Geomatics;
- Minerals and waste;
- Rural;
- Planning and development.

But reaching new recruits is just one of the criteria that this information needs to address.

5.2.4 High Levels of Remuneration are Attractive

One of the very clear benefits of the skills shortage in Australasia has been the marked increase in remuneration paid to surveyors at all levels. Average salaries paid to four-year BSurv gradu-

ates from the University of Otago increased from approximately $NZ 30,000 in 2001 to $NZ 46,000 in 2006. Typically, a surveyors' expertise adds value to clients' project far beyond that which they have traditionally charged. High levels of remuneration are one important factor leading towards higher levels of public recognition and in New Zealand have helped lead to higher levels of recruitment.

6. Conclusions

According to Williamson, (1997) *". . . the surveying profession is fortunate [in] that it has a well developed sense of history, [and that] one of the important lessons that this historical perspective provides is that change in the profession is constant and inevitable."* The solutions facing the profession need radical, dynamic, technological, managerial and procedural solutions or the current situation will remain unchanged. However, we need to reflect on who we are, what we do, how to market the profession to recruit future generations of surveyors, how to raise our profile to potential clients, and to adapt to the evolving marketplace for our services, before others take over traditional markets.

While a unification of our profession would seem to be an overly ambitious goal, at this time, we do advocate a rapprochement which should begin with a review of the core competencies that one might expect of a surveyor.

If we could reach agreement, this would at least allow a measure of coherency in marketing our message to national and international agencies, clients and potential recruits. We need to establish mechanisms to overcome the relative ignorance about the nature, structure, education and regulation which occurs in the profession in different countries. National professional associations operate largely in isolation from one another, and it is only through the global influence of an organisation such as FIG that the forum to discuss and share ideas is available. The important thing is to show the world – politicians, other NGOs, and stakeholders that our professional offerings are fundamental to the survival and well being of society.

Given that professional recognition is a major issue and that improved marketing of the profession is fundamental, the sharing of marketing resources, or indeed the development of a new core set of resources may well prove to be crucial. This would certainly be true for educational institutions whose ability to attract quality students is essential to the long-term health and future of our professional institutions.

For younger people, remuneration and life style is an influence on the attractiveness of a particular career option. It is clear that professional recognition and remuneration will only come about with a radical change in perception of the surveyor's worth. In many countries, the existing demand for those with measurement science skills and associated skills is driving remuneration higher, thus presenting the profession with a unique opportunity to invest out of its abundance.

Anecdotal evidence suggests that in the economic downturn those surveyors who operate in niche areas with good client relations and core skills are those likely to emerge the strongest. The anticipated upturn in many economies should herald a time for the profession to move from technical tasks to those that offer higher returns, and thereby secure its future.

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John Hannah BSc, DipSci, MSc, PhD, MNZIS, RPSurv, completed his first two degrees at the University of Otago, New Zealand. In 1976 he began study at The Ohio State University, completing an MSc and a PhD, both in Geodetic Science. From 1982 until 1988 he was Geodetic Scientist, and then subsequently, Chief Geodesist/Chief Research Officer with the Department of Lands and Survey, New Zealand. After a 17 month appointment to the Chair in Mapping, Charting and Geodesy at the US Naval Postgraduate School, California, he returned to New Zealand as Director of Geodesy and subsequently, Director of Photogrammetry for the Dept. of Survey and Land Information. In 1993 he joined the School of Surveying, as Professor and Head of Department, becoming its Dean in 2001. He relinquished this administrative role at the end of 2004 in favour of more teaching and research. He is a Registered Professional surveyor is on the Council of Standards New Zealand and is a Past_ President of the NZ Institute of Surveyors.

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Recruitment, retention and progression of Geomatics undergraduates at Newcastle University

Tom Bramald, Henny Mills, Jon Mills and Stuart Edwards, Newcastle

1. Introduction

Over the last 20 years, the geomatics community has endured great anxiety and debate surrounding the recruitment of young people to university courses and the profession. While debate in the international arena has ranged around the subject's name (e.g. Onsrud and Pinto (1993); Trinder and Fraser (1994); and Ballantyne (1996)), a need for community wide responses to the problem (Parker and Booth, 1999) and even the problems posed by secondary education phenomena (e.g. Lemmens, 2001), the issue of having to recruit young people has remained. The last ten years have seen drastic changes in geomatics university education in the United Kingdom. The decreasing numbers of students studying geomatics and the increased financial pressure on universities have led to the closure of several geomatics degree courses across the country. As a result Newcastle University is now the sole provider of Royal Institution of Chartered Surveyors accredited undergraduate geomatics higher education in the UK. The undergraduate programmes in geomatics are also accredited by the Institution of Civil Engineering Surveyors.

Based within Newcastle University's School of Civil Engineering and Geosciences (CEG), the geomatics group conducts a broad range of teaching, research and commercial activities. Geomatics undergraduate degree programmes, under one name or another, have been offered at Newcastle for more than 50 years and now have an annual intake quota of 35 UK and EU students, plus several "overseas" students each year. Even in the face of research, third-strand and service teaching pressures, securing an annual intake of 35 students is the biggest challenge the geomatics group at Newcastle University faces. To try and meet the challenge, the group has undertaken a wide variety of recruitment and engagement activity coordinated by the wider university, and has also undertaken a significant amount of geomatics-specific engagement and recruitment work. The group's work includes an internationally recognised geomatics public engagement project and, more recently, a new programme working with school teachers that is showing promise.

The variety of experiences and practices over the last 10 years have allowed the group to articulate a student life cycle that now underpins the marketing and recruitment work of the group. This paper sets out that life cycle and describes some of the marketing and recruitment work undertaken by Newcastle University's geomatics group.

2. The Undergraduate Student's Life Cycle

In 2006, the School of Civil Engineering and Geosciences adopted a "life cycle" approach to the recruitment, retention and progression of its students. These terms are defined as follows:

Recruitment: The process by which applications to the degrees are encouraged and the subsequent conversion process, i.e. persuading an applicant to eventually register for a degree.

Retention: The process by which students who register for the degree programmes are retained for each year of the programme through a combination of academic success and personal enjoyment/comfort in the surrounds.

Progression: The successful movement of a student after graduation. This may be to employment, postgraduate study or some other activity that is the ambition of the graduate (e.g. travelling).

The life cycle adopted is based on a student that is resident in England and who will leave school at 18 years old to join university. It can be presented as a flow diagram (Figure 1). Clearly, there are exceptions to this set of conditions but it does conform to the majority of Newcastle's geomatics students. The ability to articulate the life cycle

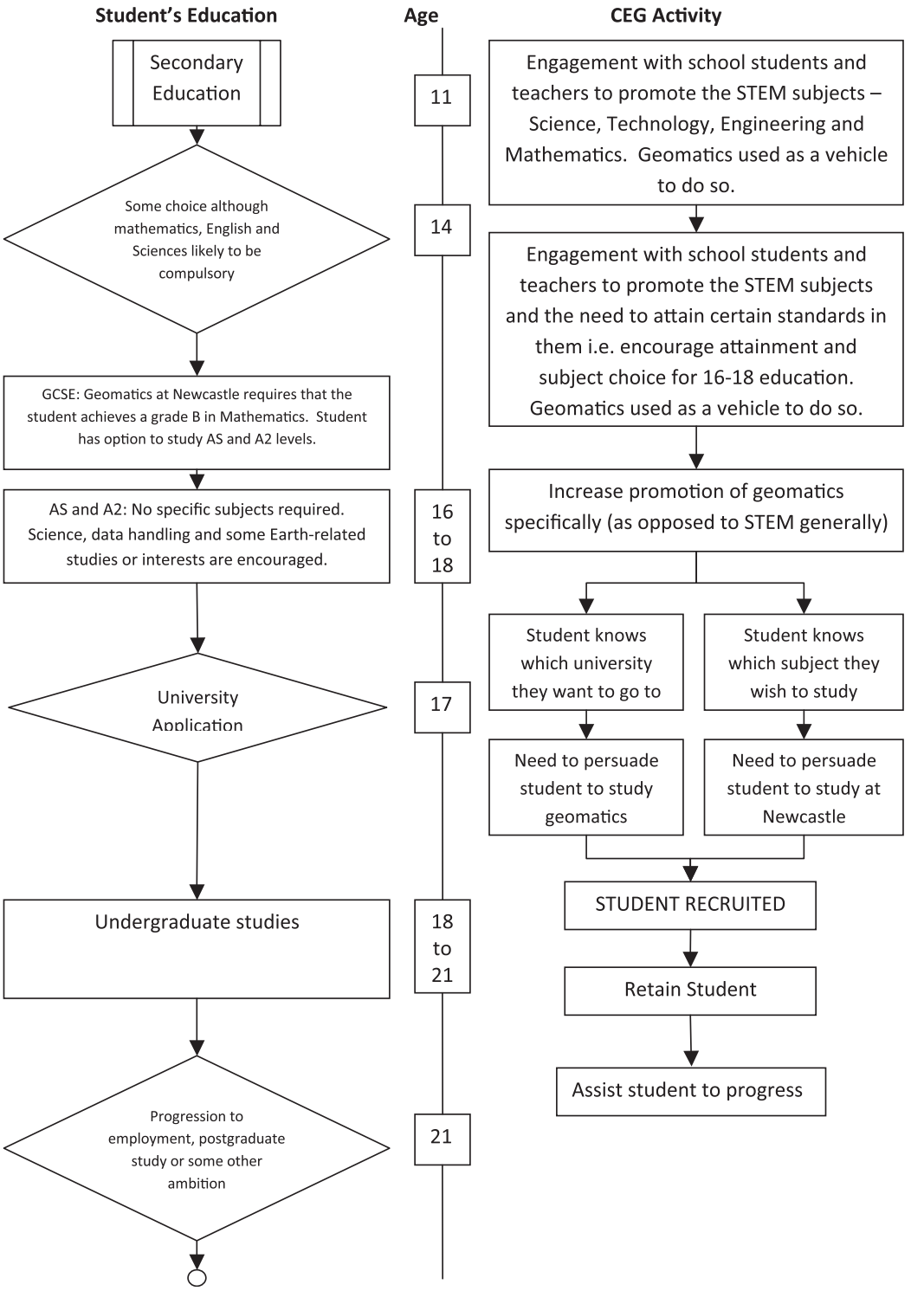

Fig. 1: The Undergraduate Lifecycle.

came after several years of continued recruitmentand promotional work. What were originally treated as separate components of recruitment, retention and progression became increasingly intertwined as virtuous links and positive feedback loops from different activities were identified.

3. Recruiting students

3.1 Recruitment at Newcastle University

Within the university, there is a variety of stakeholders in the lifecycle process to support the recruitment of undergraduate students. The contributions range from general, university-wide concern though to a geomatics-specific focus. Table 1 summarises the roles of the different groups in the university with regards to the recruitment of students.

As one would expect, there are a variety of activities undertaken throughout the structure outlined above that have an intended or a virtuous benefit to the geomatics group. These range from university-wide promotion events such as University Visit Days or Higher Education Conventions (where potential students can collect information from most, if not all UK universities from a single event) through to very focussed activities such as science taster courses or geomatics-specific promotional material. The life cycle model the group has adopted shows that university and STEM promotion all has a role to play in student recruitment and, as such, the group now accepts all invitations to contribute to any schools-focussed outreach or engagement activity irrespective of its direct relevance to geomatics.

Increasing concern and focus on the health of undergraduate geomatics programmes	Marketing and Communications Directorate (MCD)	With an overall responsibility to develop and promote the business and brand of the university, the MCD splits into four sections: ■ International Office – specific remit to meet the needs of international students joining the university. ■ Recruitment and Admissions – focuses on pre-application activities, including widening participation, and the administration of applications. ■ Marketing and Publicity – design and delivery of promotional materials for a variety of media ■ Press and Communications – media relations, corporate and internal communications
	Faculty of Science, Agriculture and Engineering (SAgE)	A team of four people exists to: ■ Act as a conduit between the MCD and the schools. ■ Realise science and/or engineering specific taster events to raise interest in those areas particularly. ■ Provide support mechanisms for schools delivering secondary education-focussed materials. Examples are the creation and maintenance of www.teacherstoolkit.org.uk and the organisation of Teachers Groups that allows practicing teachers to meet with university academic and outreach staff.
	School of Civil Engineering and Geosciences (CEG)	A broad range of academic activities with the following undergraduate focus: ■ Delivery of 6½ full time undergraduate degree programmes in Civil Engineering, Civil & Structural Engineering and Geomatics ■ Fill an intake quota of approximately 130 students through the generation of applications and subsequent selection and conversion of applicants to registering students.
	Geomatics group	■ Deliver two full-time undergraduate degree programmes ■ Fill an intake quota of approximately 35 students through the generation of applications and subsequent selection and conversion of applicants to registering students.

Table 1: Stakeholders in the recruitment stage of the undergraduate life cycle.

3.2 Geomatics.org.uk

As student numbers entering geomatics dipped in the mid 1990s, the geomatics group felt it necessary to take action of its own. Relying on university and STEM-wide activity was not proving to be sufficient in terms of recruiting students and a need for a geomatics-specific message was required to be available throughout a student's secondary education. By 2000, the first of two significant recruitment-related initiatives was in the planning.

The difficult recruitment situation was not unique to Newcastle and so, after identification of a variety of professional and practising stakeholders and contacts in other universities, in 2002, Newcastle became the leader of a UK Geomatics community-wide effort to engage secondary school teachers and students in a programme known as *Geomatics.org.uk* (Mills *et al.*, 2004). The project was not a Newcastle recruitment project, rather a geomatics-community wide engagement initiative that hoped to support all members' recruitment ambitions through increased awareness of the subject area. The project ran successfully for four years, being mainly funded by the Engineering and Physical Sciences Research Council, but also enjoying support from trade and professional bodies, other universities and enthusiastic individuals. The project name was taken from the website that was central to the project. Geomatics.org.uk aimed to provide an online portal to the UK Geomatics community that would be accessible to schools particularly; and to offer free loans of professional Geomatics equipment to support practical work in schools.

CEG still runs the scheme of equipment loans although without funding support from the Geomatics community. Since 2002 CEG, either individually or as part of the geomatics.org.uk project, has given out more than 150 equipment loans to schools, thereby increasing the awareness of Geomatics nationwide. The majority of equipment loans have supported Geography field studies, particularly in the domains of river and coastal studies, but in latter years, mathematics and science teachers saw the potential of geomatics to show real-world application of their disciplines and often in a practical and outdoor environment.

3.3 Geomatics-based Continuing Professional Development (CPD) for teachers

With the end of *geomatics.org.uk* in 2006, the geomatics group began to look for a new project to promote geomatics to secondary (11-19 years old) teachers and/or students. The new project took shape in late 2007 when the geomatics group won funding from the UK Government's Training and Development Agency for schools to design, deliver and evaluate geomatics-based Continuing Professional Development courses for secondary teachers. The courses aimed to introduce teachers of different subject areas, e.g. Maths, Physics and Geography, to geomatics and show how it can be used to support secondary teaching and learning.

A total of 24 people attended the courses, including teachers of varying experience, educational consultants and graduate students training to be teachers by completing a Postgraduate Certificate in Secondary Education. At this stage, the sample sizes for impact evaluation are small and, therefore, not too much weight can be lent to them. However, the early indicators suggest that using geomatics as a tool to run CPD for teachers has great potential. Feedback collected on the day of each course gave the following results:

- the courses were rated as Excellent (17 responses) and Good (7) on a four point scale of Poor, Fair, Good or Excellent
- asked about the relevance to their job, 14 felt the courses were excellent, 9 Good and 1 Fair
- 11 people felt that the relevance of the course to future career aspirations was excellent
- 23 felt that participation and "enjoyability" of the courses was excellent
- 20 would definitely recommend these courses to colleagues and friends and 4 would probably do so.

Comments from on-the-day feedback included:

"Enjoyed day – buzzing with ideas to begin to plan"

"I found the course materials, practical experience + the delivery excellent. Very relevant in terms of new Key Stage 3 programmes of study and also the new A -level courses. The offer of follow up sessions in schools + the useful contacts is also an excellent resource. Excellent on a personal + professional level to review + extend knowledge + skills and then disseminate to department + to pupils."

"The course has given me some excellent ideas to feedback to my organisation."

"Well run session with aims clearly outlined and relevance to subject constantly highlighted. I think it is an excellent way of raising students' interest in physics and giving them an insight into real life applications."

As part of the evaluation, delegates were contacted three months after the event and asked to complete an online survey that examined what they could remember from the course and identify any impact it had had on their teaching. The online survey results, although from a smaller pool of people than the on-the-day feedback, offered further insight in to the impact the project may have had.

Only 25% of those responding to the online survey had experience or knowledge of geomatics prior to the course. Since the event, 75% of those responding had used geomatics in their lessons. The level and form of this use ranged from a single lesson through to a week of activities taking in about 10 lessons in all, including some practical-based lessons. One course delegate responding to the survey, a Head of Geography in a high school, stated that the school has invested in some GIS software as a direct result of the course. For the course to stimulate this purchase at a time when GIS attracts a growing profile in geography curricular is a considerable positive impact. This teacher is now involved in the geomatics group's interest in realising a teacher-focussed GIS CPD course (see below, Future Work). For those that had used geomatics with their students since the course, this had taken place in all secondary year groups except at ages 15-16 when the pressure of the national General Certificate in Secondary Education limits the time available to staff and students to complete enrichment work.

All of those responding to the survey felt that geomatics-based teaching and learning is appropriate for academic and vocational learning and a large majority felt that it could be used to support learners of all abilities. Asked for commentary, the following were offered:

- Maths: It made pupils think about that area of maths in a completely different way and made them apply thinking skills.
- Geography: It developed the way students make linkages between data and the spatial location/diversity of that data – also provided interest and challenges for students who otherwise would be disinterested by traditional paper based fieldwork and follow up.
- Maths: Pupils are not often given the chance to learn by experimenting and using equipment in an outdoor setting. So pupils are given the chance to learn in a different way.
- Maths: It helped them with learning Trigonometry

Interviews with four participants from the courses afforded considerable qualitative feedback relating to the impact the courses might have had. Highlights from two of those interviews are presented below:

1) White British Male, teaches year students aged 11 – 18, has 1-5 years teaching experience and falls into the age group 25-34:

What attracted you to use Geomatics in your teaching?

It struck me as very, very different, something that none of the kids will have come across before. None of them will have had their hands on this stuff before. They like being outside, they like doing things that are different that was one thing. I wanted also to give them the idea that Maths is not just about sitting in a classroom solving puzzles. It has real world uses as well and this is something they are familiar with ..."

Will you use Geomatics in your lessons in the future?

Yes definitely, it's such a positive thing I will definitely get it again. Motivation and getting the pupils stuck into maths that isn't just run of the mill stuff it's something different and something practical. There's loads of stuff I haven't done yet.

2) White British female, teaches year aged 11 – 18, has 1-5 years teaching experience and falls into the age group 35-44:

What attracted you to use Geomatics in your teaching?

I just want to bring through to the classroom that maths is used truly outside. We can sit in the classroom and teach them, you know, how to do Trigonometry, how to use Pythagoras, angles and bearings which, for them, is far too often from a textbook or the board. This actually gives them some meaning, some understanding that things are really going on around them and I want to try to encourage them to actually stand and look to try to work out what is really going on

Owing to the success of the courses, they are being re-offered this year. Further delivery and, therefore, impact evaluation of the courses will make for a stronger report to be presented at a later date.

4. Retaining Students

It is not just the recruitment cycle that is at the core of the Newcastle Geomatics marketing strategy. Once recruited, a considerable level of support exists for the students during their time at Newcastle University and in the geomatics group in particular. With the challenge of recruiting a student being so great, it is essential that the group retains those who register. A variety of practices have been implemented or resurrected to try and ensure that the students have a stimulating and caring environment in which to work.

4.1 Induction

At the start of the first year, students are taken away on a residential induction course. The 24-hour programme involves travel to a Youth Hostel, a variety of outdoor team exercises supervised by the academic and research staff from the geomatics group, an evening quiz, overnight stay, team orienteering exercise and travel back to Newcastle. Feedback from 2008 graduates suggested that they thought this catalyst to the degree programmes should be repeated at the start of each academic year, such was its worth.

A geomatics industrial evening, run under the name of "Life during and beyond Geomatics" is also held at the start of each year which sees all students and staff join together with geomatics companies, professional bodies and trade groups for an evening of food, drink and introductions. Hosted in an on-campus restaurant, the event is designed to build bridges between the students and the wider geomatics community at the outset of their studies and then each subsequent year of study.

4.2 Teaching

At the start of the 2008-2009 academic year, CEG adopted a policy of issuing all first year undergraduate students with a student response device which can be used to interact with presentations given by teaching staff. There were two aims of adopting this system. Primarily, the system can be used to collect anonymous student opinion, feedback and be used to test knowledge and understanding. The formative feedback and stimulating benefits of student response systems in a science environment are well documented by Reay *et al.* (2005). The second aim comes from the assigning of an identifiable "clicker" to an individual and subsequently monitoring attendance. Bowen *et al.* (2005) describe some of the motivation and benefits of adopting such a system. In the case of Newcastle, the aim was not to monitor hour-by-hour attendance but rather to identify students whose absence over several days may suggest their becoming distracted from, or disengaged with, the subject and see if the group can assist in any way.

Furthermore, there have been some significant changes recently in pedagogical practice in the geomatics group. From a survey of registering students taken at the start of each of the last four academic years, the geomatics group is aware that practical and field work is the joint highest attracting factor to the geomatics degree programmes. The first year field course remains a key part of the student's experience. As well as the technical experience of the course, living and working alongside staff realises a strong bond between staff and students. Fieldcourses are being re-introduced to the final year of the degree programmes from 2009. The final year fieldcourse was removed from the curriculum in the early 2000s owing to staff and financial costs being too high for a then small cohort of students, but their value in attracting and satisfying students is now so high that they are returning to the curriculum. E-learning tools are also being adopted to support teaching and learning (Mills and Barber, 2008).

As part of the student's final year studies of *Aspects of Applied Geomatics*, a three-day study tour is also now undertaken. Staff and students travel to see geomatics applied to a large scale civil engineering project (the 2012 Olympics site), a trade exhibition, geomatics commercial practices, the Ordnance Survey (Great Britain's national mapping agency) and the Leica Geosystems UK headquarters. Initially run in the 2007-2008 academic year, the event proved to be popular with the student body and was well supported by the geomatics community.

Significant resource has been assigned to the geomatics laboratory to give the students a functional yet pleasant space in which to focus on their studies. The laboratory is equipped with 10 common user PCs that are also equipped with the specialist geomatics-software required at various points through the degree programme. An

interactive whiteboard is in place to support IT-based group working and a survey pillar and wall mounted targets have been installed to support instrument practice and demonstration. There is space to meet with peers or staff, and room for equipment set up for interactive demonstration. The availability of such working environment has been greatly accepted and appreciated by the students and led to a closer interaction between the students. There is a separate school-wide wifi enabled common room that ensures the geomatics laboratory remains a place of study and not socialising.

4.3 Pastoral care and communications

The induction and teaching activities are complemented by pastoral and communications-based support. Formal structures exist to afford feedback and dialogue between the student and staff groups, including a personal tutor, staff-student committee, board of studies, an entry survey to determine why students chose to study geomatics at Newcastle and also confidential focus groups where, shortly before graduating, students can comment freely about their holistic experience with the group.

The geomatics group also introduced a student buddy system at the beginning of the last academic year. The scheme was set-up as parent-children system, where one Stage 2 student has been randomly allocated four or five Stage 1 students to their care. For Stage 1 students, the scheme aims to assist them with transition to higher education, particularly in areas such as time management, study skills and an empathetic ear all in the sanctuary of one's peers. The scheme offers the Stage 2 students opportunity to consolidate their knowledge through sharing with others and develop personal and transferable skills that will augment their technical education. Three formal sessions are scheduled between the parent and children so as to support its implementation, but the intention is that scheme operates in an informal and *ad hoc* nature between students.

It is planned to carry out a formal evaluation of the scheme later in this academic year by using questionnaires. Initial, anecdotal assessment of the scheme suggests that the scheme is working well and is of particular benefit to overseas students.

5. Progression

To make the life cycle approach complete, it is essential that affording a graduating student exciting opportunities is as important as their recruitment and retention. In fact, the employment prospects from a geomatics degree are, along with practical work, the joint highest attracting factor amongst the Newcastle geomatics cohort. To support the student progression into the professional world, CEG has adopted different events and support schemes for the geomatics students. Foremost amongst them is the introductory industrial evenings described above. Additionally, CEG has developed close working relationships with a wide range of companies, often through alumni and, therefore, further extending the "life cycle" approach. Industrial engagement has helped to support our students in finding a job after graduation, leading to a 100% progression level of the graduate students in 2007. Such a successful graduation: job conversion rate is a helpful statistic to convince potential new students to study Geomatics, supporting the marketing of the degrees further.

The group encourages and tries to assist students in finding geomatics-related work placements during their summer vacation periods. Companies wishing to recruit students are invited to give lunchtime presentations to the students. These visits combine with the running of an on-line jobs board, the study tour and guest lectures to support students in their search for work. Excellent students are encouraged to apply for summer studentships between Stages 2 and 3 with a view to their being recruited to PhD opportunities.

6. Future Work

It is an ambition of the geomatics group to continue to improve in the area of recruiting students. Attracting more mathematically minded and able students is one of the group's primary aims. A new project started in January 2009 that sees a maths teacher working with the geomatics group to identify new opportunities that may exist for geomatics to support teaching and learning in 16-19 maths education in the UK.

The group has a strong track-record in Continuing Professional Development (CPD) provision for geomatics practitioners, particularly in the field of GIS. With the rise of GIS' presence in UK school curricular, the group has started to explore delivering GIS CPD for school teachers.

7. Summary

Geomatics higher education around the world remains in a perilous position owing to low student numbers. There have been some signs of improvement, for example the opening of new courses, but student influx remains low (Lemmens, 2007).

The situation in the UK is no different. In response to the problem, the Geomatics group at Newcastle University has adopted a holistic marketing approach to try to guarantee the annual intake of 35 students. The approach, one of working against a student lifecycle, along with some specific practices adopted by the group, have been presented. The presented actions have demonstrated success, as evidenced by the 2008 intake of 41 "home" students plus two "overseas" students.

Despite the recent recruitment success of the group, it is vital to continue to actively recruit, retain and support the progression of students. With regards to recruitment, the first aim must be that of at least stabilising student numbers at the current level and ideally growing the size of the cohort. Furthermore, one could argue for a need to raise the standard of incoming students by seeking greater experience and performance in their secondary education of mathematics and physical sciences in particular. On the retention side, the group hopes that recently adopted practices and will further increase student satisfaction levels but student and industrial feedback will be used to seek continued improvement. The global recession may pose challenges to support the progression of students. In response, the group is already increasing its direct work with students on progression.

It is hoped that this paper offers points of interest and debate for others in geomatics and geomatics higher education.

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Geomatics continuing professional development; a UK perspective

Stuart Edwards, Alison Bird and Henny Mills, Newcastle

Extended Abstract

The School of Civil Engineering and Geosciences at Newcastle University has delivered workforce training for many years with a broad portfolio of short continuing professional development (CPD) courses. During 2007/08 over 430 delegates will have attend courses in a variety of subjects and of increasing importance amongst these are those in the discipline of geomatics. Geomatics CPD offerings currently include; geographic information systems (GIS); survey computations and least squares adjustment; advanced data processing using GPS and land survey techniques for the none survey specialist. In the main all current courses have been developed in response to requests from industry and the growth in delegate numbers has come from both new and established. This increase in demand presents challenges for both the School and the individuals involved in CPD development and delivery. Moreover, increasing such outreach activities presents opportunities and challenges more widely across the University. In order to better understand the challenges of increasing CPD prevision, a study was undertaken with the aim of identifying key issues surrounding the provision of CPD. Whilst the study was school wide the findings are directly applicable to CPD courses in geomatics.

The paper will address the issues surrounding the provision of high quality geomatics CPD courses from within the UK's university system. Specific issues that will be addressed include:

The setting of appropriate and competitive course fees whilst ensuring all associated costs are met.

The benefits and inhibitors CPD activities present for the individual academic. The study demonstrated a very clear consensus that the lack of academic staff time available to invest in CPD activity, the relative merit of CPD activity compared to other activities, and the absence of a link between the staff generating the income and use of surplus, currently deterred individual academics from engaging.

The requirement for administrative support in relation to CPD development and delivery. The role of dedicated support in relation to CPD activity is explored. In particular, the difficulties of effective course promotion; accurate assessment of demand; competitive pricing of courses; and insufficient facilities were all highlighted as key issues. In this regard it was identified that any 'central university' financial levy on CPD income would remove the competitive edge of current and future courses reducing the motivation to develop new courses.

The competitive landscape of geomatics CPD provision from other UK universities and commercial training providers. An extensive comparison of course fees has highlighted the difficulty of remaining competitive whilst recovering costs.

Potential for e-learning in CPD. The advantages and disadvantages of an e-learning approach to CPD are considered within the context of geomatics.

The above elements have been identified as directly relevant to the long term sustainability and viability of geomatics CPD provision. The research explores each element through the use of qualitative questionnaire and quantitative research and offers tentative conclusions that will stimulate further debate.

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Advocating a Holistic Approach to Continuing Professional Development Provision for Practitioners and Providers.



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Abstract
This paper explores the interrelationship between Continuing Professional Development (CPD), Life Long Learning (LLL), Work Life Balance (WLB) and the linking key concept of Employability, with a view to developing a holistic approach to CPD provision.
It is understood that an important aspect of any professional person's development is CPD; it enables the vital issue of being a "Reflective Practitioner" to be addressed by professionals and assists in gaining an improvement in professional performance. One could also argue that CPD in the past has failed to be continuous and inclusive; it has not fully embraced the concept of Life Long Learning and has been fragmented and less than developmental. Concerns in the United Kingdom for CPD as a "national need" have been acknowledged by the National Committee of Inquiry into Higher Education in the report (NCIHE 1997) *"We believe that the aim of higher education should be to sustain a learning society".* The emphasis here is clearly placed upon continuity throughout life, on broader knowledge and intellectual skills as well as vocational skills, and on ownership by the learner through the achievement of personal fulfilment. This paper provides a valid methodology for addressing the full implications and incorporated aspects of CPD.

Keywords: Continuing professional development, employability, life long learning, reflective practitioner, work life balance

1. Introduction

CPD has been defined as *"The systematic maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional and technical duties through a practitioners working life"* (RICS 1993). Thus the definition introduces and links to the concept of Life Long Learning, an acknowledgment that one never stops learning. The benefits of CPD as a Life Long Learning professional life style have been established as, the achievement of success in professional practise, enhanced quality assurance in the provision of professional services, contributing to client delight [satisfaction] and contribution to sustained income generation (Le Roux et al 2004)

Thus a wider set of economic benefits that go beyond merely those of employment should be considered and embraced. This concern is for a more comprehensive and holistic notion of CPD and the provision of a framework of opportunity for practitioners throughout their working life. This issue is to be discussed further within the paper.

2. The Mixed Complexities of CPD

2.1 Work Based Learning Issues

The focus now being placed on CPD is forcing both Higher Education and Professional Institutions to re-examine their methodologies for developing and delivering CPD programmes. This is because if CPD is to be genuinely continuous, then the traditional approaches currently adopted by many universities must change. With pressures being exerted to reduce the length of degree courses there is no longer time for traditional routes on undergraduate programmes to provide professionals with all the tools and skills required to do their jobs both now and in the future.

Within Higher Education Institutions, the key client group is no longer 18 – 25 year olds, it is in fact moving towards a more mature and experienced people set, wishing to enhance their existing qualifications to meet changing circumstances and future needs. Most importantly they wish to combine these with work based activities and truly attain the status of an "Effective Reflective Practitioner". Therefore CPD can be extended to encompass the concept of "Work Based Learning" This can also be credit bearing

and linked to a formal qualification, for example, within a degree course designed at Sheffield Hallam University UK, which was built around CPD and in conjunction with the Association of Building Engineers, a 20 credit bearing module called Reflective Professional Practise was developed.

The entire course structure was designed to be delivered in a flexible manner so as to meet the CPD requirements of a professional market place. It was fully understood by the course development team that many practicing professionals have years of accumulated relevant valuable experience. Hollerton (2005) opined that *"It's not usually the level of knowledge required [that causes problems for professional body students] it's the style of [academic] work required".* Thus the new course sought to address the style issue and to utilise to a maximum those valuable experiences by providing academic credit for mature experienced students.

The credit is based on their ability to actively reflect upon occupational experience. The work based learning element cemented the notion of the value of the practical application of knowledge in the work place (Billett 1999) and further developed the situational skills (Hinchliffe 2002) or contextual Knowledge (Portwood 2000) that these authors advocate as being essential for the performance of a professional occupational role.

Thus it is imperative that the complex issue of CPD does incorporate the "Work Based Learning" concept, within the course students produce a "Portfolio of Evidence" covering the required learning outcomes/competences. For students it provides a focus for their learning and, in action, it also provides an accelerated means of obtaining academic credit related to industrial practise.

Given the current debate relating to work based learning, it is interesting to explore the role of universities and colleges in CPD. The challenge seems to be one of meeting the needs of industry in terms of identifiable benefits and flexibility of learning and yet ensuring academic quality. It could be argued that industry does not want traditional academic qualifications at all, and the problem for universities is to re-focus on valid professional competences. The emphasis here is clearly being placed upon continuity throughout life, on broader knowledge and intellectual skills as well as vocational skills, and on ownership by the learner through personal development and fulfilment.

A wider set of social and economic benefits beyond merely those of employment should be considered. This concern is for a more comprehensive and holistic notion of CPD and a framework of opportunity that embraces early years schooling through further and higher education to include mid-career as well as pre- and post retirement needs.

The development of a key skills framework is fundamental to the accreditation of work based learning. If each individual student programme is separately negotiated the key skills approach offers an effective methodology for ensuring comparability across and between programmes of work. There is, of course, no simple definitive answer to the question of what the key skills are and which are appropriate to the different levels of award within any programme of study.

2.2 Work Life Balance Issues

The concept of Work Life Balance impinges upon a practitioners working life and hence is also an integral part of CPD. Work Life Balance is not about trying to schedule an equal number of hours for each of an individuals working and social activities. It is however, about people having a measure of control over when, where and how they work. It is achieved when an individual's right to fulfilled life inside and outside paid work is accepted and respected as a norm of behaviour, to the mutual benefit of the individual, employer and society.

The result of a working and personal life that is out of balance is increased stress levels and hence an adverse impact upon work related performance.

For most people juggling the demands of a career and a personal life is an ongoing challenge. With so many demands placed on employees it is difficult to strike an appropriate balance. The objective should be to make time for what is important to the individual.

Thus having a realistic balance between the time spent working and the time one has to spend on other more social activities, such as ones family is a critical factor and an employer must be attuned to this concept in order to appropriately balance out an employees workload. After all CPD is usually undertaken as an "Add-On" activity to a normal employees workload. If an employee does not obtain time to unwind they are very unlikely to be able to maintain a sustained out-put at work.

So organisations must be aware of situations where work is taking over their employee's life, this can only lead to a lose/lose situation for both employee and employer. What in fact should be the goal of the employer is a win/win situation, this can be attained if the concept of work life balance is accepted and acted on.

One of the vital aspects of avoiding an adverse work-life balance is the leadership of managers. It is the 'people skills' of managers that seem to be lacking. Therefore managers, as do all levels of staff require training and development. Thus both the undergraduate curriculum and CPD should contain 'People Skills Management'.

2.3 Life Long Learning Issues

Life Long Learning can be defined as all learning activities undertaken throughout life, with the aim of improving knowledge, skills and competence, within a personal, civic and social and/or employment – related perspective.

Thus Life Long Learning is about acquiring and updating all kinds of abilities, interests, knowledge and qualifications. It promotes the development of knowledge and competences that will enable each person to adapt to our knowledge – based society.

Life Long Learning is also about providing second chances to update basic skills and offering learning opportunities at more advanced levels. All this means that formal systems of provision need to become much more flexible, so that such opportunities can truly be tailored to meet the needs of employees/students.

As noted above some academic awards are moving away from the traditional undergraduate and postgraduate taught course framework and towards one which can accommodate and respond to the needs of CPD, a new structure for making awards is required. Modular structures driven by credit based learning and Credit Accumulation and Transfer (CATS) have been the popular way of achieving these new building blocks. Credit based learning means that points can be earned from a wide variety of learning experiences. For such a modular credit based approach to work effectively, it has to be based on a common set of criteria with a standard metric. To this end a national system for credit accumulation and transfer, in which common and standardised tariffs are associated with a defined framework of awards offered within the higher education framework, has been developed.

Further the undergraduate and postgraduate curriculum should develop "Transferable Skills". These transferable skills should encompass the skill to learn. To explain this further, if a professional is to truly benefit from engaging in the life long learning activity then they require specific learning skills. So the curriculum has to have learning outcomes, teaching and assessment strategies based upon students acting as far as is practicable as independent learners. For example this would include the ability to conduct research, gather data and critically evaluate it, and drawing meaning full valid conclusions. Thus the shaded area in Figure.2 depicts the overlap between employability and life long learning. (Hemmington 1999).

2.4 Employability Issues

A further concept requiring noting within the paper and one which forms part of the total holistic approach to CPD delivery is the key concept of "Employability". The approach adopted by Sheffield Hallam University (SHU) in relation to 'Employability' is very distinctive because it is based upon a long tradition of providing professional vocational awards. Further in 2005 SHU was awarded national recognition (UK) as a Centre for Excellence in Teaching and Learning in Employability.

Defining Employability 'Employability' refers to a range of potential work activities and these include:

- Paid/self employment
- Creative/artistic work
- Work in/for the community
- Family responsibilities

In order to address the issues encompassed above, SHU have incorporated a strategy based upon a distinctive approach. SHU's approach is distinctive because it concentrates on 'integrating and embedding' a coherent set of curriculum features within all its awards.

Integration: bringing together all features (e.g. through a vehicle such as student placement and/or the utilisation of case studies) so that students are better able to make the relevant connections between curriculum and application.

Embedding: having learning outcomes with relevant learning and teaching methods and assessment, which are all aligned, presenting a truly holistic approach.

Therefore it is vital to have a valid curriculum designed with an input from all relevant sources, and linking learning outcomes to appropriate methods of assessment. The teaching methods should enable the material to be delivered and tested, hence the utilisation of a 'teaching vehicle' such as a case study.

The Construction Industry Council (UK) which represents construction professionals is a partner in Construction Skills, the Sector Skills and Construction Industry Training Board (CITB) Northern Ireland. Construction Skills represents the whole of the UK construction industry. The four key goals of Construction Skills have been established as:

- Reducing skills gaps and shortages
- Improving performance
- Boosting skills and productivity
- Improving learning supply.
- Employers and employees benefit from this approach by improving the quality of training and education on offer to meet both employers and employee needs. Further it ensures that the future skills needs of employers and employees are addressed (in line with SHU's definition of employability).

The above noted goals raise three vital questions:

1. How can employability enhance the curriculum?
2. How can employability enhance graduate employment?
3. How can employers be engaged? (Brown 2006)

Figure. 1 provides a pictorial guide for addressing these critical questions, it also depicts their interlinking. What is evident from the inspection of Figure.1 is that the three issues/questions cannot be treated as mutually exclusive. Employer contact and consultation influences the curriculum content which in turn impacts upon the employability agenda.

Thus it has been demonstrated that a professional's future performance, development and employability are impacted upon by the undergraduate curriculum.

However, learning does not stop upon graduation, at this point the professional should be embarking upon Continuous Professional Development (Life Long Learning).

This concept appertains to developing within graduates the skills to learn and transferable skills, these are critical skills when considering the Life Long Learning concept.

A critical aspect of this paper is the advocation of a holistic strategy when trying to address the CPD agenda for professional practitioners, rather than the disparate approach that tends to be the preferred strategy adopted by most CPD providers.

3. Case Study

Having described Work Based Learning, Work Life Balance, Life Long Learning and Employability the following provides an integrated practical application in the form of a case study. It is based on the Association of Building Engineering (ABE) and Sheffield Hallam University (SHU) UK. The ABE has a requirement for all members to engage in some form of CPD activities, and promotion can often be linked to the attainment of academic qualifications. Thus ABE membership approached the ABE for some kind of formal CPD that would both lead to a formal qualification and be accessible, as normal part-time attendance would not be possible due to employer restrictions. The initiative had to be cognisant of the following:

- many ABE members have a wealth of professional experience but may not have formal qualifications;
- SHU's mission is to forge collaborative links with relevant professional bodies.

Our main objective (at SHU) of the collaboration was to build on our existing good links between ABE and SHU, so we endeavoured to:

- design and validate an appropriate academic award built on CPD;
- develop a relevant curriculum building on the existing strengths of students, e.g. work related experience, encompassing Employability and Life Long Learning concepts;
- empower access to the award by matching student requirements with delivery mode, address the Work Based Learning agenda;
- deliver and monitor the award and if necessary take appropriate actions, to ensure the required competences and skill are incorporated into our curriculum.

The devised methodological approach was based upon setting-up a representative award planning team (including ABE and Employer

representatives) and building on existing qualifications (HNC/HND) and experience of students.

Therefore we developed module guides for the award of a BSc (Hons) Building Engineering degree containing appropriate:

- learning outcomes, addressing required curriculum and skills/competences;
- assessment criteria, engaging with employability;
- feedback strategy, addressing the reflective practioner concept;
- support systems, having appropriate support bearing in mind the delivery mode.

The programme structure was designed to be delivered in a flexible manner so as to meet the CPD requirements of the professional market place. From research conducted by Le Roux et al (2004) the "…benefits gained through implementation of CPD as a life long learning professional life style and an established organisational policy by practitioners operating in the built environment were identified as:

- [the] achievement of success in professional practice;
- [having] quality assurance in the provision of professional services
- contribution to "client delight" and
- contribution to sustained income generation."

The above were not mutually exclusive with the objectives of SHU and the ABE when we were considering the outcomes of CPD and the new award, and the above were fully embraced in our development. We used diverse methods of assessment that are consistent, practicable, and timely and effective in helping students demonstrate the achievement of intended learning outcomes. We also specified clear assessment criteria designed to help ensure standards are enhanced and to let students know what is required in order to improve their performance.

The ABE (in conjunction with SHU) now provides a CPD linked BSc (Hons) award for its membership, the award is innovative in terms of both delivery and in its assessment strategy (utilising Work Based Learning concepts). The model described in this case study can be adapted/adopted by other Higher Educational and Professional Bodies, and Figure.3 provides a valuable flow diagram of the developmental and delivery process. Again this diagram can be adopted or adapted to suit.

4. Conclusions

Within this paper the concepts of Employability, CPD, LLL and Work Life Balance have been explored. However it is important to point out that these are not mutually exclusive components of a professional's development and performance.

The undergraduate curriculum impacts upon future CPD and both employability and CPD impact upon Work Life Balance. In an ever changing operational environment where the focus is on client satisfaction within an established cost framework we must not forget the true meaning of employability, and the adverse effects of not obtaining an acceptable Work Life Balance for employees.

This paper should prove useful to the providers of CPD and practitioners, as it provides a model for adopting a holistic strategy which incorporates Continuing Professional Development, Life Long Learning, Work Life Balance and Employability to the benefit of all concerned.

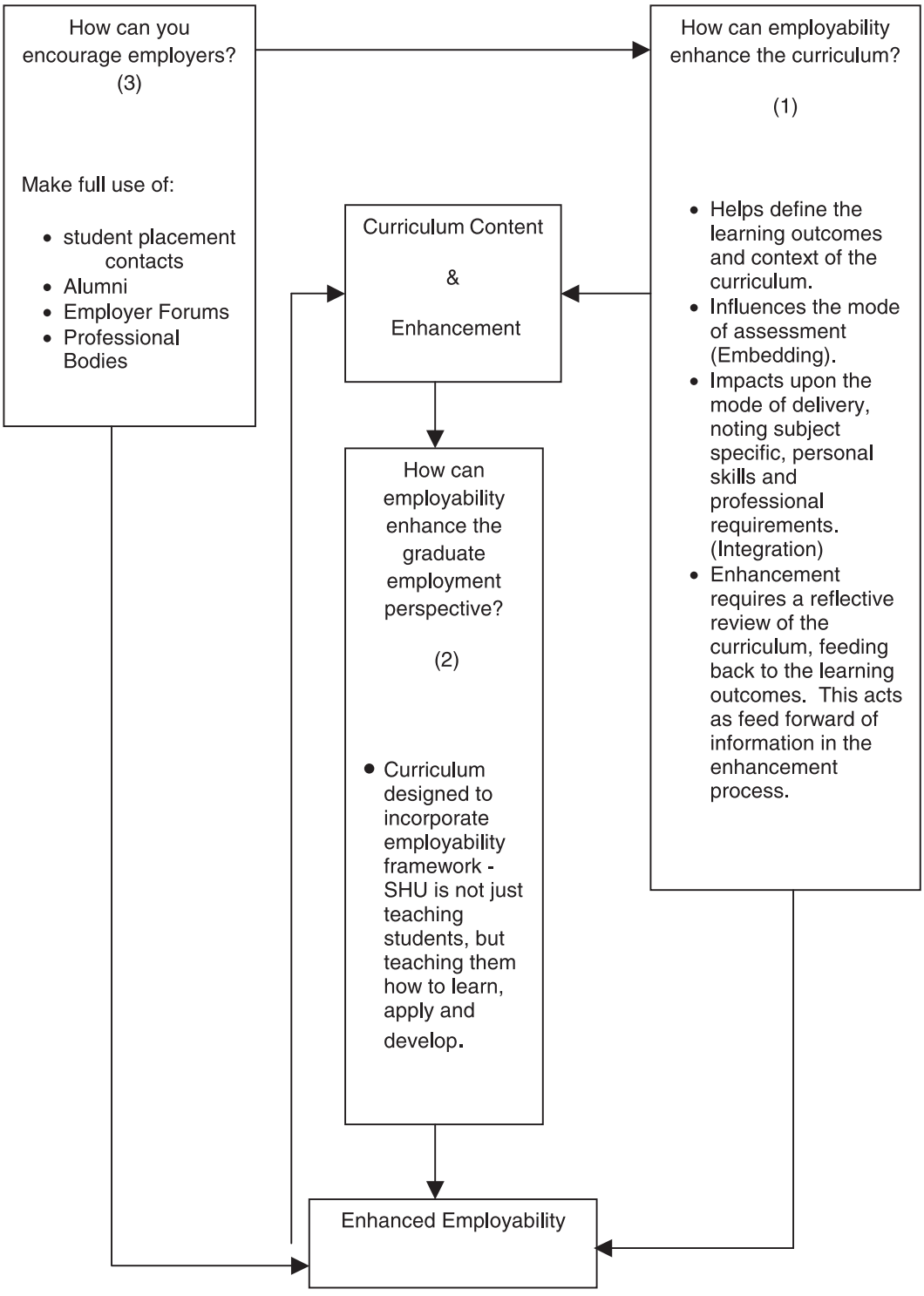

Fig. 1: Employability Entering the Curriculum.

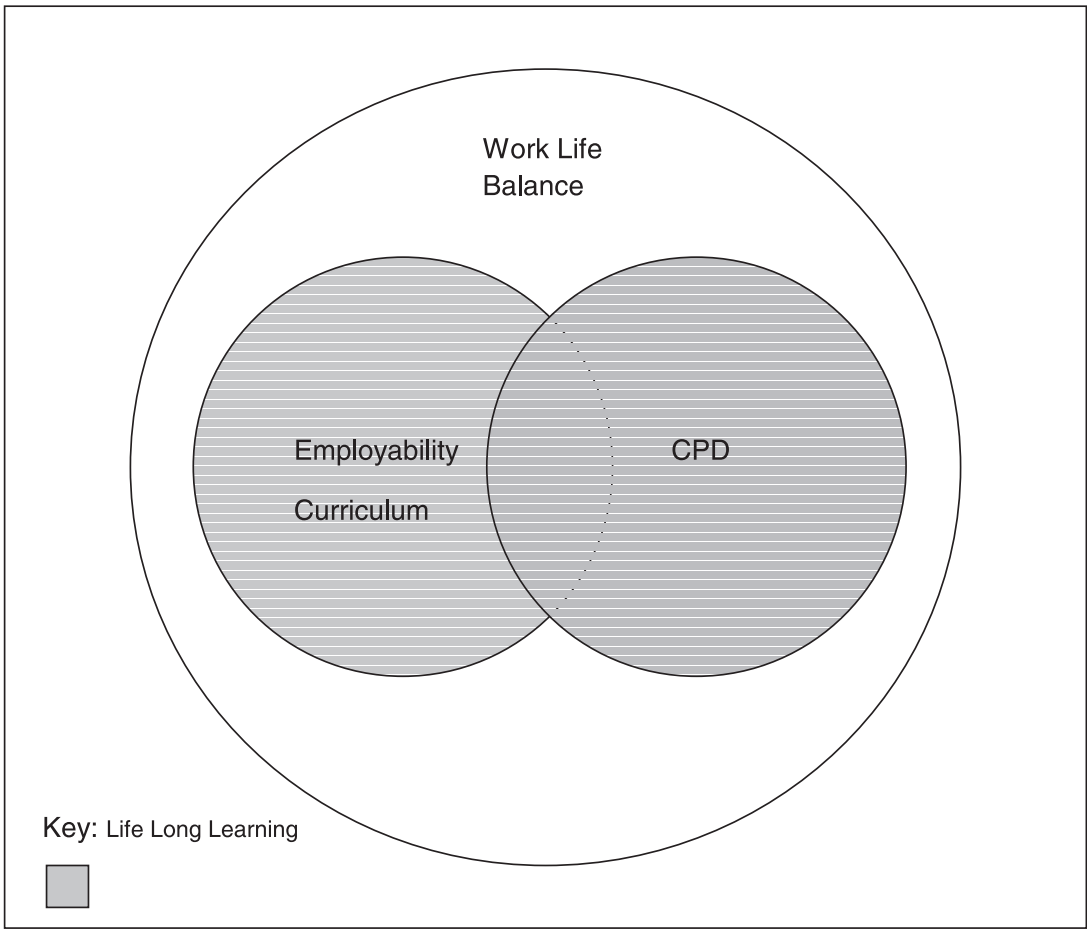

Fig. 2: Linking Employability, LLL, CPD and Work Life Balance.

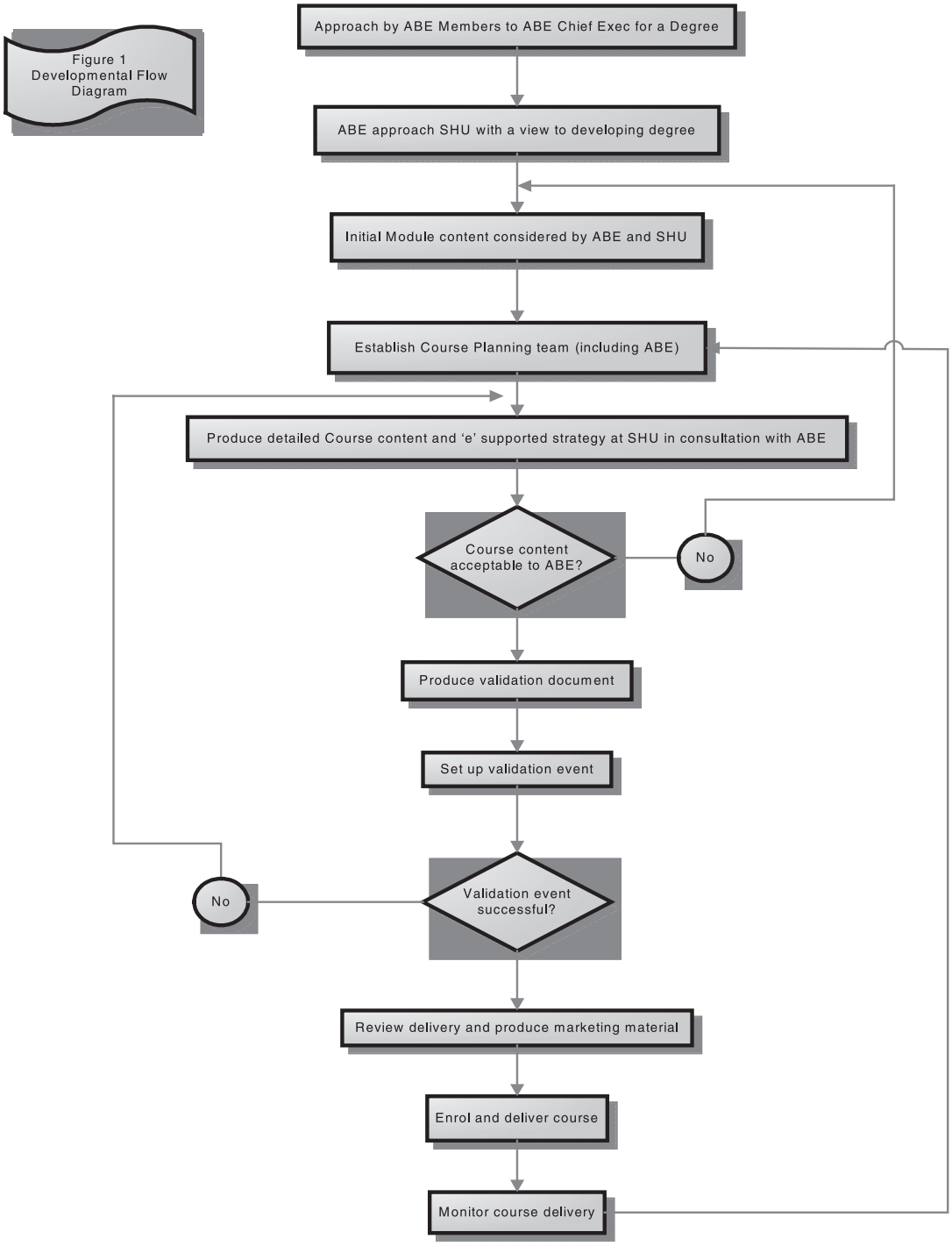

Fig. 3: Developmental Process of Case Study

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Continuous Training – the French Experience

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1. General context

While it was still conceivable in the 1950s that a professional would, after the completion of its initial training, enrich himself, this situation is over now. The fast and growing evolution of technologies, the accumulation of laws and regulations, the constant enlargement of areas of activities, the multiplication of exchanges entail that the initial formation, however complete it may be, and experience cannot anymore be regarded as a safeguard for the professional to ensure to his clients and relationships a guarantee of competence.

As a matter of fact, a new notion emerged in the second half of the 20s century, namely the notion of continuous training.

2. Concrete application to the profession

As regards the profession of surveyors, this obligation emerged very early.

3. OGE's role in continuous training

- Main provisions

The law establishing the French national association of surveyors dating back to May 6th, 1946, its consecutive decrees of application, as well as the internal rules precise the role of training.

- Article 17 of the law foresees that the French surveyors' Council "is watching over discipline and professional improving"
- Article 47 of the decree dating back to May, 31st 1996 reads that "the land surveyor shall maintain and improve its professional knowledge".

- OGE's role is to check the competence of its members

The checking of this competence is not only ensured during the registration to the association, but it is also regularly carried out during the professional life of OGE's members.

The application of the rules enacted by OGE is made at the Regional Councils' level and can be twofold :

- Periodical checking of offices – the most common way
- When clients complain or express their doubts about certain practices of a given surveyor to a Regional Council – another option.

Certain specific activities such as technical diagnostics to detect the presence of lead or asbestos in buildings, real estate management are subject to preliminary specific trainings under the control of Regional Councils.

4. The institution of mandatory continuous training

The adoption of a directive in 1999 by the French surveyors' Council rendered continuous training mandatory.

This first directive laid down a minimum of 40 hours of training per year. Those 40 hours were considered on a basis of a three year period. Every 3 years, every surveyor had to prove that he had undergone 120 hours of training.

OGE's training commission is in charge of putting on line the different existing trainings.

Regional Councils must enforce disciplinary measures in case of default which can rank from a simple warning to a ban to practice the profession in case of a serious default.

However, every sanction regarding a breach of the obligation of continuous training is subject to an appeal before the French surveyors' Council, like any other disciplinary sanction imposed by Regional Councils.

This obligation of continuous training was even more amplified by the French surveyors' Council last year.

Since January 1st, 2009, the minimum level of training consists of 5 days of direct training plus 3 days of indirect training (participation to Congresses, redaction of articles for professional

reviews…). Last but not least, the breakdown of days is made every year.

The Council indeed recognized that it was extremely difficult to ensure a checking on a 3-year period time. The checking will, from this year one, be made every year. Surveyors will have to send, before the 1st of March, a declaration of the trainings they have attended plus a justification for all of them to their Regional Council.

The trainings can either be trainings organized by the OGE or by departmental or regional professional instances, or complementary university trainings, or specializations in a given area. But in any case all the trainings must be in relation to the activities of surveyors or to the improvement in the management of offices.

Trainings can also lead to OGE's or any other instance's certifications (e.g. OGE's certification for the technical diagnosis of buildings, certification of the Town Planning Qualification Public Office).

In order to offer available trainings, a special national Commission was created with a view to:

- Suggesting themes and speakers
- Evaluating the suggested trainings
- Putting on OGE's website the different existing trainings while specifying the dates, locations, speakers, content, and the validation by OGE
- As regards the trainings organized by OGE, the content of the training and the skills of the trainer are systematically evaluated by the participants; the evaluations are then sent to the training commission which will analyze them.

Certain trainings dealing with fundamental areas have even been rendered compulsory:

- continuous training on land delimitation in 2002
- continuous training on insurances and risks in 2005
- training on numerical land registry in 2006
- training on the new town planning rules in 2007
- a training on land techniques in the framework of the delegation of public services of surveyors is under preparation.

5. Summer universities of surveyors

5.1 Basic principle

In order to mobilize surveyors on continuous training, the executive board of the council established for the first time in 2005 a new concept deriving from the notaries' experience.

The idea is to organize periodically, in one place, during a few days, half a day or full day trainings on different subjects. Here are the main advantages of this concept:

- It's better to undergo a training while being away from the office
- Spending many days in one place is good in terms of sharing of experiences with other colleagues
- It's an opportunity for the Council to communicate about the difficulties of the profession, the actions to be taken, etc
- The costs are less important
- Friendly atmosphere
- Good way to unite the profession and reinforce the «esprit de corps» of the profession
- The control of attendance record is easier

Summer universities are organized every two years (odd years) so as not to conflict with OGE's congresses that take place during even years. They last for 3 days in one of the 3 schools leading to the profession of surveyor.

The evaluation of trainings is based on the following criteria:

1. content of the programme
2. balance between the programme and professional practice
3. quality of the trainers
4. interactivity
5. distribution of time between the different subjects
6. quality of teaching aids.

We attach much importance to the diversity of subjects (legal, technical, management of offices).

Trainers can be surveyors themselves, academics, or professionals (notaries, lawyers…). Trainings are open to surveyors, managerial staff, surveying trainees, foreign surveyors coming from French-speaking countries, but also to the teaching staff of surveying technical schools.

5.2 Return of experience – perspectives for 2009

Summer universities were a great success last year and gathered more than 400 participants during 3 days. According to the statistics, 96% of the participants declared that they will come back the year after. The global budget for the last 2007

summer universities amounted to 400 000 euros. At the end of the day, the balance sheet was positive. For 2009, let me briefly give you a selection of different subjects that will be covered:

- The reform of our urban planning code
- The financing of public equipments
- The right of way : how to avoid conflicts?
- Real estate taxation
- Land delimitation
- The management of meetings
- Ethics and deontology
- GPS for "dummies".

5.3 The future of universities – the development of the concept

The success of the 2005 and 2007 summer universities cannot but lead us to perpetuate and improve this event. While at the beginning we planned to organize such meetings only every two years, the constant increase of mandatory days of training may, one of these days, lead us to launch annual summer universities. Similarly the length of these meetings could grow from 3 days to 4 or 5 days (as it is already the case for the notaries) Workshops will have to be divided in two level groups: "beginners" and "confirmed".

Summer universities cannot as such cover the number of mandatory hours of continuous training but they could, at least, cover half of the needs on fundamental subjects. The second half could be covered at the regional level with smaller groups of participants and more specific topics. Besides, a degree of flexibility is of course required should a new law or new provisions trigger a need for a specific training.

6. Conclusion

In the framework of a more and more globalisation and a growing complexity of our professional practices, our professions can only perpetuate if their members are highly competent. This competence necessarily stem from a high level of initial training but also a top-level continuous training. The duty of professional organisations in this area is:

- To render continuous training mandatory
- To evaluate and offer top-level trainings
- To control the participation of surveyors
- To impose sanctions in case of default.

Last but not least, one cannot but be delighted at the European recall of this legal and technical obligation of continuous training in the recommendations of the Strasbourg declaration which was signed in September 2008 by the two European associations of surveyors, namely the Comité de Laison des Géomètres Européens (CLGE) and Geometer Europas (GE).

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Continuing Professional Education via Distance Learning – Success Factors and Challenges

A case study based on the worldwide UNIGIS network


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1. Overview

The UNIGIS network of universities has offered postgraduate distance learning in GIS&T since the early 1990s (Molendijk and Scholten, 2006). Since then it has grown from a European consortium into a global network offering different types of academic programmes and qualifications in several languages. This paper discusses insights gained from UNIGIS courses graduating several thousand students in many countries and from very different backgrounds.

Taking for granted the fact of an increasing demand for professional and management skills in the geospatial technologies and GIScience sectors, it is clear that continuing (and in-service) education plays an increasingly important role as first-cycle education does not entirely fulfil the needs of the marketplace. This is particularly true in a cross-sectional methodology-oriented discipline where many experts have graduated from their original ‚application discipline'(e.g. Ecology, Geosciences, Forestry, Marketing, Computer Sciences, Public Health and many others). After some years of professional experience in any one of these fields frequently the demand for deeper knowledge in a key methodology area – geospatial science and technologies – will become evident and lead to a desire for further study and qualifications.

2. Clearly Defined Professional Qualifications

Qualifications and their acceptance depend on a number of factors like:

- Curriculum and syllabus
- Professional relevance and employability
- Track record with alumni and in industry
- Formal accreditation and quality indicators.

These and several more factors are being discussed below in more detail, outlining experience from past courses as well as current developments within and beyond the UNIGIS framework (Strobl, 2004 and Strobl, 2008).

With UNIGIS programmes primarily taken in part-time, in-service mode by professionals already active in the field of GIS&T, learning is directly coupled with professional practice. Employers have and express clear expectations and learners already know from on-the-job experience about their strengths and weaknesses, and thus about deficits to be compensated and gaps to be filled. In-service programmes therefore are undergoing daily practical checks of relevance, and receive immediate feedback regarding topical priorities and curricular completeness.

Anecdotic evidence stated like: ‚*our programme was perfectly matched with my professional needs, I found answers in my studies as issues kept popping up in work*' of course are a misperception, even if teachers are happy to hear such positive feedback. Rather students are sensitized to topics currently dealt with in their study programme, and now recognize issues in their professional practice which otherwise would have gone unnoticed. This kind of awareness building is a core objective of advanced courses, ‚seeing problems' often is considered a more critically important qualification than solving them. The ability of identifying and structuring problems certainly is considered a higher level skill than working through an already defined set of tasks following a prescribed ‚algorithmic' routine.

Reputation is widely considered a critical factor in sustaining success, whether in education or other knowledge-centric activities. A documented and evident track record of delivering what has been promised, of fulfilling the personal and professional objectives of students, and above all of advancing the professional capabilities and careers of alumni are important factors in attracting and convincing future applicants to

pursue a particular education track. Professionals interested in taking up the UNIGIS programme routine get in touch with current students and alumni to check their own expectations with their predecessors' experience.

The UNIGIS programme has given birth to a loosely knit alumni network (‚Club UNIGIS'), based on its strength of *not* having a clearly defined operational mission. Rather, this alumni network autonomously collaborates on a broad range of topics from simple (or not so simple) technical support to information about job offerings, jointly tackling more complex projects or looking for particular expertise on a given subject. There is a lot of giving and taking across this network, recently MVP's (most valuable professionals) have been identified by their generous contributions through sharing advice and offering support. All this works without an organisational framework or institutional infrastructure, demonstrating the power and effectiveness of online communities sharing a common background (mastering a challenging educational experience) and set of interests defined by their professional environments.

3. Curriculum Development

Particularly the development and implementation of curricula and the development of course content and media are continuous challenges in a rapidly evolving area like the geospatial sciences. This requires cooperation with institutions across many disciplines and the integration of experience and care for regional differences. UNIGIS has been and still is very actively involved in multilateral curriculum development projects (e.g. the originally US-based Body-of-Knowledge – DiBiase et al 2006) aimed at firmly anchoring current and future courses in all relevant disciplines and professional practice.

For the entire UNIGIS network, a common core curriculum is a key constituting element, a strong common denominator binding programmes in a variety of languages, institutional and legal frameworks and variants in their mode of delivery together. In a continuously evolving environment like GIS&T, a curriculum cannot be considered as being set in stone, it rather has to adjust to innovation, demands from professional practice, and an expanding set of application domains. Rapid change, though, would create confusion and organisational challenges, and unstable expectations regarding educational outcomes. Therefore managing curricular change is an ‚art' of balancing adoption and innovation with a certain level of stability and continuity.

Curriculum development is a major ‚export article' of UNIGIS, as partners in the network have been and still are involved in curriculum development projects around the world (see e.g. Car and Strobl 2007). Typically conducted as consortia projects in particular regions, and frequently co-funded by European Commission programmes, new curricula (plus their implementation) are set up at institutions launching or enhancing education in GI&T. Each of these projects provides valuable feedback and suggestions for modifications to the UNIGIS common core curriculum, and frequently offers opportunities to enhance the UNIGIS network itself.

On a more general level, work on academic curricula offers a much needed ‚distancing' and abstraction from the everyday practice of teaching and tutoring. Taking this higher level view of what is being taught, why, and with what expectations benefits instructors by providing an important background to their daily routines.

4. Distance Learning

The distance learning / eLearning / online learning mode of delivery clearly is the key factor why prospective students choose this type of programme. Compatibility with continued professional activity, family and other social obligations, mobility restrictions etc. are the driving forces behind the emergence of distance learning as a leading organisational model of continuing education.

Over several years it has become increasingly evident that there is no one-size-fits-all model for organisation and delivery of postgraduate qualifications in GIS&T (Howell et al 2003). Many students aim at a well-founded and prestigious MSc degree, while others prefer the more directly applicable outcomes from a professional diploma. Full distance learning serves part-time students well while there is a growing demand for ‚going back to school' for a condensed full-time study experience (which might be split over several periods) or even entering postgraduate online learning immediately after undergraduate studies.

The organisation and communication concept behind a distance education offering clearly are a core success factor determining the long term sustainability of programmes like UNIGIS (Molendijk et al 2008). Several factors deserve attention, like

- Combination of advantages of centralized course delivery with regional access to support
- Leveraging of novel Internet-based communication facilities to really ‚stay in touch'
- Balancing an accepted core set of knowledge and skills with flexible options to enable individual choices of elective subjects.

While distance learning clearly is a ‚unique selling proposition' for an academic programme, it is not a value per se. It is valuable, if it enhances the accessibility of continuing education for a target group of learners. The actual USP therefore is the catering to the needs of a mature, well motivated and professionally active community of learners who are less mobile due to their job locations as well as social commitments. Bridging distances, and facilitating communication by online media is a very helpful element in allowing access to continuing education.

5. Quality Assurance

Regional differences in educational systems, cultural expectations, online access and levels of prior learning are significant across the globe. Maintaining a common standard of qualifications therefore sometimes turns out to be an impossible objective and likely will be a challenge forever. Still, the common denominator between North America and Central Asia, between Europe, Latin America and the Indian subcontinent is larger than it might be expected, not the least due to the unifying and ‚standardizing' force of a global software industry and common issues in professional practice.

Quality Assurance is an permanent challenge in academia, and even more so in a distributed set of programmes being taught across all boundaries of cultures, languages, professions and levels of economic development (ENQA 2005). UNIGIS (Car 2008) has implemented a clearly defined framework of goals, tools and indicators facilitating the integrity, monitoring and continuous improvement of academic qualifications awarded. These start from a common core curriculum referenced to established benchmarks, standards for teaching and performance assessment, and cross-programme checks like joint degrees, credit transfer options and mutual evaluations.

QA is not a one-time procedure, not just one step in a process chain, but rather a continued set of cross-cutting activities and perspectives enveloping the entire education process including the targeting, design, development, implementation, delivery, monitoring and assessment of outcomes (IHEP 2000). As the value and the validity of education is determined by its manifest and perceived quality (Finnie and Usher 2005) QA is at the core of UNIGIS and a continued priority for everybody involved.

6. Assorted Challenges

The varying background of students (as opposed to ‚vertically organised' higher level qualifications directly continuing and expanding first qualifications, like an Ecology Master's built on top of a Biology Bachelor) poses a particular challenge to the design and implementation of postgraduate, and even more for continuing education programmes, as entry requirements and assumed prior knowledge differ considerably.

As a major asset continuing education students tend to have professional experience, which means they already bring their questions and a clear sense of mission to the study programme. This high level of motivation is balanced by the above mentioned fact of students having a broad range of sometimes very different backgrounds. This, though, helps with moving from a ‚centrifugal' concept of ‚knowledge dissemination' to a collaborative vision of knowledge creation. Virtually any intake or other larger group of students collectively exceed their instructors' skills and knowledge, substantially changing teachers roles (which is frequently the case in adult education). Teachers are challenged as moderators and coaches, helping with building knowledge instead of dispensing it. Over time, while approaching advanced stages in their programme, students notice that they increasingly learn from and with each other. Teachers then are less in a central role, but rather serve as facilitators in a semi-autonomous educational process.

Likely the most important success factor, and challenge, is the evolution of UNIGIS into truly global qualifications recognized by a wide range of industries and professions. This is due to the geographically distributed, multilingual programme offering by a set of well integrated institutions which is based on a common framework, joint courses and even international summer schools, use of common platforms and GIS software and, most importantly, a large body of tightly cooperating faculty from across the globe.

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SQLtutor

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Abstract

SQLtutor is an interactive online web based tool for teaching and examining students' knowledge of SQL. It was introduced into education at the Department of Mapping and Cartography of the Faculty of Civil Engineering at the Czech Technical University in Prague in 2007. The paper informs about the first practical experience gained from the first year of application of the project in education, deals with some uncovered problems and discusses the next possible developments of the project.

By introducing the SQLtutor to an introductory database course, there were several goals followed. One of them was to offer the students a learning tool that would help them to impair some casual bad practices brought from secondary schools, like occasional dull mechanical memorizing. This tool would lead them spontaneously to individual learning and logical thinking in order to be able to solve simple SQL queries. The students need to understand basic principles and they need to learn thinking in the categories of sets. A previous knowledge of procedural programming might be paradoxically a disadvantage.

1. Introduction

SQLtutor project was introduced for the first time at our faculty workshop Geoinformatics FCE CTU in 2007 [5]. The main goal of the project is to come with a simple and user friendly tool for teaching, active learning and testing the SQL that could be exploited at the study program of Geodesy and Cartography at the Faculty of Civil Engineering, CTU Prague.

The need of the subjects such as the Introduction to Relational Databases and SQL Language in the field of geodesy, geoinformatics / geomatics and other related study programs is obvious. Students should be educated in practical database management and usage at least on a basic level, even if they are going to follow the traditional study branches like geodesy. An example that demonstrates such a need might be our paper on adjustment of densification network presented at FIG WW in Stockholm in 2008 [3] (it would be unavailing effort to maintain all the adjustment data without a database support).

SQL language and the introduction to databases are presented to the bachelor students of our study program during the second semester of their curricula and SQLtutor is used as a *gentle introduction to SQL*. As with any other computer language it is nearly impossible to learn SQL without practical training and exercise and that is why the SQLtutor offers an online web access to its training database for the SQL novices. For the bachelor students of geoinformatics (at the fourth semester), it also represents a simple project that demonstrates how to program trivial client applications, simple web services and some other basic programming techniques.

The SQLtutor project consists in part of a C++ program of the same name sqltutor released under the GNU General Public License (GNU GPL). Its source codes are available from the Savannah CVS server [4]. The second part of the project is a free collection of SQL questions and answers representing SQL tutorials. SQLtutor enables to run one or more tutorials in different languages from a single database. The sqltutor program is a CGI script that selects SQL questions from its database, checks the answers and evaluates the final score. The home page of the project is [1], SQLtutor is implemented on the top of a relational database system PostgreSQL [6].

2. SQL tutorials

SQLtutor was inspired by the interactive tutorial SQLzoo [2] by Andrew Cumming from the School of Computing, Napier University, Edinburgh, UK. Andrew Cumming kindly agreed on using his datasets and SLQ queries within our project. Implementation of the database and the sqltutor program is not dependent neither derived from the SQLzoo tutorial.

From the very beginning of planning the project, our basic idea was that all materials from the project must be freely available to students before being used during examinations. One of

our tasks for the coming years is to enhance the volume of the collection of questions and answers to the level, where it would be practically impossible to memorize them.

A tutorial in SQLtutor is implemented as a set of plain text files with tutorial questions (or problems) and correct answers (SQL queries). More than one solution can be applied for a given problem; the first one listed is supposed to be the most suitable from the point of view of (learning) the SQL language. Typically, each file describes a set of related problems to be queried over a common set of database tables. In the SQLturor project a set of questions and related tables is called a dataset and the corresponding text file uses default filename extension .quiz.

Dataset files can contain comments introduced by # character (remaining text up to the end-line is ignored during the file processing). Questions and answers are written in SQL with questions put in comment lines and answers written as the following SQL code, as demonstrated on the following example of ''airplanes'' datasets (file airplanes.quiz) with three relational tables.

```
# passenger_airplanes (id, manufacturer, airplane, radius_km, seats)

# airline_companies (id, company, country, region, alliance, founded)

# airline_fleets (company_id, airplane_id, number_of_airplaines)


# – id = "601" dataset = "airplanes" category = "select" points = "1"

# –

# – Show all airline companies.

#

# SELECT company FROM airline_companies;


– id = "602" dataset = "airplanes" category = "select" points = "1"

–

– Which airplanes have capacity higher the 300 of passengers?

– Show manufacturer, airplane and capacity.


SELECT manufacturer, airplane, seats

FROM passenger_airplanes

WHERE seats › 300;


– id = "603" dataset = "airplanes" category = "join" points = "4"

–

– Which airline companies have in their fleets airplane Douglas DC-8?

– Show company, country and the number of airplaines.


SELECT A.company, A.country, B.number_of_airplaines

FROM airline_companies A

JOIN

airline_fleets B

ON A.id = B.company_id

JOIN

passenger_airplanes C

ON C.id = B.airplane_id

WHERE C.airplane = 'Douglas DC-8';
```

For easier debugging, the tables are listed in the introductory comments together with their attribute names in parentheses. This file format was chosen to enable debugging in the textual mode as it is available for example in GNU Emacs or in any other text editor supporting SQL command execution, such as editors Gedit or Kate. The first question (id 601) is commented out and thus it is not to be included in the database.

Format/content of the leading comments (–) is obligatory. The first line defines question attributes, *id* is the integer question identifier (primary key in the table questions), ''dataset'' is the name of corresponding data set (it is not derived from the file name), ''points'' is a point evaluation and attribute *category* defines categorization of the given question to one or more categories of SQL queries (multiple categories are separated by the character "|"). In the current version, the categories are not processed; this attribute is reserved for use in future versions.

Dataset files *.quiz are processed by an auxiliary program quiz, that converts them to an SQL batch used for populating the database. Some leading commands generated by program quiz for the dataset *airplanes* are shown in the following example.

```
–

– generated from input file : airplanes.quiz
```

–

```
BEGIN;
INSERT INTO questions (id, dataset, points, question) VALUES ( 602, 'airplanes',
1,'Which airplanes have capacity higher the 300 of passengers?\
Show manufacturer, airplane and capacity.\
' );
SELECT merge_category(602, 'select');
INSERT INTO answers (question_id, priority, answer) VALUES ( 602, 1, 'SELECT manufacturer, airplane, seats \
FROM passenger_airplanes\
WHERE seats › 300;\
' );
INSERT INTO questions (id, dataset, points, question) VALUES ( 603, 'airplanes',
4,'Which airline companies have in their fleets airplane Douglas DC-8?\
x Show company, country and the number of airplaines.\
' );
 ... etc ...
```

Building the database and processing of all *.quiz files is controlled by a hierarchy of Makefiles generated by GNU Autotools. The database can be populated directly by SQL commands without the system of plain text datasets files described. We decided to prefer the batch processing, mainly because tutorial text files are easier to maintain.

3. Educational database

Tutorials, questions and answers are stored in SQL tables tutorials, questions and answers

tutorials (tutorial_id, language, tutorial, label, ord)

questions (tutorial_id, id, dataset, points, question)

answers (tutorial_id, question_id, priority, answer)

Primary keys are tutorial_id, (tutorial_id, id) and (tutorial_id, question_id, priority) respectively. As there can be registered more than one answer (solution) for a given question, the table of answers contains also an attribute priority. The highest priority (value 1) is assigned to the first answer listed after the question.

Datasets and information about their tables are registered in the table datasets

datasets (dataset, ord, ds_table, columns)

where attribute ord defines the order, in which the tables are listed during the dialog before the text of a question, see Fig. 1. The list of columns is a simple, comma separated list of the attribute names.

A table dataset_sources contains basic information about the information source of the given dataset

dataset_sources (dataset, year, sources)

for example

company	2007	Pavel Stěhule
films	2007	http://www.fdb.cz/
trams	2007	http://www.dpp.cz
unesco	2007	http://whc.unesco.org/en/list/
countries	2006	http://unstats.un.org/
airplanes	2007	http://www.letadla.info/
rivers	2007	http://hydro.chmi.cz/hpps/op_list.php
premyslids	2007	http://www.vicher.cz/

The dataset source table is not displayed during sqltutor tests and plays only an informative role in the project.

Tables categories and questions_categories categorize individual questions. As mentioned earlier, the categories are not actively used in the current version

categories (id, category)

questions_categories (question_id, category_id)

Each test is registered in the table sessions and answers to the questions in the table sessions_answers

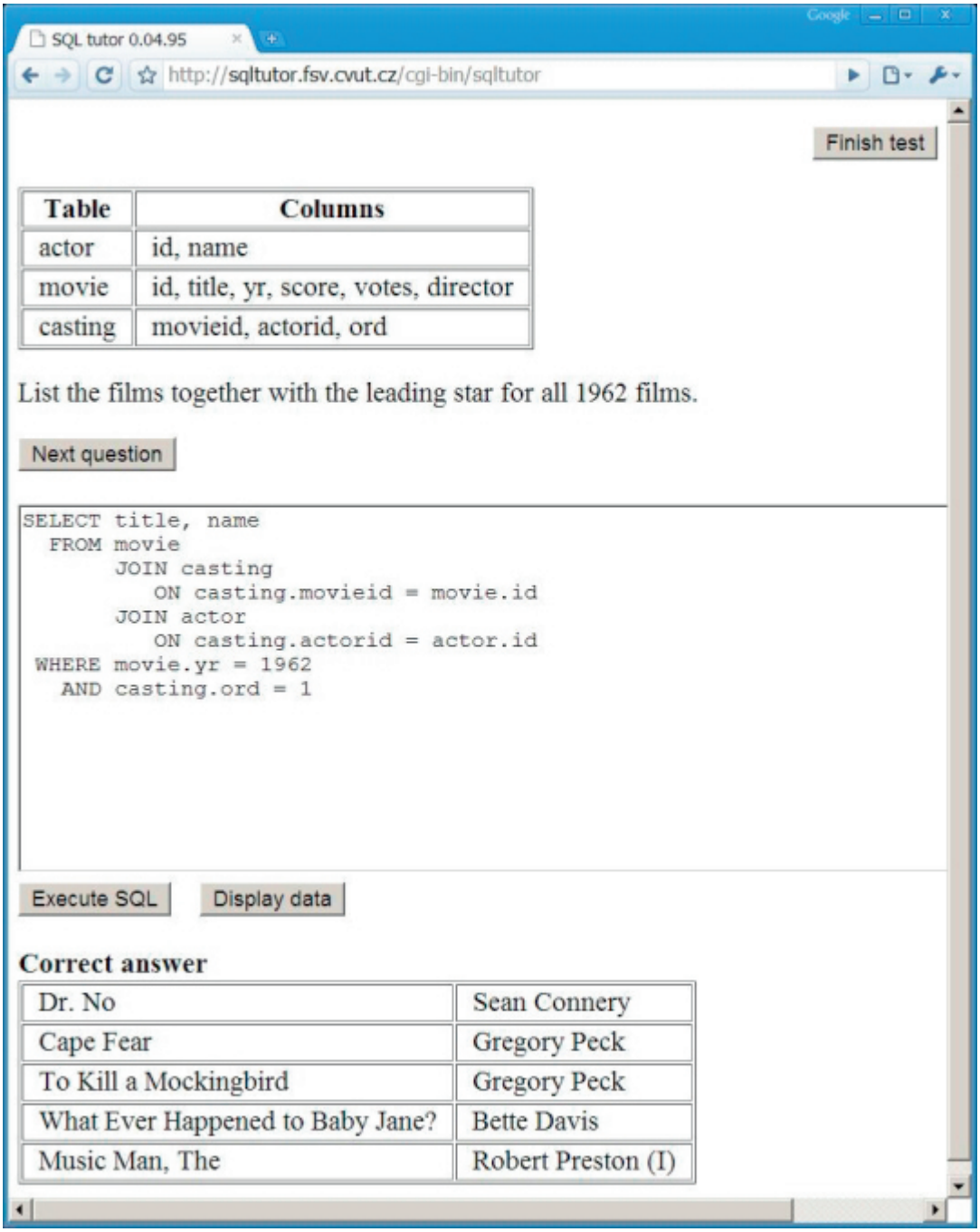

Fig. 1: Example of SQLtutor dialog with an SQL query and the result.

sessions (session_id, tutorial_id, login, password, points_min, points_max,

dataset, help, host, time, status)

sessions_answers (session_id, tutorial_id question_id, answer, correct, time)

Some attributes of the sessions are currently not used and are reserved for future enhancements. Attribute status may be in one of two states ''open'' or ''closed' and is used for locking the session after the test is finished. It also serves as a protection against subsequent tampering of the final score.

4. First empirical results

By introducing the SQLtutor to an introductory database course, there were several goals followed. One of them was to offer the students a learning tool that would help them to impair some casual bad practices brought from secondary schools, like occasional dull mechanical memorizing. This tool would lead them spontaneously to individual learning and logical thinking in order to be able to solve simple SQL queries. The students need to understand basic principles and they need to learn thinking in the categories of sets. A previous knowledge of procedural programming might be paradoxically a disadvantage.

Students have the full collection of questions and answers freely available, clear and simple rules for final test evaluation are given in advance and students can be preparing for the final examination during the whole semester. The first practical contact with SQL is a kind of *culture shock* for many freshmen students. They have not met anything similar during their secondary school studies and they *cannot imagine* how they could ever learn anything like that. But the success rate in final examination is quite high. This way, the SQLtutor fulfils another of our goals to support sound self confidence of students at the very beginning of their studies and to prove them clearly that if they work hard, they are going to be able to manage much more difficult tasks later.

Before introducing the SQLtutor into our standard education in the second semester of bachelor studies, we verified the new study plan together with the collection of exercises and parameters of test evaluation on experimental teaching of a class of students from a master degree program in geoinformatics. The most crucial task was to tune the parameters for final examination grading, based on the resulting point scores. Together with the students, our common conclusion was to have 60 minute test with rating 30/60/90 points for rating *good/very good/ excellent*. The chosen scale of 60 points has been also selected, because it suits 15 points division for a new grading A/B/C/D/E/F that has been adopted by our university in 2008.

The first semester of introduction to databases with SQLtutor went smoothly without noticeable problems. During examination we did not discover any incidents with cheating (the test was running on local computers in a room with network closed down), students did not try to dispute the given grading scale. Nevertheless, the first semester confirmed the well known experience that most of the students always try to go the easiest way, even though we could not imagine what it might be.

One of the supplementary rules declared in advance was that, if anyone finds an error in the collection of examples (questions and answers), he will get the benefit of the point score for his final examination. Confusing and unclear questions were considered as errors. Absolute majority of errors was cleaned up with the help of the students from the experimental class. Still, two or three errors remained, which proves that even excellent students sometimes take study materials uncritically. Distribution of our first 119 questions in the collection by the datasets and point evaluation is shown in the next table.

Majority of the questions is concentrated in the lower point ratings and as we could see from evaluation of answers during examinations, a number of students opted for the method of *brute force* and simply ignored questions from some datasets, namely the questions from the dataset of Premyslid royal dynasty and the dataset of rivers. Because in the SQLtutor premiere questions were selected in random independently of the point rating, in some cases this strategy proved to be successful.

The interesting point on the analysis of examination results was that this strategy was not only adopted by students who were trying hard just to pass through, but also by some of the best students. Resulting point score was calculated as the sum of points for correct answers multiplied by the ratio of the number of correct answers to all questions asked. Total number of questions was limited only by the total time limit of 60 minutes, eventually by answering all available questions.

points	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
dataset	total																
films	4	2	1	4	2	3	1			1	1						
airplanes	1	3	2	10	3	2	1	1	1	2	1						
office	1	4		1	2			1									
premyslids		1								2				4	1		1
states	3	5	4	3	2	2			2								
trams	1	1	2	2		2		1		2							
unesco	4	6	1	1	1	1	1										
rivers	1		1					1			2	1	1				1
total	15	22	11	21	10	10	3	4	3	7	4	1	1	4	1	0	2

Review of students with final grading ''excellent''

student	questions	correct	point evaluation
2003	83	76	299
7005	79	66	238
14003	53	53	219
12012	35	32	182
6005	54	43	168
19006	48	39	160
4009	27	27	145
19005	67	48	141
13003	30	28	139
14004	32	31	136
14010	40	35	132
13004	52	40	131
10009	54	40	127
12011	59	42	121
18025	49	39	113
12005	33	29	108
16009	33	29	108
4010	42	29	104
3002	34	28	102
16014	31	26	101
5010	28	27	100
3003	24	22	97
11009	32	25	97
14005	31	25	91

Following two tables summarize distribution of final results by point evaluation

interval	number of students
0	32
30	35
60	21
90	10
120	8
150	2
180	1
210	2
270	1

and distribution of students by final grading (including failure results)

grading	students	%
excellent	24	21
very good	21	19
good	35	31
failed	32	29

In the two tables above, there are not included students from the September reparative examination and students who failed to fulfil the credit limit for the first year and had to finish their studies.

As well as in the case of the experimental class of master degree students, the best bachelors

tended to compete among themselves to gain the highest possible point score (some of them doubted at the beginning of semester, if they would be able to pass the test). The best result of 299 points is the outcome that will probably never be beaten, it is admirable but it was also a warning that the algorithm of questions selection had to be changed. The aim is not to memorize the collection of test queries and write in the speed that forecloses logical thinking. The test should lead students to solve presented problems, SQL queries.

This can be achieved not only by substantially enlarging the number of tutorial queries, but mainly by changing the strategy for selecting questions. Even during the first experimental class, the students objected that trivial questions are wasting their time and obstruct them from gaining higher scores.

For next term, the SQLtutor will always start asking the simplest questions with one point rating. After the first has been correctly answered, two correct answers for two point questions will follow. After that, the questions with three and four points will asked in the very similar way. If a student answers all ten questions from the first test stage, his score will be exactly 30 points (grading E). In the following second stage, the questions with 5 or more points will be asked in random.

This way, the final evaluation should not be distorted by answering trivial questions, namely in the case of high ratings. Surely, for the second stage some better strategy will be needed. We can possibly define an algorithm that would balance the number of questions asked by categories.

Conclusions

SQLtutor is a small and simple project, but we hope that some of our colleagues might find it helpful, even if not for other reason than a toy to practice SQL queries.

One of the latest changes in SQLtutor database was an introduction of common schema ''sqltutor'' for all tutorials and enhancement of the database design to enable multiple languages and/or tutorials in a single database. We would also like to add other SQL commands such as DELETE, UPDATE and INSERT in the later versions. One of our plans for next year is to prepare an online tutorial for PostGIS spatial queries.

We would like to thank Andrew Cumming for his kind approval to use his data and tutorials from SQLzoo [2] in our project.

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Experience-Based Learning in the Geo-Information Sciences: 15 Years of Nuts Game

Liza Groenendijk, Enschede

Keywords: Experience-based learning, surveying education, natural resource management, land professionals

Abstract

One of the most successful modules offered at the International Institute for Geo-information Science and Earth Observation, ITC, The Netherlands, is the so-called NRM Module 1. The module is based on the Spiral Model of Learning, an experience-based learning methodology, and is particularly developed for adult education. The knowledge and the professional experiences of the students are seen as an important source of learning. The education process is organised in a six-stage cycle involving six adaptive learning modes – initial expectation and readiness, description of experiences, diagnosis and reflection, conceptualisation, experimentation and practice, and integration and action planning. Each of these stages requiring a series of carefully developed individual or group exercises.

Through its interactive and reflective nature the module is constantly changing and adapting to new realities and changing directions in the professional field. New learning tools, such as e-learning and the use of a virtual learning environment, appear to be developed for experiential learning. The Spiral Model of Learning methodology promotes lifelong learning and fits the concept of continuing professional development. It is recommended to further explore this approach and similar approaches in the search for new and sustainable curricula for future land professionals.

1. Introduction

The discussion on the changing nature of the surveying profession has been a key issue for more than a decade. Experts in the field expressed their concerns, analysed the issue and developed new insights on the nature of the surveying profession and practice (Enemark, 2002; Osskó, 2008).

The major key international trends in the surveying education are summarized as follows (Enemark, 2007):

- Management skills, versus specialist skills
- Project organized education, versus subject based education
- Virtual academy, versus classroom lecture courses
- Lifelong learning, versus vocational training

University and training institutions looked for new ways to respond to these trends and the challenges they represent (Enemark, 2002, 2004, 2007; Markus, 2008; Sternberg & Krebs, 2008; Lam &Chan, 2007; Coleman & Dare, 2007; Mansberger & Steinkellner 2007).

This paper highlights the experiences with one of the successful modules offered at the International Institute for Geo-information Science and Earth Observation, ITC, The Netherlands, the so-called Natural Resource Management Module. The paper describes the educational approach and structure of the Natural Resource Management Module, illustrated with some of the typical exercises and one in particular, the so-called "Nuts Game".

In the search for new educational approaches for training of future land professionals, it is worth while considering this example of an experience-based learning approach, where the experiences of students are the source of learning and development.

2. The need for a multi-disciplinary module

The Introduction to Natural Resource Management, or the so-called NRM Module 1, marks the start of the Master of Science Degree and Postgraduate Diploma Course in Geo-information Science and Earth Observation for Natural Resources Management at the International Institute for Geo-information Science and Earth Observation (ITC), Enschede, The Netherlands.

This introductory module has a history dating back to 1993. At that time ITC was offering several separate courses in the field of Natural Resource Management: Forest Survey, Soil Survey, Rural and Land Ecology Survey, Survey Integration for Resource Development and Forestry for Rural Development. The management of the institute recognised the importance of a multi-disciplinary

approach towards Natural Resource Management and how could this be better promoted than in a common introductory module for these courses?

Considering the aim and objectives of the module and the particular target group, the Spiral Model of Learning methodology (FMD Consultants, 1993) was selected for this module. This student-centred training methodology is based on the principles of experiential learning and is in particular applicable for adult education.

The Spiral Model of Learning methodology was earlier successfully applied at ITC in the postgraduate course Forestry for Rural Development (1990- 1997). In this course, with its particular focus on community involvement in forestry and forest surveying, participatory and action research approaches were very much promoted. The Spiral Model of Learning was the appropriate education approach for this course.

A multi-disciplinary team of lecturers was invited to develop a module to form the common start for all Professional Master's and MSc Degree Courses in the field of Natural Resource Management. To bring staff from different disciplines together was at that time a unique and challenging undertaking, and not at all an easy one. Next to their different professional backgrounds, most staff members were not familiar with experience-based learning principles.

The different disciplinary courses became "specialisations" of a NRM Programme in 2000, and from 2008 further integration resulted in one new MSc and Postgraduate Course in Geo-information Science and Earth Observation for Natural Resources Management.

The 15 years old NRM Module 1 survived all these curriculum changes, adapted to new insights and realities. It still brings together the experiences of the students based on which a common and solid framework is developed for their further MSc and PG study trajectory. The educational approach, management and basic structure of the module have remained unchanged during the years the module is being offered.

Through its interactive nature the module is constantly changing and adapting to new realities (Box 1). Each year the module is updated through the input of new contributing staff and the experiences of the students, mostly mid-career professionals. More than 50 different academic staff members contributed as module coordinators, facilitators or moderators, while more than 1000 students, from all over the world, participated.

Changing Aims of the NRM Module 1.

The NRM Module aims at eliciting from the students, and further developing, a common basis for the assessment of multi-actor and multi-disciplinary nature, and thus the complexity and conflicts involved in Natural Resource Management (Study Guide, 1999).

The module aims to support the MSc and PG degree students, in acquiring a critical attitude towards the role of geo-information science and earth observation for natural resources management while emphasising a system approach towards solving natural resource management problems. (Study Guide, 2008)

Box. 1: hanging aims of the NRM Module 1.

Not only the content is constantly adapting to new realities, also new educational tools and techniques, including e-learning, are easily taken up and integrated. In particular young students are responsible for the introduction of challenging digital tools such as Wiki, but also new forms of interactive presentation techniques.

3. Experience-based learning

3.1 Basic assumptions

The knowledge and the professional experiences of the students are seen as an important source of learning. Much of the training in the NRM Module is based on exchange, analysis and systematization of these experiences. This means starting with the student and working with the experiences they gained in their organisation and actual working situation.

Experience-based learning also means students learn from systematic reflection on what they do individually and inside a training group, gaining essential skills for multi-disciplinary teamwork. But also other basic professional and academic skills such as critical thinking, independent learning, presentation and communication skills, reading and writing skills are part of the learning objectives.

3.2 The Spiral Model of Learning

The Spiral Model of Learning is based on the principles of discovery learning and is in particular applicable for adult education. The Spiral Model of Learning is based on the theory of experiential

learning developed by Kolb (1984). Learning is defined as the process whereby knowledge is created through the transformation of experience. Kolb, in his structural model, describes the process of experiential learning as a four-stage cycle involving four adaptive learning modes – concrete experience, reflective observation, abstract conceptualisation, and active experimentation.

The Spiral Model of Learning distinguishes the following main steps in the education process:

1. Initial expectation and readiness
2. Description of students experiences
3. Diagnosis and reflection on experiences
4. Conceptualisation and analysis
5. Analysis, experimentation and practice
6. Integration and action planning

In the following paragraphs the different steps of the Spiral Model of Learning are explained and illustrated with practical examples of learning exercises from the Natural Resource Management Module.

3.2.1 Initial expectation and readiness

The learning process starts with the expectations of the students about the course. These are presented and compared with course objectives, and differences are discussed to reach a shared learning perspective. The training process is clarified for a clear and shared understanding of how learning is organised.

To stimulate favourable learning conditions, emphasis is on developing an open atmosphere of mutual respect, trust and commitment within the group. Students are stimulated to play an active role in the learning process.

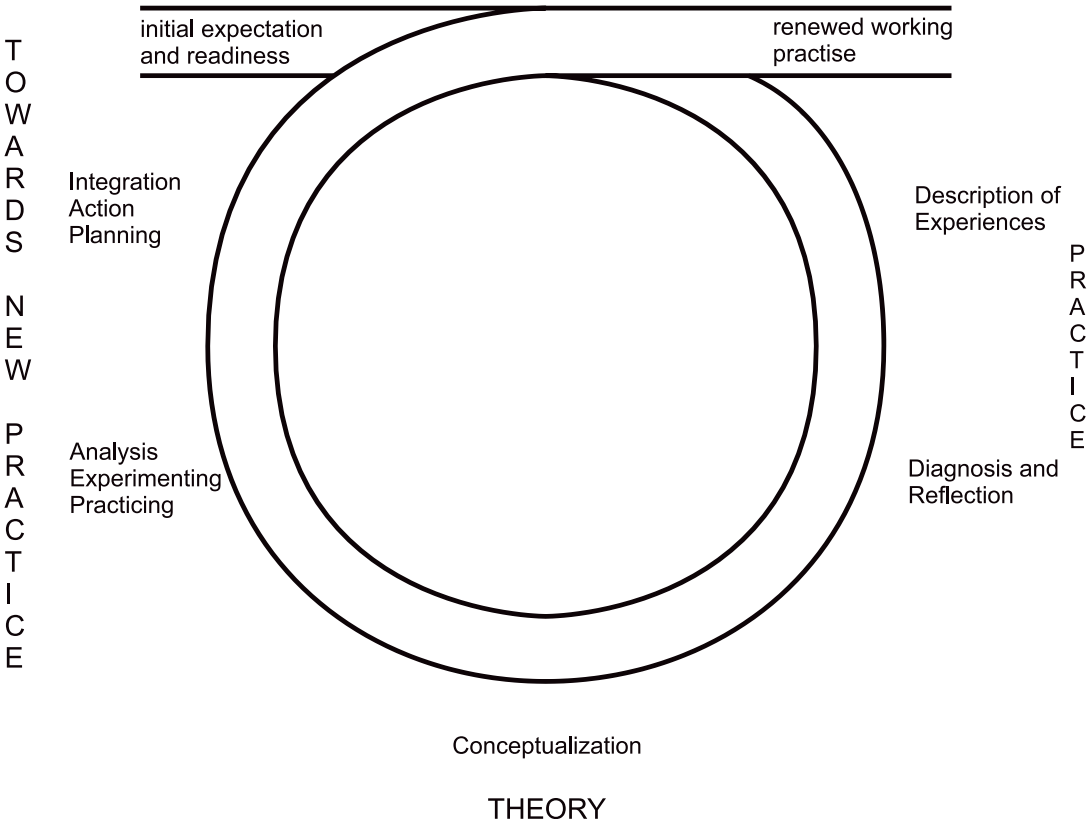


Fig. 1: The Spiral Model of Learning (FMD Consultants, 1993)

Reporting and Animation Committee

At the first day, participants are invited to take part in one of the following committees: reporting committee or animation committee. Through these committees they are made responsible for the course and their commitment for the learning process is increased.

Reporting Committee

The Reporting Committee is in charge of making a daily report of the activities and outcome of the module. In this way the outcome of the module is documented, and the information can be used by students who arrive later in the module, and serves as input in other exercises. Each morning the report of the day before will be presented by two reporters.

Participants in earlier courses (1993) used hand written reports, later followed by digital copies and PowerPoint presentations. The last years the digital learning environment Blackboard is used to publish and manage the daily reports. One of the recent groups organised the reports in a Wiki-environment, which allowed for more interaction and easier management of the reports.

Animation Committee

The Animation Committee takes care of a good working atmosphere in the group and promotes active participation. The committee proposes the use of animation games when appropriate in the module, e.g. at the start of the morning sessions or afternoon sessions. An active animation committee may even organise social activities during the evenings or weekend.

Participants make use of a guide for workshop facilitation (Groenendijk, 2006). But more often they use there own experiences and ideas about group animation. This can vary from the well known ice-breakers and energisers, to traditional dances, songs and music plays. The use of You Tube was a remarkable experience in the 2008 course: various students were very eager to show their home or aspects of their work or projects they are involved in.

Mr. Toru Nagayama, Japan, demonstrating the Koto, NRM Module 1, 2007

One of the Kenyan students explaining her traditional ornaments, NRM Module 1, 2007

Box. 2: Example of a learning exercise in step 1. Initial expectation and readiness.

3.2.2 Description of students' experiences

In this step the present knowledge and experiences of students within their working context is analysed and systematized. Students are stimulated to describe their knowledge and experiences through a series of carefully developed individual or group exercises:

- To express their knowledge and ideas
- To reflect their working experience and practice

- To reflect on their regular working behaviour or attitude
- To describe their working or institutional context

A central part of learning is that individual experiences are being expressed, discussed and compiled for further brainstorming in the group.

Various exercises are developed to explore students' perceptions on Natural Resources and Natural Resources Management. Analysis of student's working experiences result in on an overview of success and failure factors in Natural Resource Management.

Success and Failure in NRM

Various exercises are developed to explore participants' perceptions on Natural Resources and Natural Resources Management.

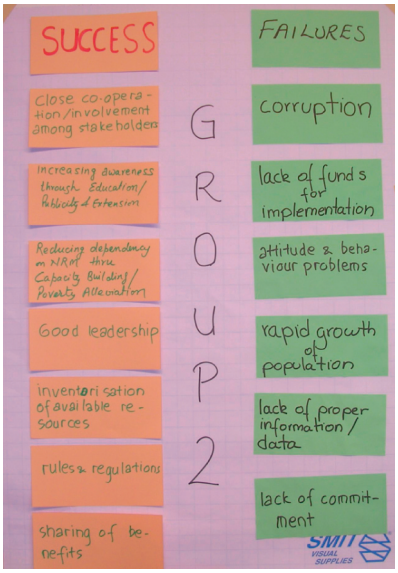
What are the key issues in Natural Resource Management? In this exercise students explore their working experiences to answer this question. The focus in this exercise is on success stories (what went good and why?) and the failures (what went wrong and why?) in NRM in their daily work. Further analysis and relating the findings to the outcome of earlier exercises will lead to a list of key issues or problems in Natural Resource Management.

Students are asked to answer the following questions and discuss these in teams:

- What do you see as a successful achievement in NRM in which you have been directly or indirectly involved?
- What do consider an 'unsuccessful' NRM activities in which you have been directly or indirectly involved in your work?

In plenary the results of the teams are presented, compiled and further analysed resulting in and overview of achievements and difficulties and a consolidated list of success and failure factors in NRM.

Participants NRM Module 1, 2006. Group 2.



Box. 3: Example of a learning exercise in step 2. Description of students' experiences.

3.2.3 Diagnosis and reflection on experiences

Students systematically compare their a priori ideas of their situations with the emerging picture of actual practices and conditions under which these practices develop.

Such a comparison leads to the identification of gaps between their actual (what they really do) and desired situations (what they think they do). It enables the students to evaluate their role in the past and motivates for further learning.

Based on the diagnosis of students' experiences, gained in the earlier steps, the key issues and problems in Natural Resource Management are identified. These issues will be further studied in the next steps.

In 1993 the following key issues in Natural Resource Management were identified by the course students: Participation, Multi-disciplinarity, Sustainability and Spatial variability; in 2008 one of these issues has been considered still relevant, sustainability, but others have been replaced by more prominent aspects like Competition and Conflicts, and NRM in the International Context.

The village sketch map

Students are asked to draw a sketch map of a village they know very well (e.g. home village, or the village of their parents or grand parents, or a village they visit often for their work). They are asked to include aspects of build up area, different land uses, infrastructural features, water ways, elevation and other relevant aspects of the landscape. A legend is added to the map.

The sketch maps are used to discuss in teams, and later in plenary:

- The natural resource areas in the sketch map
  - Location
  - Trends (increasing/decreasing area)
- The actors involved in managing the natural resources.
  - The owners, the users, the managers, …
  - Interests and objectives of these actors.
- Management systems involved in NRM
- Issues of resource tenure
- Importance of geo-spatial information for Natural Resource Management

Example of Village Sketch Map, by Rhoda Nyaribi, Participant NRM Module 1, 2005.

Box. 4: Example of a learning exercise in step 3. Diagnosis and reflection on experiences.

The Nuts Game

A typical experience-based exercise and the exercise that has become the flagstone of the module. The Nuts Game marks the start of a learning block on the key issue of sustainability. Through this exercise participants reflect on stakeholder behaviour with respect to the use and management of scarce natural resources and recognise the role of institutional mechanisms to ensure sustainable use of natural resources.

The Nuts is a game played in teams of 5-7 participants. Each team gets a bowl and a number of nuts, and a scoring table (Harvest Recording Sheet). Each player's goal is to accumulate as many nuts as possible during a so-called life cycle. A life cycle consists of one or more seasons. After an explanation of the rules, the teams start the game.

Immediately after the game, the moderator will summarise the total scores of the different teams and the results, including the different strategies followed by the teams, are discussed in plenary. The discussion focuses on the analysis of players' (stakeholders') performance and underlying factors and the attitudinal changes and development of co-operative strategies. Being the basic question: "What did you learn from this exercise in relation to the management of scarce Natural Resources?"

Participants NRM Module 1, 2000, Group 1.

Conclusions

- People are "greedy"
- Powerful people profit most, others "hungry"
- Everybody for his own sake is not sustainable
- Rules needed for sustainable use of natural resources
- Control!
- Everybody supposed to follow the rules, if not it will not work
- Women are best resource managers: equal representation
- Democratic rule/decision maker

For a complete description of this game see: Edney (1975), ITC (2008)

Box. 5: Example of a learning exercise in step 4. Conceptualisation and analysis.

3.2.4 Conceptualisation and analysis

Only at this stage new theories and experiences from external sources are being offered to the students in the form of special lectures, reading assignments, reflective exercises, internet searches, or videos. The key issues identified in earlier stages are now further studied.

The main elements for a framework for a multi-disciplinary approach in NRM are developed, the emphasis of which on the role of geo-information in NRM. Central to the approach is the interconnection between the key issues identified. This will create a new understanding of the role of surveying and geo-information within NRM.

The continuation of the course fits into this initial conceptual framework of NRM developed based on the experiences and realities of the students.

3.2.5 Analysis, experimentation and practice

The students gain more insight experiment the concepts and developed approach during a fieldtrip. Under field conditions they validate their new insights and approach, which contributes to further learning and consolidation of concepts.

Students are responsible for the planning, organization and reporting of this one-day fieldtrip. Trained skills in earlier modules have to be applied and gained insights are being tested.

3.2.6 Integration and action planning

In the case of NRM Module, the Spiral Model of Learning methodology is applied in the introductory phase of the course. In this case, the concepts and approaches developed in the introductory module serve as a "framework" for the remaining part of the course. Regular moments of reflection on the learning progress throughout the course are organized in which the learning experiences of the students are integrated in this overall framework.

At the final stage of the course, students prepare themselves for the implementation of the developed framework in their own working situation: the training spiral is becoming a full cycle.

4. Potential for training of the new land professionals?

The learning approach applied in the NRM Module at ITC has been particularly developed for training of adult and mid-career professionals from mainly developing countries. It has proven to be an excellent educational approach to train surveying professionals with different working and cultural backgrounds.

The typical nature of the experiential learning approach makes each module or course a new adventure. Changing realities in the professional field are brought in by the students and become the basis for further learning and developing the module or course. If the only constant in the surveying profession is change (Enemark, 2007), this more than 15 years old module has proven to be an excellent and sustainable educational answer to that.

It is clear that experience–based learning, and as applied in this case, the Spiral Model of Learning, promotes lifelong learning and fits the concept of continuing professional development. Each new individual training effort can be considered a loop in the spiral model of lifelong learning.

E-learning and the virtual learning environment, in this case Blackboard, increased dramatically the available number of educational tools and training challenges. Discussion boards, Wikis, Blogs and Communities of Practice are typical examples of these, and it seems as if they were developed to support experiential learning.

Next to the content and technical skill training, experience-based approaches address professional and academic skills such as: critical thinking and independent learning, communication skills, group work, presentation skills and information skills.

It is recommended to further explore this approach and similar approaches in the search for new and sustainable curricula for future land professionals.

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Usage of a Multidisciplinary GIS Platform for the Design of Building Structures




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Abstract

Topic of this paper is the usage of the multidisciplinary GIS platform for Design of Building Structures and GIS platform for education at the Brno University of Technology (BUT). The GIS technology has been made use of at BUT Brno in a limited extent since as early as the 90's, but as it was out of acceptable price range the utilization in greater extent was not possible. With the support of research projects the GIS platform became part and parcel of accredited study programmes at BUT Brno three years ago. Current informatics infrastructure was completed with necessary systems Geomedia 6.0 (Intergraph) and Arc/Info (ESRI), which are commonly widespread platforms. On initiation of Institute of Geodesy, Faculty of Civil Engineering GIS data warehouse has been established for the needs of tuition at BUT Brno, it contains all types of basic maps of CR and other types of data (ZABAGED, Orthophoto, BM – CR of various scales, cadastral maps, purpose-built maps, historical maps, special data – laser scanning, DMT, satellite data and others) in the localities of interest. The data warehouse is continuously supplemented. A part of GIS platform is a catalogue of maps containing fragments of cadastral, civilian and military map works since 1825 till now.

Hardware for the platform is the server HP Proliant DL380 G5 rack with 2x Quad-Core Intel Xeon Processor E5440 (2,83 GHz, 80 Watts, 1333 FSB), 32 GB RAM memory PC2-5300 Fully Buffered DIMMs (DDR2-667) with Advanced ECC, disc space 8x 146 GB HDD SAS 10000 rps, Hot-plug and net interface 2x Gbit LAN. ArcGIS requires database connectivity. As the university information system and additional university applications are in the long term based on Microsoft technology, in this case the platform MS SQL 2008 in 64 bits version was also used.

On the basis of standard multidisciplinary GIS platform the interests of several individual branches and worksites has been succeeded to be integrated e.g.: branch of Geodesy and Cartography (application in range of real estate cadastre, geology and geodynamics, GIS of small municipalities and others), branch of Water Management and Water Structures (solution in the field of hydrology), branch of Construction and Traffic Structures (GIS in traffic) and others. Informatics infrastructure is guaranteed at Faculty of Civil Engineering by Institute of Computer Aided Engineering and Computer Science, within the BUT by Faculty of Information Technology. The software solution of tasks in Open-GIS systems (Grass) ranks among contemporary trends. This article will be completed with demo results of hitherto solved tasks in the GIS sphere at the Institute of Geodesy, Faculty of Civil Engineering, BUT. Current civil constructions and structures are designed as optimized from a lot of aspects. Information integrated within the information system enable when proportioned to take into account even the influence of the outer conditions resulting from the geographical position and there out arising parameters e.g. the amount of rainfall, the speed and the direction of the wind, length of sunshine intensity, geology etc. The platform provides database enabling to simulate different variability of practical conditions of project assignment in the region. Data structure provides localized and geospatial data from global or regional character up to the detailed information of a particular cadastral allotment.

Modern decision making in flood risk management is based on theoretical means which make possible objective forecasting of flood consequences, both qualitative and quantitative. Necessary tools for the practical implementation of the risk analysis methods in floodplains are the contemporary mathematical models of water flow in the inundation area linked to a powerful GIS. The main task of GIS is to administer the input data, to analyse them and to present the results.

Keywords: GIS, data warehouse, application of GIS.

1. Introduction

Geographic Information Systems (GIS) belong among the youngest but at the same time the most developing sphere of information technology. At Brno University of Technology (BUT) this technology has been introduced into practical tuition in a limited extend since as early as 90th and gradually it has found multidisciplinary usage.

Information concentrated in GIS and being made use of in a lot of technical civil engineering branches prove to be very suitable and important. For example a landscape planning often made in a principle nonreversible way has a great impact

on the life of the whole society. If the basic goals and tasks dealing with the landscape planning are to be attained, the influences on sustainable development of landscape to be evaluated, the influences of the intentions dealing with our environment to be judged objectively, then for reaching these decisions we should have right and reliable information at our disposal. Quality of processed spatial analytic source material as well as landscape planning documentation play an important role in these cases [3], [10].

Referring to the protection of basic rights and freedoms of an individual the process of landscape planning has to be interconnected with the land record in the frames of information system of the real estates which is one of the most significant items of a democratic society in a state respecting the rule of law. The building act emphasises a continuous updating of spatial analytic data on the basis of Base Map of CR. This map and its digital equivalent – primary base of geographic data (ZABAGED) is updated in the form of a periodic aerial surveying of one third of the state territory, which at present enables a real 3 – 5 year period of updating of the Base Map of CR and taking into account the landscape development and a changes rate. In the future there will be a tendency to update some geodetic elements in shorter periods out of external databases – for example the road database. Topography of the state map is created by a cadastral layer updated on the basis of cadastral map topography. If the project of Czech Office for Surveying, Mapping and Cadastre to digitize cadastral maps until 2015 is carried out we can think about a digital state map at a scale of 1:5000 covering the whole state territory after 2016 [2], [3], [7], [8].

In present time we are seeking for constitution of a common platform and GIS standards on the basis of experience and data flow of the individual platforms working by higher area administration unit e.g. county or municipalities or facility managements e.g. ČEZ, E.ON, RWE, O2 etc. [1], [4], [5], [6].

Technical specializations lectured at BUT realize the necessity and advantages of making use of GIS sources for development of their study programs as well as special subjects. Guarantee of the platform is Faculty of Civil Engineering (FCE) with contribution of Institute of Geodesy, Institute of Water Structures and Institute of Computer Aided Engineering and Computer Science. The FCE applies GIS databases in the accredited study programs Civil Engineering and Geodesy and Cartography. GIS platform within BUT is participated by other faculties too: Faculty of Architecture, Faculty of Business and Management and Faculty of Mechanical Engineering.

2. Information infrastructure of GIS

The development of information infrastructure at BUT is guaranteed by the Centre of Computer and Information Services. Each faculty is connected with the system by its own network. A basic qualification to take advantage of GIS progress at FCE is the faculty network serviced by Institute of Computer Aided Engineering and Computer Science.

In 2006 with the support of the development projects together with the Ministry of Education at FCE projects ESRI – ArcGIS products and Leica Extensions products for ArcGIS have been installed. As a whole, it concerns 300 licenses of 10 different modules working through web user interface. The multidisciplinary usage is ensured by the GIS BUT data warehouse.

From the point of view of guarantee the complexity of GIS at BUT, the Institute of Geodesy FCE stands guarantor also for GeoMedia. The platform Intergraph GeoMedia came into being by joining the international project RRL (Registered Research Laboratory). By virtue of the observed publishing activities, Intergraph provides the RRL members with the free license so that they can test GeoMedia products, and also offers a possibility of free consultations 15 hours a year through e-mail (Intergraph Synergy email Support Services), one position for being trained in basic functions of the system, one position in the course for handling any functional overlay GeoMedia module for one year and one free participation in yearly World conference Intergraph for one person. Within this program each year about 30 students are provided with license (for one year).

At present an innovation of the above mentioned GIS platform is under discussion:

- it is pondered above the extension of the platform by ArcGIS server with multi-user's access. This server enables the access to spatial data through software ArcGIS mobile clients included, AutoCAD and web browsers. It gives you scope for the publication of GIS projects on the geoweb,
- innovation of mobile technology data capture in field with making use of standard PDA+ArcPAD,

- upgrade of program module MGEO (MicroStation V8) for geodetic and graphical data processing,
- sustainable development of platform is ensured in the form of maintenance for existing GIS products.

Information infrastructure described above is in preference built with the aim of maximum usage in all branches not only within the FCE but also BUT both in full time mode and combined mode study. It can be used even in the processes of the lifelong learning programs for the practice in civil engineering and public administration, for supplementary activities of faculties and for research development and expert activities. By implementation of GIS platform the tuition has been extended and the quality has increased not only with the subjects that have a lot in common with GIS but also with the subjects using spatial data. In view of general trend of digitalization even in the intermediate horizon we can expect graduates to became involved in work more easily which is one of most important criterion to judge the quality of education. Another contribution is a possibility to offer specialized subjects covering the needs of the practice mainly in the programs of lifelong learning for practice in civil engineering as well as in public administration.

3. Multidisciplinary data warehouse GIS

In the frame the project integrated and multidisciplinary tutorial information system for GIS contents of multidisciplinary data warehouse BUT in corporation with FCE, Faculty of Architecture, Faculty of Business and Management and Faculty of Mechanical Engineering have been formulated. The main aim of the project was to build information system, which would technically integrate the tuition of various technical branches and disciplines. The project paid particular attention to the development of modern technologies applied in bachelor's, master's and doctoral study programs in full time mode and combined mode including the support of medically handicapped students and applicants recruited of disadvantaged social groups. The platform of data servers has been built on ESRI ArcGIS technology.

Data contents of multidisciplinary data warehouse – see Fig. 1.

a) digital state cartography works

b) ortophotos

c) digital purpose maps of large-scale

d) digital terrain models

e) laser scanning

f) satellite surveying data

g) historical data and maps

Multidisciplinary data warehouse should be used by authorized access through BUT intranet up to the level of source data.

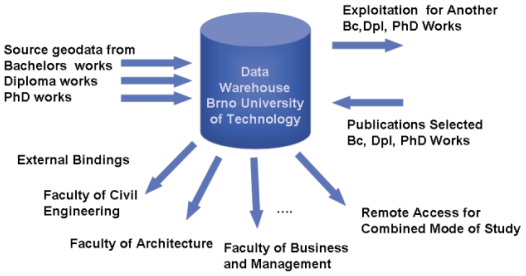

Fig. 1: Structure of the Multidisciplinary data warehouse GIS BUT.

Multidisciplinary data warehouse covers needs of Faculty of Civil Engineering (FCE) in bachelors, masters and doctoral study programs Geodesy and Cartography, Civil Engineering and Architecture of Building Structures. At the Faculty of Architecture BUT ensures study programs Architecture and Urbanism. At the Faculty of Business and Management BUT supports the study program "Software Engineering and Informatí" specialization "Management Informatí", subjects: Data and Functional analyse, Database systems, further study program "Economy and Management" specialization "Economy and Management of Enterprise" subjects: Strategic Management, Information Support of Processes, Applied Mathematic. At the Faculty of Mechanical Engineering BUT the facultative subject Land Information Systems was initialized, taught in the frame of study program Geodesy and Cartography at FCE as offer of extension subjects among faculties of BUT.

4. Hardware guarantee of GIS platform

Hardware parameters of the platform were estimated in part of applications needs, which are necessary for these processes, further by average values representing volume of student's projects (space of GIS project in Bachelor's or Master's thesis is approximately from 600 MB till 4,5 GB, in average 1 GB). The main element of hardware platform is the server dedicated to ensuring access to the spatial data by software

ArcGIS (including of mobile clients), AutoCAD and web browsers. From multiyear experience the HP Proliant DL380 G5 rack server in following configuration was selected:

- processor – 2x Quad-Core Intel Xeon Processor E5440 (2.83 GHz, 80 Watts, 1333 FSB)
- memory – 32GB RAM PC2-5300 Fully Buffered DIMMs (DDR2-667) with Advanced ECC
- disc space – 8x 146GB HDD SAS 10000 rps. Hot-plug
- net interface – 2x Gbit LAN
- redundant supplies and fans

For maximum performance 64 bit platform was chosen. System is based on Windows 2003 Server R2 – 64 bit version. Disc subsystem was initialized in RAID-5 mode with one disc in hot-swap mode.

ArcGIS server demands database connectivity. Because the university information system and others university applications are in the long term based on Microsoft technologies the tested platform MS SQL 2008 in 64 bit version was chosen. With regard of the server singularity within faculty and whole university the processor's licensing was chosen.

Server is located in central node of FCE network and connected to 1 Gb port of central switch HP Procurve 5412zl – see Fig. 2. To speed up the connection rate the port duplexing will be made. In the next stage the 10 G bit connection is proposed.

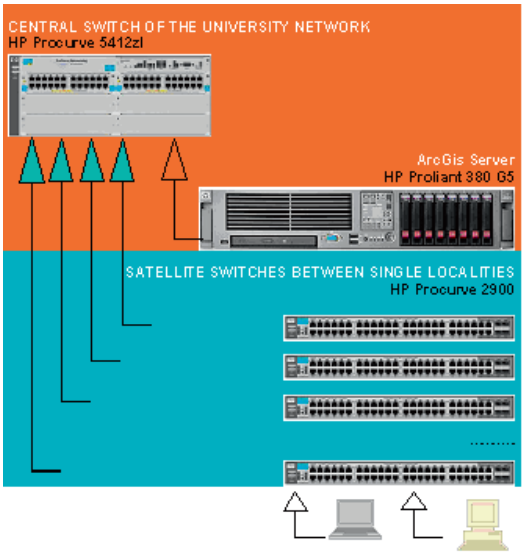

Fig. 2: Configuration of server for GIS platform.

5. Tuition of GIS at BUT

GIS according to one of many definitions is an information system with special determination consisting in the integration of various branches on the homogenous information platform. From this point of view it belongs to interdisciplinary branches and according to [9] it has a close relationship to information technology above all to geodesy (data capture) and cartography (presentation). It is clear that the Institute of Geodesy has primary integrated GIS tuition into its program of Geodesy and Cartography. Nowadays it contains basic information about GIS foundation of information systems, database systems, methods of data mining, basic graphs theory, topology (DIGEST norm) data models (vector, raster, matrix), digital terrain model, data capture, metadata, data quality, data sources, map algebra, spatial analyses, perspectives of further development of GIS. GIS appears in the syllabus of Faculty of Civil Engineering BUT. Further it is taught in the Institute of Water Structures in the subject called "Hydroinformatics", the aim of which is to get acquainted with the principals and functions of hydroinformation in water supply to give necessary information about data capture and simulation models in water economy and get practical skills making use of hydroinformation in semester projects. The subject involves: theoretical and practical bases of utilization of modern information and communication technologies for modelling, management and decision making in field of water management, collecting and processing of input data. Application of simulation models in water management (rainfall-runoff models, simulation of water flow in pipe systems and open channels, ground water flow modelling, simulation of sediment load motion, solute transport), processing and evaluation of modelling results (application of GIS etc.).

Institute of Landscape Water Management teaches GIS in the subject "Geographic information systems" in the first year of master study program in the specialization Water Management and Water Structures. Tuition of Geographic information systems has to provide students with basic information about the principles of data of digital technologies. The conception of tuition is devoted to history and basic of GIS focusing on spatial analyses, digital models of relief and tools for solving the problem of watershed and nature protection.

GIS teaching has a good tradition in the specialization "Construction of Traffic Structures"

at the Institute of Railway Structures and Constructions. Students are introduced to the problems of database systems and geographical information systems and to practice acquiring knowledge and skills. GIS teaching consists of: introduction into GIS problems, definitions and divisions of GIS, data GIS models, phases of formation, typology of GIS, GIS managing data structures, definition, collection and organization of graphical data, procedure within formation of a GIS project, planning of geographical technologies, geographical analyses, spatial questions, questions on mapping objects and attribute tables, characteristics of programming products of firms Intergraph, Autodesk, Bentley, ESRI, introduction into problems of modelling over GIS platform, basic tasks – transport optimization, goods delivery, optimal routes, region attendance, crisis management, application of GPS systems in transport etc, new trends of GIS development, connection of GIS and the Internet, usage of GIS within public authorities, usage of GIS for certification of line constructions, expert systems and its usage within railway transport. The same structure has also the doctoral study program.

Current civil constructions and structures are designed as optimized from a lot of aspects. Information integrated within the information system enable when proportioned to take into account even the influence of the outer conditions resulting from the geographical position and there out arising parameters e.g. the amount of rainfall, the speed and the direction of the wind, length of sunshine intensity, geology etc. (Fig. 3). The platform provides database enabling to simulate different variability of practical conditions of project assignment in the region. Data structure provides localized and geospatial data from global or regional character up to the detailed information of a particular cadastral allotment.

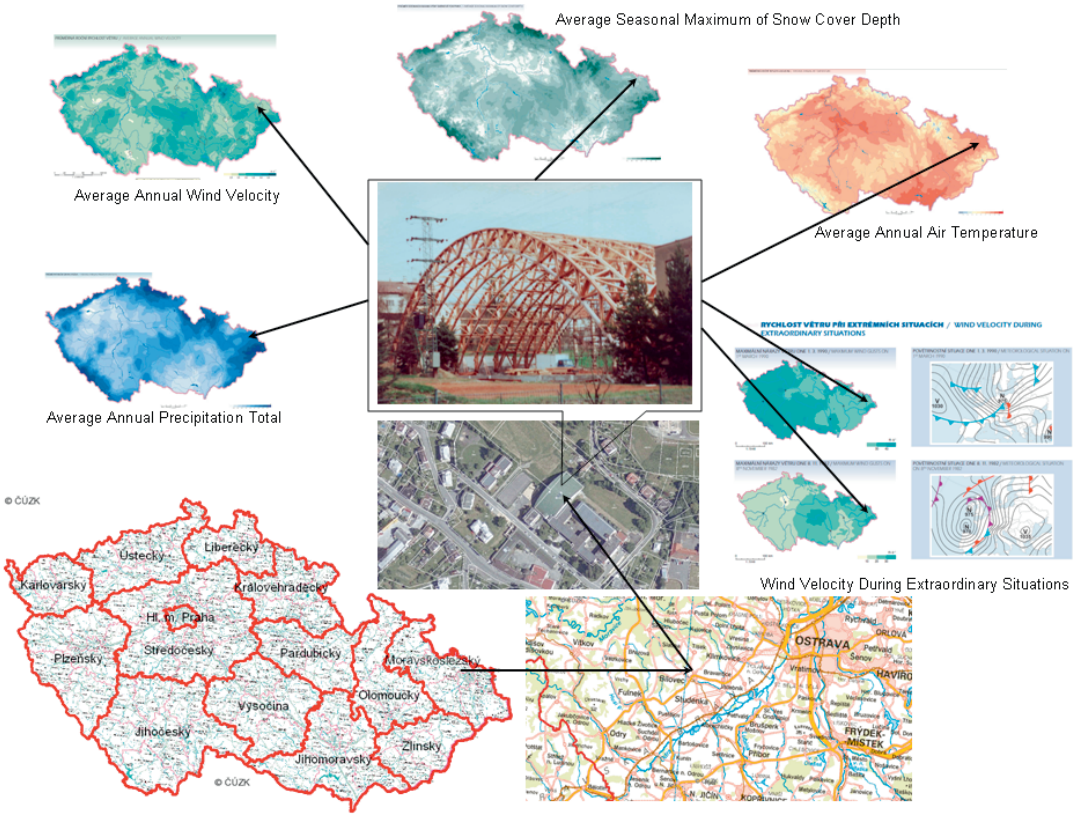

Fig. 3: GIS Usage for designing of civil engineering structures.

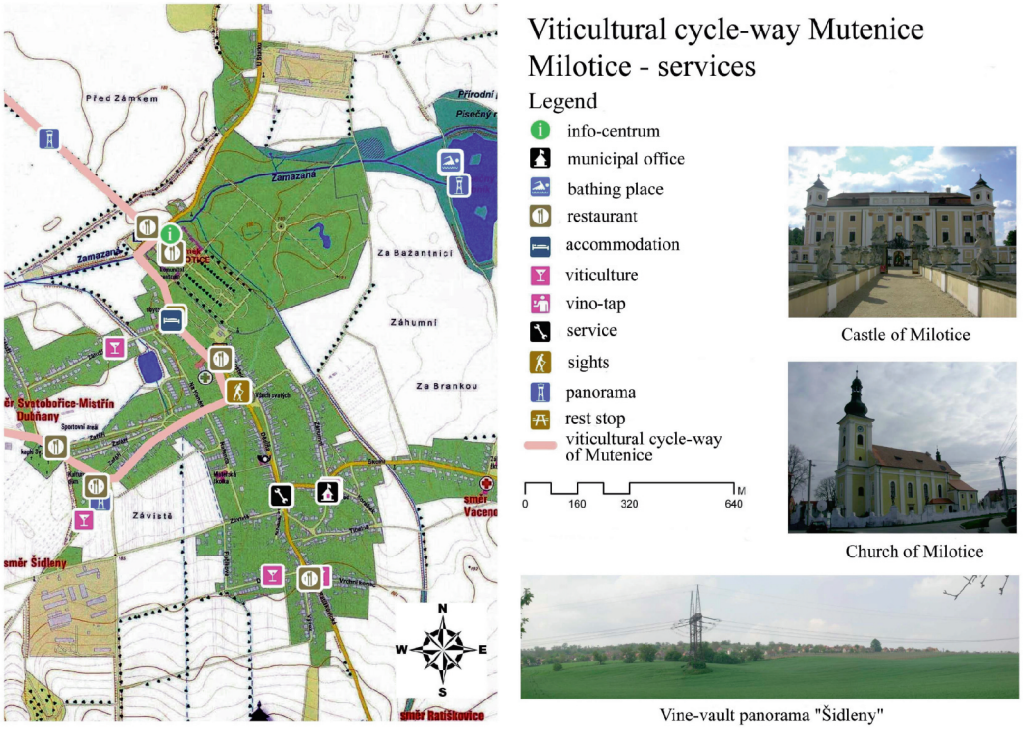

Fig. 4: Output of the diploma project "GIS of Moravian Viticultural cycle-ways".

6. The selected applications

Applications in the GIS sphere at the FCE date back to early 90th that time, the staff of Institute of Geodesy worked on the project of AM/FM (Automated Mapping/Facility Management) applications. It concerned the system for maintenance of gas pipeline LINDA, program for data management of anticorrosive protection of CR gas pipelines – GASACOR and GASSERV and a program PEARSON for evaluation of pipeline defects. The applications go back to the beginning when GIS started to be used for the first time. Nowadays LINDA product was integrated into more sophisticated graphical system VKM (geodetic software for the creation of map of medium and large scales, geometric plans etc.) and a GVIEW system (interactive map browser with possibility of conversion of a number of various data formats and some GIS functions implemented). The taking advantage of GIS, marked a great boom when it was used for solving particular tasks which was connected with the introduction of ESRI products e.g. the system Arc/Info implemented with the platform modules Leica and Intergraph GeoMedia. The branch of Geodesy and Cartography of the FCE in the fields of research and applications concentrated on 4 main directions: geological applications, GIS of small municipalities, GIS of maintenance of field points and GIS for tourism and sport. Fig. 4 shows GIS layout from the diploma project "GIS of Moravian Viticultural cycle-ways".

One of the most important tools of data management in GIS is their updating by data capturing. With the development of new electronic integrated mobile communication technologies it is possible to make use of computer PDA (Personal Digital Assistant), which are equipped with GPS (Global Positioning System), camera, high quality display, memory and GSM (Global System for Mobile Communications) technology – see Fig 5 and Fig. 6. The technology of data capturing is controlled by software e.g. ArcPad (ESRI) or Terra Sync (Trimble) etc. This process is under way either by the system of surveying the object in field or by its locating and demarking in field on the basis of coordinate GIS data. Ordinary accuracy of position destination is within the range

Fig. 5: Data capture and updating of objects in flood area

Fig. 6: Survey extent of flooding line

of 2 – 10 m. Mobile GIS is suitable for territorial arrangement in the sense of the pegging of basic directions in the field determined for a precise detailed geodetic surveying etc. Through the GSM communication technology there is an easier access through authorized internet client to data of basic servers and thus the update can be made directly in the source data.

7. GIS – based flood risk management

The modern decision making in flood risk management is based on theoretical means which make possible objective, forecasting of flood consequences, both qualitative and quantitative. Necessary tools for the practical implementation of the risk analysis methods in floodplains are the contemporary mathematical models of water flow in the inundation area linked to powerful GIS. The main task of GIS is to administer input data, analyse them and present results. Next describes basic ways and means of application of GIS in flood risk analysis.

System definition and qualitative analysis

- Preliminary phase of the risk analysis process which is based on putting together enough input data dealing with the floodplain properties, hydrologic and hydraulics conditions etc.

Quantitative analysis – flood hazard quantification

- Preparation of input data for hydrodynamics models. (pre-processing) and computing results evaluation (post-processing).
- Data evaluation from historical flood events.
- Flood hazard map creation (see Fig. 7, 8).

Quantitative analysis -Estimate of floodplain vulnerability

- Floodplain classification (see Fig. 9) resulting from vulnerability definition of individual sub-areas (categories). The content of category depends on floodplain occupancy (population, buildings and civil engineering works, public services, utilities and infrastructure etc.)
- Determining of vulnerability through the post-disaster survey of damages in floodplains.

Quantitative analysis – Evaluation of risk

- Evaluation of risk and flood risk map creation (see Fig. 9).

8. Conclusions

GIS at Faculty of Civil Engineering BUT has its long-term tradition both in teaching and in the implemented application. Because of the initial individual attitude and a lack of unity concerning particular solution in relevant branches it has not been subject to a great publicity up to national or international standard. The third dimension of GIS emerged by synthesis of a varied kind of spatial information and its interpretations. Thus we can obtain new information, which is not directly measurable but geometrically simulated and represented graphically in geographic contexts. By synthesis of geographic information we can access for example the influences of construction towards our environment and vice versa the influences of the environment upon construction of buildings mainly on their durability. Ecological interventions change the picture of the climate in the vicinity of the construction. Geographic arrangement has an influence of the existence of warm and cold areas interconnecting with the sunshine of a landscape wind stream, transmission of noise and others. With respect to the

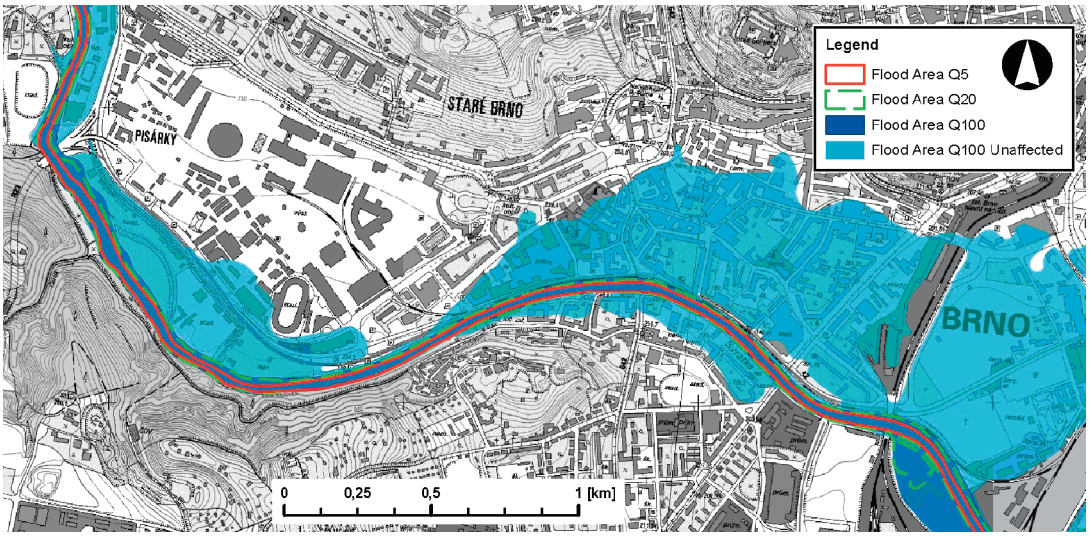

Fig. 7: Sample of Flood Map – Locality Brno

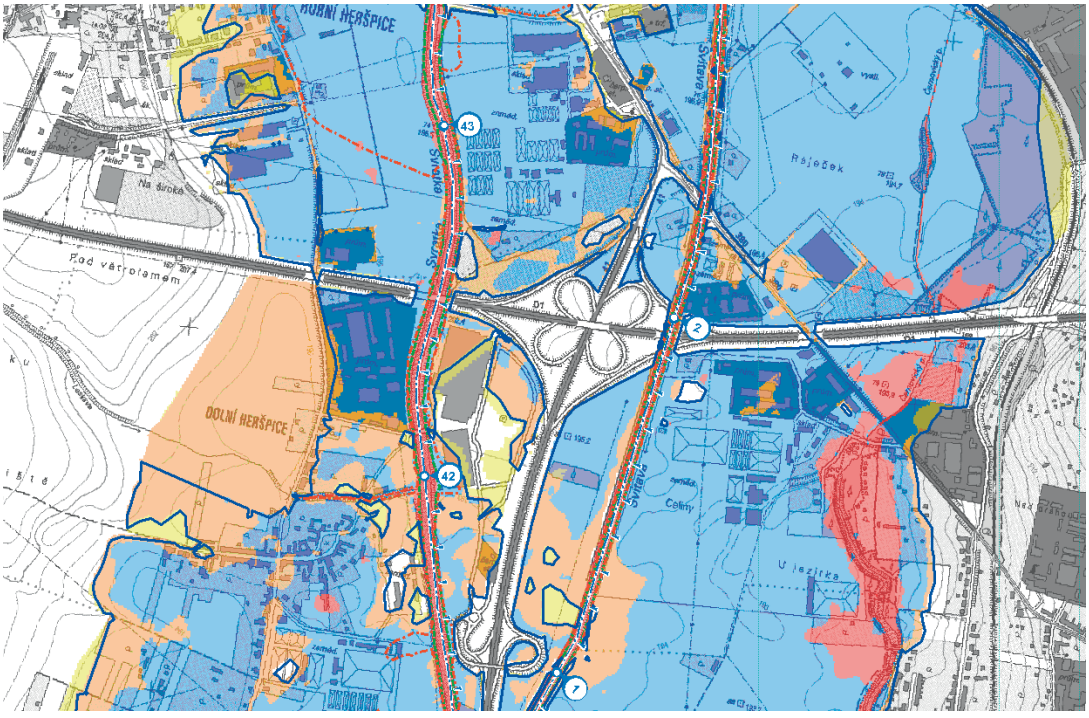

Fig. 8: Sample of Flood Hazard Map – Locality Brno

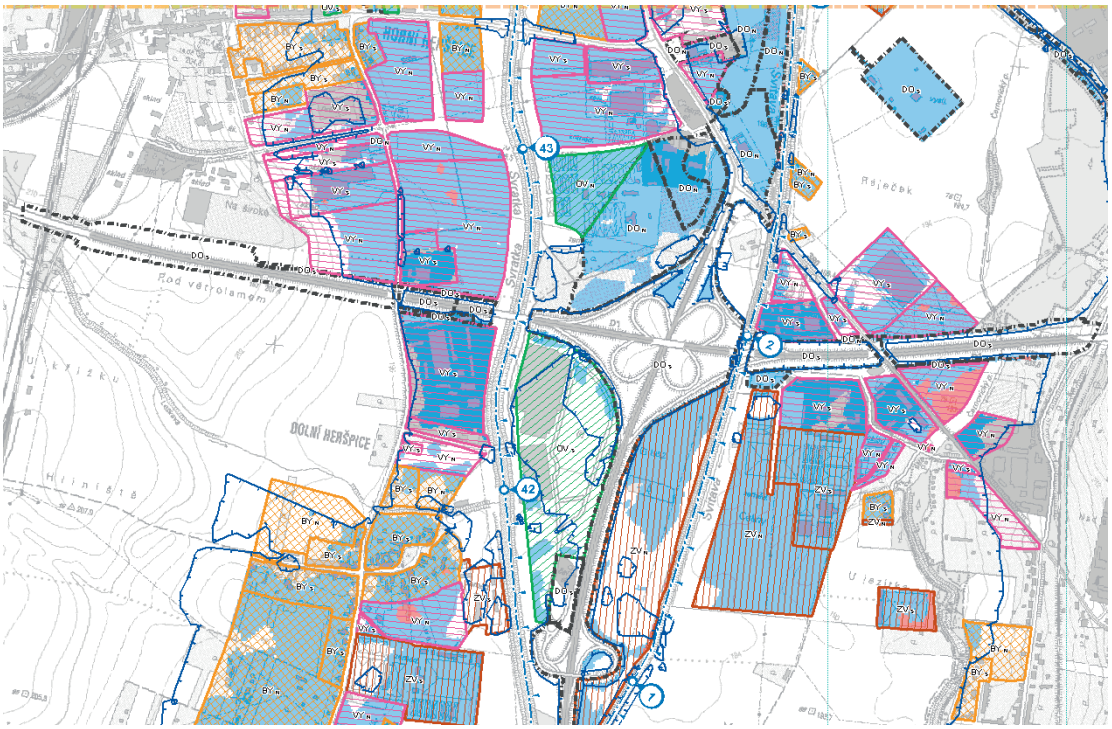

Fig. 9: Sample of Flood Risk Map – Locality Brno

protection of our environment the complexity of linking the information is necessary for safe run of the construction especially with large road structures (highway, railway corridors, biocorridors etc.). In the sphere of building industry GIS is important at the synthesis of information for the project of new construction location of the construction geography, weather, rainfalls, level of bottom waters, snowfall areas, flood areas geology etc. It aims to make periphery marginal conditions of construction designs more precise and of higher quality.

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ICT-Supported Learning and Training Tools for Terrestrial Laser Scanning Applications



Erwin Heine, Vienna; Mario Santana Quintero, Bjorn Van Genechten, Gent

Abstract

This paper describes the approach and developments of a project called '3DRiskmapping'. The project aims were to create a 'learning on demand' tool for the use of terrestrial laser scanners in documenting our built environment. The deliverables of the project include a number of 'ICT-supported training tools' that can be used and adopted by academic institutions in their current and future curriculum.

The resulting package consists of a theoretical introduction on laser scanning and laser scanning data processing completed with a number of case studies in the form of online tutorials, lesson e-books and decision flowcharts for procuring 3D spatial information surveying projects with laser scanning.

The course material is available in five languages: English, Spanish, German, Romanian and Dutch.

Future users will be able to register themselves online at the didactic portal and download all the course material free of charge.

1. Introduction

Terrestrial Laser Scanning (TLS) is a very innovative and useful surveying tool for capturing 3D surface data. Since its beginning in the early 1990s, it has been used in industrial applications, such as piping or in the automobile industry, but it has also emerged in the cultural heritage sector as well as in environmental risk characterization. In spite of these increasing interests, its application has not been fully exploited, among other things, due of lack of appropriate didactic material available at academic institutions and deficiencies in communicating the potential benefits based on real-life case studies.

The aim of the project called '3DRiskmapping' was to create an e-learning platform for utilizing 3D terrestrial laser scanning techniques for risk characterization of our built environment.

The project was launched in autumn 2006 and ran for two years and was co-financed by the European Leonardo da Vinci Project. The project group consisted of eight partners from six EU countries: four academic institutions – KaHo Sint-Lieven Ghent (BE), Universitatea tehnică "GH.Asachi" Iasi (RO), University of Natural Resources and Applied Life Sciences, Vienna (AT) and Universidad Politécnica de Valencia (ES); three surveying companies – Plowman Craven PCA (UK), BnS (BE) and Globe (BE); as well as one engineering company in 3D modelling and simulation – DelftTech (NL) .

2. Didactic approach / Teaching Material

The didactic material of this training course is designed to be used in an e-learning environment. The entire material is available at an online didactic portal on the Internet and consists of *lesson e-books*, *best practice training material*, *decision flowcharts* and an *information hub*. A compiled data set on DVD is available for dissemination to areas with limited Internet access and/or broadband.

The didactic content prepared in this project follow a pragmatic approach, where the following characteristics are present:

- Tutorials cover various applications
- Real data of a measured object
- Use of the most advanced laser scanning tools to address the project needs
- Sufficient case study material to illustrate common problems of TLS in practice

2.1 Lesson e-books

The Lesson e-books are designed to procure an theoretic background on laser scanning, also including:

- the process of procuring technology
- the application of technology for recording three-dimensional spatial information: process of collection and registration

- the application of software to provide three-dimensional spatial information: process of modelling and visualization

2.2 Training material

Examples of industrial application, heritage documentation and deformation monitoring are available to the trainees. All these tutorials are based on commercial off-the-shelf (COTS) equipment and software. They all follow a strict format, where each processing step is explained in detail and an online evaluation is possible at each stage of the work.

Didactic modules used in the tutorials:

The trainee is guided step by step through the entire workflow of a scanning project; from the problem statement at the beginning to the final visualization possibilities.

- Interactive instructions: The textual part of the tutorial consists of a verbal description of the procedure and detailed step-by-step instructions to follow up the work flow. Cross-references as well as hyperlinks offer further information on the specific items.
- Video tutorials: Additionally, the more complex processing steps are explained using short film sequences.
- "To do" summary: At the end of the chapters a so called "To do" summary is available to recapitulate all steps necessary to achieve the required result.
- Self test "Question boxes": The trainee is asked to explain the reasons for failures or errors that occurred during data processing. This self test offers the user a possibility to evaluate the knowledge attained of a specific item.
- Success control using pre-processed datasets:The trainee can compare the results he/she has achieved with the "correct" results, which are available at different stages of the course.
- Modular training : The above mentioned pre-processed datasets also offer the possibility to select individual modules for training. Thus, for instance users with experience in data capturing (scanning) can start the tutorial at the section *data processing* or even *3D modelling*.

2.3 Decision flowchart

Interactive flowcharts were developed to find adequate solutions to different questions. These decision-making tools are individually coordinated with the requirements of the respective processes; each stage of the cycle provides the trainee with information on how to apply this technique effectively and adequately.

For example, a *quality control flowchart* describes the processes for the correct acquirement of the built environment using laser scanning (Fig. 1)

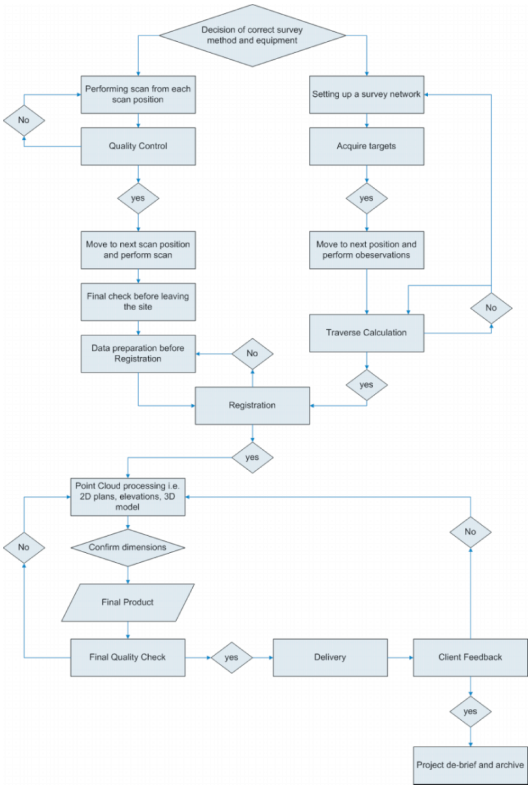

Fig. 1: Decision flowchart "quality control"

2.4 Information hub

A resource hub – compiled by the partners – with relevant information and links for the target group beneficiaries in the application of these technologies. A first version including further reference material and subject specific organizations around the world is available at: http://www.3driskmapping.org/site/

3. General description of the tutorial

The course developed within this project consists of two main parts, a theoretical part and a practical part, or so called hands-on tutorial, based on real-life case studies.

3.1 Theoretical part

The first part of the course is dedicated to the theory on TLS and is divided into 4 chapters:

Chapter 1 serves as a general introduction to laser scanning and the applications for which it can be used. The following topics are discussed:

- What is risk assessment?
- What is laser scanning?
- Static and dynamic laser scanning
- Applications of laser scanning

Chapter 2 is a theoretical exposé of various laser scanner types and how they work. It also explains the different metrological aspects that need to be taken into consideration when scanning. Topics discussed:

- The electromagnetic spectrum and light
- Lasers
- Important properties of laser light
- Laser safety
- Measuring using light
- Metrological aspects: error analysis
- State of the art laser scanner equipment

Chapter 3 explains the process of performing a laser scanning job. Every step of the process is explained in detail, providing tips and tricks based on expert experiences. Topics discussed:

- Survey planning
- Field operation
- Data acquisition
- Data preparation
- Registration & geo-referencing
- 3D point cloud processing
- Quality control & delivery

Chapter 4 provides a view on the problem of data management. A set of meta-data tags that are important for the dissemination and archiving of laser scanner data were defined. Topics discussed:

- Laser scanner data formats
- Scanning metadata
- Project metadata
- Registration information
- Storage media

3.2 Best practice training examples

The practical part of the course is designed as a hands-on training part based on real-life case studies. This tutorial contains 3 case studies, each chosen to illustrate certain problems, benefits, purposes and limitations of the recording technique utilized. Each of the case studies also focuses on different aspects of the laser scanning process:

Heritage Case Study (St. James Church)

The heritage case focuses on both the registration phase and post-processing of data. The dimensions of the church and the inside-outside relationship of the scanned surfaces provide an excellent challenge for linking scans taken from different positions. On the other hand, the level of detail requested and required deliverables require a time-consuming post-processing phase using highly specialized software (Fig. 2).

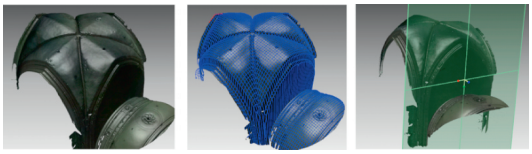

Fig. 2: Cupola of St. James Church

Industrial Case Study (FPSO vessel)

This case study explains the possibilities of using laser scanning in surveying industrial sites. An extensive overview of possible uses of the processed data during the engineering phase is given: it also tackles the actual scanning itself, using a software tool that simulates a laser scanner, providing insight into how to set up the scanner and the correct parameters (Fig. 3).

Fig. 3: Petrochemical installation of the FPSO

Civil Infrastructure Case Study (Hydroelectric Dam)

This case study describes the use of laser scanning data for monitoring deformations over time. Special emphasis is placed on determining the optimal laser scanning and target locations and on comparing different datasets for monitoring purposes (Fig. 4).

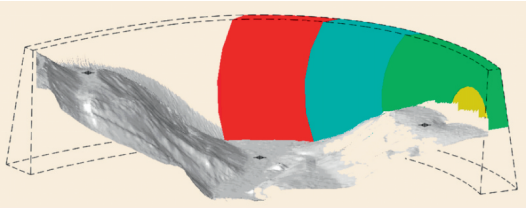

Fig. 4: Model of arch dam of "Kops" reservoir

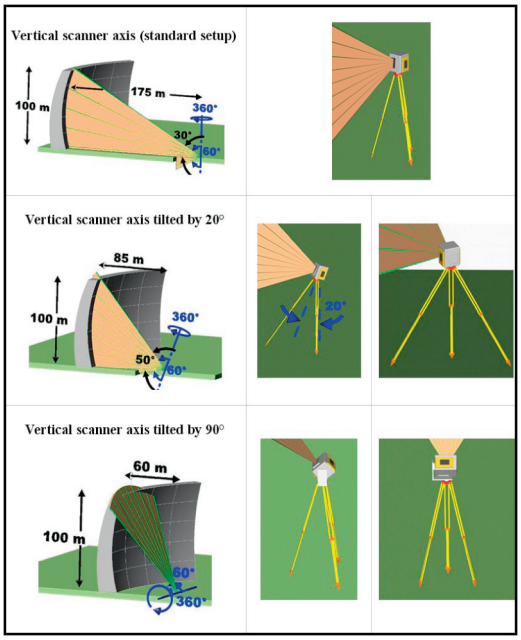

Fig. 5: Scan distances at different scanner set-ups

4. Exemplary excerpt of the tutorial

4.1 Determining the optimal scanning position

In case of scanning an object with a height of 100 m under a field-of-view of ±30°– (Figure 5a), the Trimble GX 3D scanner requires a horizontal distance from the object of:

Solution 1: $l = 100\,m/\tan(30°) \approx 175\,m$

However, it is possible to decrease this distance by tilting the laser scanner a few degrees (e.g. 20°, Figure 5b):

Solution 2: $l = 100\,m/\tan(50°) \approx 85\,m$

To reduce the distance between scanner and dam even more, it is necessary to use a totally different mounting for the scanner. An orthogonal mounting bracket can be used to turn the scanner by 90°. In this case, the vertical scan direction becomes the horizontal one and vice versa. So the resulting field of view of the scanner is 360° vertical by 60° horizontal (Figure 5c).

With this adjustment, it is possible to come closer to the object. To avoid the appearance of low intersection (sharp) angles, we keep an angle of 30° between the object's surface and the laser beam:

Solution 3: $l = 100\,m/\tan(60°) \approx 60\,m$

4.2 Registration – Finding errors

Open the ***Registration menu*** and start the ***register*** command. When this procedure is finished, the error column is filled and an error vector column has been added. The constraints can be sorted in descending order based on the error value by clicking the header of the error column. In this way, the constraints can be analyzed (see video *"registration_interior_part6.avi"*).

To Do: Sort the error column and check the error values.

In the error column, the first *4 (reduced dataset: 2)* constraints have an error measure of more that 2 meters; *Target 17* is also involved in all these constraints. By double clicking on a constraint, *Cyclone* opens both *ScanWorlds* involved in the 2 viewers below (Fig. 6).

Question 1: Double click the second constraint matching ScanWorld 5 and ScanWorld 6 and zoom to target 17. What is wrong with target 17?

Answer to Question 3 (remark: The answers are located at the end of the tutorial): "We can see that Target 17 in ScanWorld 6 (the right viewer) is not well-defined in the point cloud."

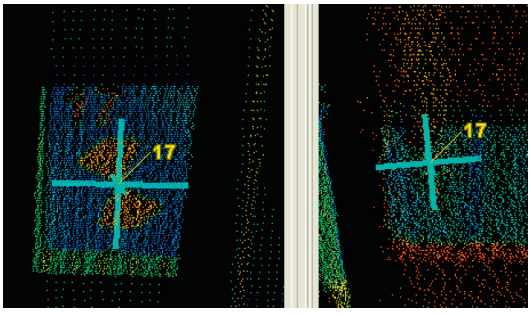

Fig. 6: Target 17 in ScanWorld 5 (good position – left) and in ScanWorld 6 (bad position – right)

5. Conclusion

These training tools will benefit the surveying community as well as the laser scanning industry by making people more aware of this new technology and its possible applications. Besides an introduction to laser scanning, its processing and decision flowcharts help the trainee to decide which recording technique is best for a certain situation. The final outcome of this project is not meant to be a commercial advertisement for laser scanning, but rather an in-depth analysis of the possibilities and limitations of using this technique for recording the built environment on the one hand, as well as a manufacturer-independent, quality-oriented tutorial for the application of terrestrial laser scanning.

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Scope of Competences of Future Serbian Surveyors Educated under the New Master Study Program in Land Law and Economy

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Keywords: Faculty of Civil Engineering, surveying education, master programme

AbstractThis article deals with quality control and main outcomes of the new MSc program at the Department of Geodesy and Geoinformatics (DGG) developed under the Tempus project at the Faculty of Civil Engineering (FCE), Belgrade University (BU). Master program covers the area of Land Law and Economy and it is the first program with this specific contents in Serbia. The main aim of this Project is to take into account actual needs of the Serbian surveyors today and to prepare a curriculum, more cooperative with modern European education practice in this area. In this Project we cooperate with the colleagues from Stockholm, Helsinki and Ljubljana Universities, with special heading role of Royal Institute of Technology (KTH, Stockholm). We are now near the end of the Project. The teachers from four domestic faculties with foreign colleagues are going to prepare teaching materials that is expected to be finished until the August 2009. It is a multidiscipline program with legal, economic and technical subjects back grounding with a Land Management Center which should be established during this Tempus Project, also. With the help of Land Management Center which is prepared and equipped with modern computers, knowledge innovation courses and process of permanent education of Serbian land surveyors will be organized in a new manner. In this intention we expect much help from European colleagues and every initiative will be of great importance to us. We also ask all colleagues to think about mutual cooperation with DGG in sharing experiences in all directions of education process and professional surveyor's development.

1. Land Market in Serbia and the Needs to Establish a Modern Education System

Private ownership of land and real property is a prerequisite for rapid economic development of any country. In a state, where it is unclear, who owns what and where, who has which kind of obligations and what mechanisms are available to enforce payment of the claims, the economy is constrained and sluggish. Thus assets cannot be used for obtaining added value through multiple property transactions because of their unfixed nature and uncertainty. In such a state, assets have similarities with dead capital. Therefore, every country in the world is trying to avoid such situations.

Serbia is now in transition from poor economy to a welfare state, in transition from unsecured to secure system of registration, from unreliable to an up to date property register, with clear, safe and guaranteed ownership rights. This road is long and treaded with obstacles, but has to be taken. The economic growth of the country cannot be imagined without reliable, secure and efficient source of information concerning real property. In other words with reliable information about an asset and well implemented legal framework, real estate is no longer just a physical object, it becomes a ground for future investment and production of new capital.

At present the government of Serbia is undertaking measures to meet the European standards and values in real property sector through implication of the concept of legal reliability and predictability, the transparency principle, the principles of accountability, efficiency and effectiveness. However, the corresponding legislation needs to be improved, the procedure for registration of land units and land rights should be simplified and accelerated. In particular, Serbia needs to make the cadastral system suitable and attractive for future economic investments. Real properties must be transformed into capital in order to help the economy to rise to a new level. In 2000 Serbia initiated the modernization of a property registration system that is still going on.

2. The Serbian Efforts to Establish Modern Education System of Surveyors

In 2002 the rules for private practice in Serbia were established and since then experiences of market surveyor's position were taken and analysed. To improve actual curriculum, DGG organized a questionnaire in which about 40% of private companies were included. We obtained a very clear picture of their position and opinions related to their work conditions and influences of

professional education on their job success. We saw that the surveyors have been asking changes and all of them were aware of need that permanent education (lifelong learning) should be normal. We use it as an argument for the improvement of the education process in Serbia.

In 2002 there were only 92 private companies in Serbia in which 500 surveyors were employed. Now, there are 740 surveying companies with 2000 workers. They work on free market and apply public tenders to get jobs. Most of them work in projects related to boundary formation, real estate transfer or topographic surveying for urban purposes. More than a half are engaged in cadastre.

Until 2006 in Serbia there was only one place in which students could take academic degree in surveying - FCE. Now, we have two places. It was one sign else that the old curricula at FCE must be changed, and last occasion for new suitable education program, the Tempus project offered . We knew that it was not possible to do that easily and we found reasonable that it should be prepared with the help of well experienced university respective staffs in land surveying.

At the beginning of the new challenge we were aware that to achieve the objectives and establish a good real property market in reality is impossible without new type of specialists who will possess legal, economic and surveying knowledge related to land and real property. In other words, such professionals shall be well familiar with the following key issues of real property sector such as:

- Policy issues, i.e. when efficient and effective policies with regard to development of land markets are to be developed and their implementation is monitored,
- Legal issues – national cadastre and land registration laws that must be precise and must harmonise with other related laws and comply with international and European regulations and standards,
- IT issues – technological developments is also of crucial importance, especially the balance between latest state of the art on international basis and the necessity of its implementation, and
- Financial issues – the development of a functioning land market involves huge financial means, from the state and / or from the private sector.

For development of a functioning land market all these key issues must be addressed by modern university training programme.

3. The Main Characteristics of the New Master Programme, its Aims, Outcomes and Study Rules

The process of integration of Serbia into the European Union, initiated in 2000, offered the opportunity for qualitative reform of higher education, as well as for restructuring of the current educational system in accordance to Bologna objectives. In 2001 the Serbian Ministry of Education and Sport declared establishment of a modern system of higher education as its main goal for the on-going reform of higher education. Following that goal, the new Higher Education Law was passed (2005), National Council for Higher Education was established (2005), and Accreditation and Quality Evaluation Commission was formed (2006).

The FCE as the oldest and the most important education institution in this area here, seeks a leading role in development of new educational programmes not only in geodesy and geoinformatics but also in land management and cadastre. Having taken into consideration the on-going educational reform at UB as well as the new Higher Education Law and changes in the society in general, it has been decided to develop a new master programme based on the current undergraduate programmes in geodesy and geoinformatics and fruitful cooperation with Royal Institute of Technology (KTH). The programme shall pay attention to legal and economic questions especially related to land consolidation and urban/suburban land development. The FCE has high expectations from this new master programme in terms of a growing interests among future national and international students (especially Balkan region), in terms of increased competence of Faculty teaching staff and therefore, of quality of education in general, and of strengthened cooperation between the UB and participating EU universities through finding mutual interested research topics. Moreover, we hope the Faculty will increase its level of technical support of the whole educational process. Apart of the European Higher Education Area objectives (competitiveness, adaptation to new labour market conditions, reinforcing European citizenship, reinforcing shared values) adoption with this new master program we honestly want to accept the specific Bologna objectives (readability and comparability of degrees, adoption of a two-cycle

system, establishment of a common system of credits, removal of obstacles to freedom of movement of students, quality assurance in higher education and promotion of European dimensions in higher education).

New master programme is a result of co-operation between three European universities – Royal Institute of Technology, Helsinki University of Technology and University of Ljubljana and two domestic institutions – Faculty of Civil Engineering and Republic Geodetic Authority. The Master's Programme - Land Law and Economy profile aims to qualify students in land development, economic development, law aspects, socio-political organization, and environmental sustainability in an international context by using an interdisciplinary approach to teaching. After successful completion of the program, students will receive the Master of Science (MSc) in Land Law and Economy academic degree - which will qualify them for professional work and scientific research. This academic degree will enable students to enter PhD programs, also.

The Master's Programme in Land Law and Economy - is a four semester program. The first semester introduces students to the area of law and gives them some basic information on property market, geographical information systems and project methodology. In the second semester students are trained in land cadastre, land consolidation, urban land management and receive knowledge in real property investment. In the third semester students continue their education choosing the courses which give them more managerial skills and exercise in group work doing projects in urban planning or real estate. At the end of the third semester students spend two weeks in adequately chosen geodesy office where they are faced with practical problems of the profession. The fourth semester is dedicated to the Master's Thesis.

Classes and practical work are structured into units. The units are composed of lectures, seminars and practical work. The method of teaching is suited to the contents of the course and modern technology is used in education. The lessons are organized in a modern classroom specially equipped for this program (Center for Land Management - CLM) and each student is provided a personal computer. The objective and contents of each unit are presented in MSc Handbook, as a guide. The detailed program for each unit and unit-requirements are outlined in the unit specifications which will be handed out to the students at the beginning of each unit. In order to pass a class-unit, students must actively participate in class work, present a written or oral presentation and/or pass the final exam with being accredited at least sufficient passing mark.

The Master's programme also includes an integrated full/time internship period, related to Land Law, Economy and Land Management. The internship takes place between the third and fourth semesters. The Faculty is responsible to find internship placement. Students are also encouraged to arrange their internships by their own efforts in case of which they will be advised by their supervisor in accordance with their academic profile and interest. The aim of this activity is to give students the opportunity to apply their theoretical knowledge to the practical work in public and private institutions dealing with cadastre transactions, land valuation, land consolidation, urban and rural land management, etc. During the external practice, they are expected to start their project as a separate unit in this area and which is expected to be the base for master work. The minimum length of internship is two weeks.

During the last semester, students must write the Master's Thesis under supervision of a faculty professor. A total of 30 ECTS credits are assigned to the successfully completed Master's Thesis. The time between the official beginning of writing the Master's Thesis and its completion must not exceed 3 months and will require a full-time involvement. Students' choice of topic for their Master's Thesis should be done in close collaboration with their advisers. They are encouraged to write their Master's Thesis on a topic focusing on practical issues

In order to register for the official start of writing the Master's Thesis students need to fulfil the following requirements:

- Having successfully completed all unit requirements;
- Produce proof for two week internship period; and
- Meet the registration deadline which is 3 months before the last day of semester 4;

The latest possible date to hand in the completed Master's Thesis is the last day of semester 4. Master's Thesis could be written in Serbian or English.

Student's performance will be assessed throughout the Master's Programme. All work during the study is structured into units with their

No.	Courses/Semesters	7	8	9	10
		ECTS	ECTS	ECTS	ECTS
1	Real Property Law	7			
2	Environmental and Planning Law	6			
3	Property Market	5			
4	Geographic Information Systems	7			
5	Elective course 1	5			
6	Project Methodology		5		
7	Land Development and Consolidation - basic		5		
8	Real Property Investment Analysis		5		
9	Real Estate Cadastre 2		5		
10	Urban Land Development		5		
11	Elective course 2		5		
12	Land Development and Consolidation – continuous			5	
13	Real Property Valuation and Taxation			5	
14	Elective course 3			5	
15	Elective course 4			5	
16	Elective course 5			4	
17	Elective course 6			4	
18	Internship			2	
19	Master Thesis				30
	Total	30	30	30	30

Table 1: MSc curriculum – Land law and economy profile

	Course name	Elective course					
		1	2	3	4	5	6
	Project management	+		+			
2	WEB GIS	+		+			
3	Geodesy in space and urban planning	+		+			
4	Negotiation and communication		+				
5	Rural Land Development		+				
6	Infrastructure				+		
7	Natural Resources				+		
8	Environmental Protection					+	
9	Professional English					+	
10	Real Estate Project						+
11	Geodetic Project in Urban Planning						+

Table 2: Elective courses

respective credit points. The number of credit points assigned to each unit reflects the workload for the student in order to complete the unit in question. The weight of individual units corresponds with the European Credit Transfer System ECTS. The success of a student in mastering a subject shall be continually under scrutiny and shall be expressed in points. By complying with the pre-examination obligations and by passing exams a student may earn 100 points maximum. A study programme establishes the ratio of points earned through pre-examination obligations and those earned at the exam. The pre-examination obligations shall account for 30 points minimum and 70 points maximum. The success of a student at the exam shall be expressed from grade 5 (failed) up to grade 10 (excellent).

An exam shall be consolidated and taken orally, in writing and/or in a practical manner. It should be taken at the seat of a higher education institution and/or on the premises specified in the work permit. The Faculty may make arrangements for taking exams outside its seat if so required by the nature of the subject involved. A student shall take an exam immediately upon completion of the course in that subject. The examination periods shall be in January, April, June and September. If a student fails an exam, he/she shall have the right to take the exam two more times during the same academic year. Exceptionally, a student who has one exam remaining from the study programme of the year he/she has enrolled in, shall have the right to take that exam in the subsequent examination period prior to the beginning of the following academic year.

Successful completion of all requirements of the Program means that students have passed the Master's Exam. The person who finishes the graduate academic studies acquires the academic title – graduated, with the name of the second degree of graduate academic studies in a corresponding area – master. In addition they are given Diploma Supplement with listing of individual units and grades received throughout the Master's course as well as the topic of their Master's Thesis. The diploma and the Supplement Diploma shall also be issued in the English language.

4. Sustainability of the New Master Programme

- Talking about sustainability of the new master study programme – Land Law and Economy profile, we can account:
- Financial sustainability will, first of all, be achieved through the financial support of the state. It means that new Master programme shall be accredited by the Ministry of Education. After successful accreditation and introduction of the programme into universities' curricula, it will be financed on regular basis as other study programs at UB. Since new Master programme will meet the modern requirements of the society, we assume the high interest among potential students to enter this programme.
- Centre for Land Management as a new organization unit formed under the project will ensure sustainability by providing retraining courses for professionals from the Republic Geodetic Authority and other relevant governmental authorities in the future. The Centre for Land Management will continue its activities after the project ends. The training courses at the Centre, which are planned in the future will be run on commercial base and will ensure the financial sustainability of the Centre.
- The new MSc program will be sustainable as new curriculum and courses are developed in accordance with the educational standards of Serbia, the requirements from professional practice and experiences of three European Universities.
- Trained teaching staff will guarantee institutional sustainability of the project.
- The involvement of Republic Geodetic Authority will ensure that the new Master programme is relevant to the labour market and covers land management problems in Serbia.
- The involvement of the students graduated so far at KTH into teaching process at UB will assure further development of the new Master programme and application of modern teaching methodologies at FCE. The graduates will become a bridge between KTH and FCE and will facilitate international cooperation in education and R&D.
- The leading position of FCE in Serbia and its experience in professional education is one more valuable asset.

5. Conclusion

The new master programme at Faculty of Civil Engineering prepared with the help of three European Universities guarantees that the content of the programme is familiar with European experiences in this area. We hope that this fact should be very important argument that we are at the good road. Taking into consideration all

aspects of very good cooperation with three European institutions during this Project, we accepted European harmonization education principles: 1) put quality assurance systems to be comparable, 2) take one step towards compatibility of the European two-cycle system, readability and recognition of degrees, recognition of the need to balance the objective of competitiveness with the improvement of the social dimension in European higher education, 3) accepted reaffirmation of the principle that higher education is a public good and a public responsibility, 4) go one step further into the need for development of lifelong learning in higher education, and 5) give emphasis on the priority of academic values and academic autonomy in Serbia.

Biographical Notes

Branko Bozic:

From 1982 to 2006 employed at the Military Geographic Institute in Belgrade. Work activities related to surveying lasted until going to the Faculty. Since 2000 assistant professor at the Department of geodesy at the Faculty of Civil Engineering in the area of surveying. From 2003 to 2005 head of the Institute for Geodesy at the same Faculty. From 2001 to 2005 head of Belgrade's Geodetic Society. Since 2006 as associate professor engaged in several subjects related to the adjustment and calculation. During the same period head of Belgrade's other technical discipline designers in Serbian Engineering chamber. Local coordinator in TEMPUS III project – MsC study programme in Land Law and Economy. Author of more than 30 articles and projects and editor of 3 university books.

Zagorka Gospavic:

Born in 1959. Graduated in 1983. as Dipl.-Ing. in Geodesy and obtaining doctorate degree in 2002., both from Belgrade University, until 1988. Teaching assistant at Belgrade University. Since 2003 Assistant Professor of Geodetic and Project Management. During the period 2003 - 2007 working as members of board directors of Republic Geodetic Authority in Serbia. Delegate on the Commission of Surveying Technical Academy and Delegate on the Commission of Surveying Technical Academy. There are 21 works published, 6 of those were published and presented in the international symposiums, while 15 were presented in local conferences internationally and nationally relevant and main editor of Serbian geodetic journal 'Geodetska sluzba'

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Professional competences of Surveying (Geodetic) Engineers




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Abstract

Globalisation, as a process and a condition of the space for higher education, dictates the guidelines for development of study programmes. A special challenge has appeared in the fields depending on the fast developing information technology, including spatial information science, and in the fields of licensed disciplines such as land surveying. Due historical reasons, surveying, geodesy and cartography have been often part of a common academic study programme in the most European countries. The competences of classical surveying, geodetic, and cartographic higher educational programmes have been changing and new areas are developing rapidly. In the article, we focused on competences of the surveying (geodetic) higher education in today's society, where findings of actual international discussions are summarised. Furthermore, the renovation of higher study programmes of surveying in Slovenia is presented (official translation is geodesy), which has been partly influenced by historical facts, and current European and international guidelines in higher education of surveying and geodesy. In this respect, the competences of the new higher educational programmes of surveying (geodesy) in Slovenia are presented.

Keywords: Surveying, geodesy, higher education, competence, Slovenia

1. Introduction

The new, fast developing technologies and methodological approaches in different professions are inevitably entering the everyday practice, which dictates the guidelines for study programmes in the higher education area all over the world. There is not only development in technology but also social-economic conditions and guidelines in higher education, research and science are changing, which demands the renovation of current curricula [1]. Therefore, the technological development is not the only driver in developing professions and their competences. A special problem for developing or renovating higher educational programmes has appeared in the fields depending on the fast developing (information) technology, and in the fields of regulatory (licensed) disciplines, where surveying is characterized by both challenges. In general, the surveying profession has to adopt and follow the spatial information revolution and at the same time endeavour to maintain traditional services. Since surveying has been traditionally related to the land, additional phenomena are shaping the surveying professional competences, such as need for sustainable spatial development and sustainable development in general.

The study objects in surveying, geodetic, other spatial and land related studies have changed and broadened a lot during the last decades. There have been several discussions on the topic of surveying (also geodetic, geomatics) higher education in the last years on national, European level as well as worldwide (see [2], [3], [4], [5]). Because of historical reasons, and because of methodological and technological dependence, surveying, geodesy, cartography and spatial information science are often included into a common study programme of surveying, geodesy, geomatics, geoinformatics or similar. The fields covered by the surveying (geodetic) study programmes are diverse among the countries. In addition, surveyors, geodetic engineers in some countries provide professional services, which are provided by different professionals in other countries. However, the list of functions, activities carried out by them is common to most countries, at least in Europe.

2. Surveying profession and competences

The history of surveying goes back to the centuries when man permanently settled the land. The importance of this crucial natural resource forced the human to develop technical and methodological solution for evidencing and registering the land, and consequently protecting of rights on land. On the other side, man has been interested in learning about the Earth from the old. Geodesy was developed in order to understand natural phenomena which are related to the size,

shape, gravity field of the Earth. Terrestrial surveys and geodetic measurements have been the fundaments for determining size and shape of the Earth and position of spatial phenomena. Together with astronomy, geodesy is among the oldest sciences and is the oldest geoscience. However, surveying and geodesy were based on the same principles – even more, the relative local and absolute positioning was usually performed with the same instruments and both disciplines complemented each other. Furthermore, surveying and geodesy provided the basis for modern mapping. These three disciplines got a common higher educational curriculum, at least in the most European countries [6].

The nature of surveying, geodesy, cartography and related fields has been changing because of new technologies, methodologies and growing demands of the society for spatial data and information related to the geographical location. Consequently, the competences of the surveying, geodetic engineers, and cartographer have been changed in the last decades and the new definitions of surveying profession were formed. The international trends of surveying educational profile is much more focused on land management and administration than it used to be, where the areas of measurement science and land management is supported/associated by interdisciplinary paradigm of spatial information management. Such a professional profile aims to be able to design/build/manage the natural and built environment and connected spatial/legal rights and restrictions (see [7]).

2.1 Competency standards and challenges for surveying profession

Competency can be defined as the ability to apply knowledge and skills to produce a required outcome [8]. It is the ability to perform activities within an occupation; to function as expected for employment; and ability to do a job under a variety of conditions, including the ability to cope with contingency. Competency is expected to develop from the three components over an employee's lifetime, comprising education, training and experiences. Certifying a certain level of competency is separate from what is described variously in different countries as legal registration or licensure, which is legally enforceable registration of an individual by a regional jurisdiction. Competency cannot be directly observed; hence it has to be inferred from indirect evidence and is therefore performance based. Competency is defined by a set of standards, which define the level of attainment at various levels [8].

The benefits of professional competency standards are that they can test the effectiveness of professional education and training, improve recruitment, identify training gaps, lead to improve efficiency, worker safety and employee retention. In addition, the competency standards can be understood as the answer to professional organizations, where the intention of the European Commission for securing the free movement of professionals within the single market place of the EU has to be emphasized on the European level. Furthermore, the World Trade Organization (WTO) aims to support the global market place for services, for which mutual recognition of qualifications is of big importance (see [9]).

Focusing on surveying profession, the tasks of the surveyor's profession vary in the different European countries, just as in other parts of the world, but the profession can be said to originate in mapping and in the definition of boundaries for real estate units and other spatially based rights. The emphasis on these activities varies between countries and from the historical perspective. The interesting point, though, is that an original knowledge of real estate has enabled the surveyors to develop new activities such as legal counselling, planning, land development, property valuation and property management. Meanwhile technical progress has been rapid. Internationally, then, the surveying profession, as a whole, has a wide range of professional practices that can change according to how readily new tasks can be assimilated [10]. According to FIG definition, the surveying profession is not focused only to the technical aspects. On the international level (FIG) it is argued that any future educational profile of surveying should comprise measurement science and land management, and that it should be supported by and embedding in a broad interdisciplinary paradigm of spatial information management [3].

2.2 Higher education in surveying (geodesy) – European contents

The past years have been a time for preparation and implementation of new curricula in the history of the European higher education. The main concern has been on the reformation of the structure of national higher education systems in a convergent way in accordance to the Bologna Declaration [11]. The main goal of the Bologna

Declaration has been to create a European space for higher education in order to enhance the employability and mobility of citizens and to increase the international competitiveness of European higher education. Three main priorities of the Bologna process are [12]:

- introduction of the three cycle system (bachelor, master and doctorate),
- quality assurance, and
- recognition of qualifications and periods of study.

Although the higher educational programmes have to be flexible and follow the newest technological trends and needs of the society, and are therefore denoted with the constant called "change", the transition to three tire system of the academic education according to Bologna provided an opportunity to introduce novelties or at least changes in a larger scale, which was also the case in Slovenia. Based on competences of the higher educational programmes, which were defined on questionnaires for graduates in surveying (geodetic) engineering and employers in Slovenia, and following the main guidelines of the surveying profession on the international level, the new study programmes have been introduced at Department of Geodesy, Faculty of Civil and Geodetic Engineering, University of Ljubljana.

3. Higher educational programmes of surveying (geodesy) in Slovenia

3.1 Historical background

The profession of surveyor in Slovenia has its roots in the far 18th century where Slovenia was part of Habsburg monarchy. The professional education programme of surveying in former Carniola was adjusted to the need of technical support in Idrija mercury mine. Towards the end of the 18th century, the initiatives for establishment of the university in Ljubljana on the model of Vienna University were getting very strong. In that time, some study programmes were performed in Ljubljana, and in the framework of the humanistic educational programmes also surveying was included; but the contents was dependent on lecturers. The surveying course was mainly carried out in the framework of the tradesman's education, adjusted to the needs of the society (land measurement and surveying mapping). Study of surveying in Ljubljana was again introduced in the period of Ilirian provinces (1810) but remained only for two years. Since then, only periodic educational programmes of cadastral surveyors and cartographers were organized in Ljubljana, while for higher degree Slovenes had to study at foreign higher schools and universities [13].

In 1919 the University of Ljubljana was founded. In the framework of the university, the permanent higher education of surveying (geodesy) was introduced. There were some changes and also interruption of performing this study programme in the following 25 years. However the German (Austrian) influence shaped the study programmes at the university. Right after the World War II (1945/46), the Department of Geodesy was established at the University of Ljubljana, which introduced 9-semester study programme of surveying, mainly dedicated to the needs of the post-war economy. Already in 1956 the narrow oriented study programme changed and courses from public infrastructure, urban planning and spatial development were included, and in 1957 the higher educational study programmes of surveying (geodesy) got part of university study programme at the new Faculty of Architecture, Civil and Geodetic Engineering [13].

Today, the academic education of surveying (geodetic) engineering is still carried out in Slovenia only at the University of Ljubljana, Faculty of Civil and Geodetic Engineering. Mainly because of historical reasons, but also due needs of the society, the study programmes of surveying (geodesy) in Slovenia cover the fields from geodesy, land surveying, to spatial data management and land management. Since the Slovenian world "geodezija" usually represents all these fields, some dilemmas appear when translating these study programmes in English. In the paper, these fields are mentioned as "surveying (geodesy)", except the official translation of the programmes, where the world "geodesy" is used. At the moment, the study programme is in transition from the old study programmes to tree tires study programmes following the Bologna guidelines. Recently, the study programmes have been based on German higher educational system. The graduates at the "University study programme of Geodesy" (9 semesters, the last enrolment in the 1st semester in 2008/09) have got title "university diploma engineer of geodesy", which is comparable to a master's degree in countries that use consecutive system of higher education. The "Higher professional study programme of Geodesy" (6 semesters, the last enrolment in the 1st semester in 2007/08) is comparable to study programmes at Universities or Colleges of Applied Sciences (in Germany: Fachhochschule). Its diploma may be compared to the degree of a bachelor at honours

level. Diploma at this study programme entitles the graduate ("diploma engineer of geodesy") to practice in nearly all fields of surveying with the exception of certain fields of geodesy and surveying [14].

The above mentioned programmes are not old, because the previous higher educational study programmes of surveying (geodesy) were renewed in the framework of Phare-Tempus Programme (1996-1999). The main changes in the study programme at that time were incorporation of new courses of the principles of law and economics as well as land management and real estate valuation. However, already at the end of the project in 1999, it became obvious that changes of curricula were in fact the start of a permanent process of changing. The rapid development of science and technology, and new dimension of the surveying profession demanded that the started process should rather be a cyclical one. Therefore, as a more intangible outcome of the Phare-Tempus project, the agreement prevailed at the Department of Geodesy that the continuous attendance of surveying study programmes are necessary. In this context, the last Bologna changes make a logical continuation and the study programmes of surveying (geodesy) are having been replaced by Bologna study programmes. However, contrary to experiences in some Western European countries, in Slovenia there has been solid interest in surveying (geodetic) study programmes in the last decades and the number mainly varied because of changing enrolment regulation – the limitation of number of students in the first semester, which has been becoming stricter recently (Fig. 1).

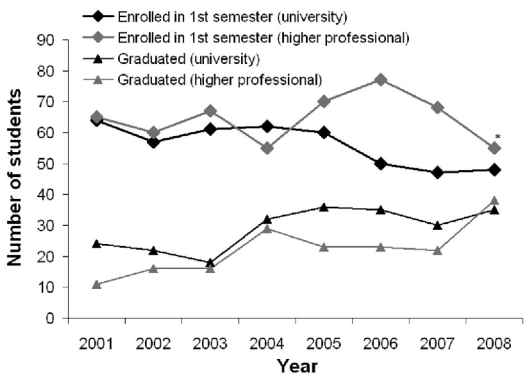

*Fig. 1: Number of students in the 1st semester and graduated at the University of Ljubljana (Slovenia) at the university- and higher professional study programmes of surveying (geodesy) in 2001-2008 (*in the academic year 2008/09, the new professional bachelor study programme was introduced instead of the old higher educational programme).*

3.2 Renovation of higher education of surveying (geodesy) in Slovenia

The adoption of Bologna declaration at the Faculty of Civil and Geodetic Engineering, University of Ljubljana, which is the only institution in Slovenia that carries out the academic education in surveying (geodesy), started in 2004 with preparation of new study programmes at all three levels: Bachelor, Master and PhD. This gave an additional opportunity to adjust the higher educational study programmes to the needs of the society. The main idea of new study programmes follows the Bologna guidelines where learning outcomes are instruments that make studies more compatible and comparable. However, one of the most important factors in renovating study programmes was to follow the need of the society.

For this purpose, the analysis of the situation about the surveying (geodetic) profession in Slovenia was performed, based on two questionnaires: for graduates (in 2005; see [15]) and employers (in 2006; see [16]). All of 98 graduates at Department of Geodesy in Ljubljana, who answered questionnaire, had no problem to find a job after they graduated and were employed at that time. Fig. 2 shows fields of work of graduates in surveying (geodesy) (graduates at the University study programme of Geodesy and graduates at the Higher professional study programme of Geodesy) in Slovenia. In general, diploma engineers of both study programmes suggested that the topics of real estate registration, real estate management, spatial informatics, law and business economics should be included in the new surveying study programmes in the future (see also [14], [15]). The general opinion of Slovene employers (50 answers) was that graduates in surveying (geodesy) are rather prepared for work in their company regarding their professional knowledge and skills. The main subjects of critique of employers in private companies were regarding graduates' knowledge and skills in business management, organization and ability to be self-critical and critical in general (see also [14], [16]).

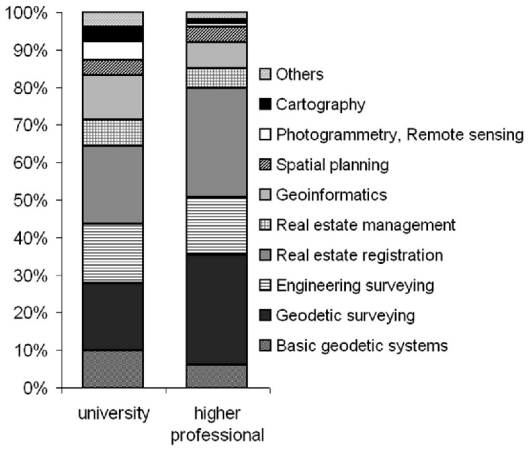

Fig. 2: Field of work of geodetic (university) diploma engineers in Slovenia [13].

As characteristic in the most European countries, the need to change the focus in surveying education from predominantly an engineering focus to a more managerial and interdisciplinary education was shown also in Slovenia. Based on the results of the research (questionnaires) and therefore taking into consideration national needs beside the global trends in surveying (geodetic) profession, the study competences of new Bologna study programmes in Slovenia has been introduced. This provided the main basis for formation of new study programmes at the Faculty of Civil and Geodetic Engineering of University of Ljubljana. It was decided to introduce four study programmes at the Department of Geodesy at the first and second level:

(1) "Professional Bachelor degree study programme Technical Real Estate Management" (introduced in 2008),

(2) "University Bachelor degree study programme Geodesy and Geoinformation" (will be introduced in 2009),

(3) "Master degree study programme Geodesy and Geoinformation" (planned in 2010), and

(4) "Master degree study programme Spatial Planning" (planned in 2010).

In addition, a special attention was given to the doctoral study programme (3rd level) where advanced student will get opportunity to join advance courses in two of three branches in the framework of common PhD study programme "Built Environment" at the University of Ljubljana, Faculty of Civil and Geodetic Engineering. Three study and research branches of PhD study programme "Built Environment" are "Civil Engineering", "Geodesy" and "Spatial Planning and Land Management", where the last two makes a direct upgrading of both above mentioned master degree study programmes at the Department of Geodesy.

Names of new study programmes were selected to reflect the last situation in profession (new technologies) and society, what can contribute to promote the profession and increase the affirmation of the profession [14].

3.3 Proposed competences of the Surveying (Geodetic) Engineer in Slovenia

As already ascertained, the educational competences represent only part of the professional competences, which are resulting from life-long learning and practice. However, the society (employer) demands some certain knowledge and skills already from the higher education in order to get the profile of graduates to be able to develop and upgrade his/her professional quality. The competences of introduced Bologna study programmes (at the first two levels) at the Department of Geodesy, Faculty of Civil and Geodetic Engineering, University of Ljubljana were defined by knowledge and several skills, the graduates should acquire during study period through learning and practice. In general, the competences can be summarised as described in Table 1.

	PROFESSIONAL COMPETENCES	BA TUN	BA GG	MA GG	MA SP
	GENERAL COMPETENCES				
	Understanding and solving technical and/or business related problems using high level thinking skills (applying theory into praxis); the capabilities for individual learning, critical evaluation of learning sources;	X	X	X	X
	The possession of appropriate personal and professional values, behaviours and responsibilities; the abilities to make sound judgements in a professional and ethical context;	X	X	X	X
	Advanced language, numerical and IT literacy; communication skills and appropriate public appearance; comprehensive knowledge of related fields and the ability for interdisciplinary work;	X	X	X	X
	Understanding and using scientific methods; the abilities to define, research, understand and advanced solve practical and theoretical problems, principles;			X	X
	Understanding and critical evaluation and use of professional/scientific literature; the abilities to critical, analytical and synthetic thinking; the abilities to professional and scientific expression;			X	X
	KNOWLEDGE (PROFESSIONAL SPECIFIC) COMPETENCES				
	Understanding the role of surveying, geodesy, spatial data in the society; the familiarity with spatial data acquisition, data sources, data quality.	x	X	X	x
	Understanding the role of technical real estate management for the sustainable development; the familiarity with spatial data acquisition, data sources and its quality as support for spatial planning and spatial policy.	X	x	x	X
LAND MEASUREMENT	Comprehension and professional use of advanced technology and methodology in surveying measurements;	X	X	X	
LAND MEASUREMENT	Maintaining the basic geodetic systems; designing, organizing, managing, implementing less exacting measurements; land cadastre measurements;	x	X	X	
LAND MEASUREMENT	Designing, establishing, maintaining, renewing of basic geodetic system; performing of advanced, precise geodetic measurements; developing advanced geodetic technology and methodology; monitoring the position of natural and man-made objects in space and time.			X	
LAND MEASUREMENT	Advanced comprehension and critical monitoring of geographical and human environment, understanding of graphical presentation of the space;	X	X	X	X
SPATIAL DATA MANAGEMENT	Understanding of conceptual modelling and model presentations of the geographical environment, including intangible entities;	x	X	X	x
SPATIAL DATA MANAGEMENT	Designing, managing, maintaining geographical, cartographic, land information systems; advanced problem solving and research in the fields of topography, cartography, photogrammetry and remote sensing.			X	
SPATIAL DATA MANAGEMENT	Solving practical problems from the fields of spatial and land related data acquisition, valuation, presentation and maintenance; use of surveying and other spatial/land related data independently (also in GIS);	x	X	X	x
SPATIAL DATA MANAGEMENT	Understanding, planning, implementing advanced spatial data acquisition; developing advanced solutions in spatial data management, IT solutions;		X	X	
SPATIAL DATA MANAGEMENT	Understanding, designing and maintaining real estate recording/multipurpose land information systems;	X	X	X	
SPATIAL DATA MANAGEMENT	Registering the real estate: determining, presenting and recording technical characteristics of real estate and rights referring to the real estate (land).	X	X	X	

LAND MANAGEMENT	The familiarity with legal framework of surveying, spatial data acquisition, real estate recording and management; Professional participating in planning and implementing spatial interventions, spatial planning, urban and rural development; and in land management;	X	X	X	X
	Valuation and appraisal of different values of real property (market value, investment value, cost value, property rent etc.	X	x	x	X
	Studying natural and social environments and surveying of land resources; critical use of spatial and land related data (physical, economic, environmental, social attributes etc.) in spatial planning (urban and rural);	x		x	X
	Policy making in spatial planning (local, regional, national), urban/rural and land development; considering also public opinion;				X

Table 1: Educational competences of new study programmes at the Department of Geodesy, Faculty of Civil and Geodetic Engineering, University of Ljubljana (Legend: BA TUN – Bachelor study programme of the first degree Technical Real Estate Management, BA GG – Bachelor study programme of the first degree Geodesy and Geoinformation, MA GG – Master study programme of the second degree Geodesy and Geoinformation, MA SP – Master degree study programme Spatial Planning; X *– full competence, x – limited competence).*

In performing in the Table 1 mentioned competences, the graduates of new study programmes take relevant legal, economic, ecological and social viewpoints affecting different projects in surveying (land management, land measurement and spatial data management) projects. The common competences of graduates in the study programmes are also capability for gathering and evaluating land information and other spatial data, and to apply this information for the purpose of planning and managing the land, sea and structures, as well as the objects on them. Furthermore, the graduate will be qualified for developing geospatial services adapted to various users' groups.

4. Conclusions

The term professional competence relates to the status of expert and cannot be achieved only through university graduation as well as it cannot be achieved solely through professional practice [7]. However, the higher education is one of the important parts in developing professional competences.

Based on experiences in Slovenia, we would like to emphasize that the structure and the content of the higher educational curriculum have to be flexible in order to quickly adapt to developing technology and changing demands of the society, profession. The study outcomes, competences of graduates, seem to play an important role in developing the profession in the future. It is widely recognised that the adequate competences of the higher education are crucial not only to the renovation of study programmes but also to the future of international mobility of students, researchers and teachers in every profession.

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The Role of the Engineering Consultant for Surveying in Foreign Projects

Michaela Ragoßnig-Angst, Vienna

1. Background

Austrian engineers have been renowned as experts, not only domestically, but also abroad for centuries. One only has to think of names such as Viktor Kaplan, Joseph Ressel, Carl Ritter von Ghega or Ferdinand Porsche. But the country has also produced a number of prominent geodesists: Joseph Liesgang, for example, made a major contribution to land surveying during the era of Maria Theresia. Between 1761 and 1765, he oversaw the surveying of the Vienna meridian, which extends 320 km from Brunn am Gebirge via Vienna to Varaždin. The starting point for the measurements was a 12km long section of what is today Wiener Neustädter Strasse, which was then known as the Neunkirchner Allee. From 1785, he headed the work on the Josephinen Kastaster, the land register, in Galicia.

Another renowned Austrian geodesist was Simon von Stampfer who played a significant role in the federal and provincial surveying between Bavaria and Austria in 1819. During the measurement of the well known meridian triangulation arc, the so-called Struve Arc, which extends from Hammerfest (near the North Pole) to Izmail (near the estuary of the Danube into the Black Sea), Stampfer undertook the conversion of the Russian etalons to the Austrian fathom (Klafter) standard. He also published logarithmic-trigonometric tables for universities which were used throughout the entire empire [1] [4].

Today, Austrian engineers are also renowned for being reliable and competent. The outstanding standard of education and the high technical status of the profession in Austria are key factors when it comes to projects abroad.

2. The role of the engineering consultant for surveying

In principal, the geodesist provides land-related information which serves as a basis necessary for various commercial activities, further planning work, for infrastructure projects and for buildings of all sorts, for agriculture, environmental protection and for the preservation of the cultural landscape. The EU has indisputably brought fundamental changes to all professions; more competition, however, also means more opportunities in new markets. The limited geographic size of Austria places limits on the domestic market, making it both an opportunity and a necessity to expand into new markets. If one goes back to the 1990s and the period immediately after the fall of the Iron Curtain and compares the Eastern European countries of then with the status quo today, then one can see the rapid technological and economic development which has taken place. This was only made possible by western investors and lenders who financed and implemented necessary projects – projects that also require reliable partners.

Every projects starts with a search for suitable land and sites. The clarification of boundaries and ownership rights are the core activities of the engineer consultant for surveying. In several countries there are still no land registers and restitution issues remain unresolved. It is still possible, however, to reconcile the (mostly complex) requirements of investors with the local conditions in these markets.

Austria has had an exemplary land register system since the 19th Century which is admired worldwide. The quality of the system is highlighted by the fact that the majority of the countries in the former Austro-Hungarian Empire have again introduced this system and other countries such as Poland and Russia have also based their systems on the Austrian one. Austria is also playing a pioneering role in the modernisation process. The Austrian land database is serving as a model for modern solutions in several Eastern European countries [2].

This system-based knowledge is an advantage for engineering consultants for surveying working on projects in these countries. We often come across old land register plans that we are accustomed to. In technical terms, the details contained on these old plans are soon understood, allowing us to focus on the considerably more difficult issue – the question of ownership.

3. Partnerships – one approach to implementing foreign projects

Since many investors often favour an overall solution for their technical projects, it is important to take the opportunity to enter into inter-professional partnerships with other consultants such as land planners, architects, cultural technicians, etc in order to be able to offer such comprehensive solutions. The future also lies in international partnerships. The realities of the EU demand such international networks, particularly when one considers that Austria is a small member state with numerous neighbouring countries. The main focus of this paper will therefore be on the countries of Central and Eastern Europe.

What were the reasons behind our company, Vermessung Angst, acquiring investments abroad and involving itself in projects? Following the setting up, in 1968, and experience in managing a medium-sized surveying office in Vienna, the founder of Vermessung Angst, my father Josef Angst, began to look beyond Austria's borders for opportunities to expand. He sought footholds in those countries enjoying the economic boom and, as a result, set up various international operations in Central and Eastern Europe as a supplement to the company in Austria. There were no plans to outsource Austrian contracts abroad in order to take advantage of the lower wages, nor was the idea to use Austrian personnel abroad to any significant extent. The central idea was simply to establish strong partnerships abroad, particularly in Eastern Europe.

In the course of the expansion of the EU, these partnerships have given rise to a wide variety of advantages. For example, it is important to have a local partner in the home country where the project will be implemented when submitting tenders for international projects. In addition, the lack of effective borders has created numerous synergy effects such as the simple exchange of instruments and equipment. This makes investments more profitable. A specialisation in various key areas on the part of the individual companies can also be advantageous.

It is difficult to manage foreign projects only from Austria. True to our firm belief that the whole is stronger than the individual parts, the partnerships and cooperations with local companies that Vermessung Angst has entered into have proven to be extremely successful. The following factors have played a role in this success:

- The most difficult task, and one which requires more than a little good luck, is in the selection of the right foreign partner. A decision has to be reached in a short period of time and it has to be the right one in technical, organisational and relationship terms. The possibility of failure can never be excluded, which is why you need to be careful with investments in the early stages. Training of the future partner at the offices of the parent company and getting to know the key personnel in one's own office has proven to be effective and reduces the risk of later failure.
- The relationship with the general managers in situ should be on the basis of a partnership among equals. Any form of dictatorial management should be avoided.
- Suitable profit-sharing models (in terms of revenues and profits) and a reasonable dividend policy are a means of binding general managers more closely to the company.
- Financial support from the Austrian company is something which should be confined to the early stages if possible. The foreign company must be able to finance itself in the short-term.
- Good training of the partners and leading employees during the company's first few years also appears to be a further important success factor. Another is constant controlling and monitoring of the situation.
- One of the tasks of the Austrian company is to pass on information regarding technical developments to the partner companies and also to ensure that these companies update their technical equipment to the extent that this is financially possible and prudent.
- It is also important to constantly communicate requirements and to define targets in terms of turnover and profits. The Austrian company should also be a source of ideas with regard to the companies' strategic direction.

4. Training situation in CEE countries

One key factor relevant to a partnership-based approach to implementing foreign projects is the local training situation. The following is a summary of our experience to date in this regard in selected CEE countries:

- Czech Republic and Slovakia

The training of personnel (particularly in the Czech Republic) is excellent. Many academics have even completed two degrees (mostly one technical and one commercial). The quality of the work is very high.

■ Hungary:

The level of training and technology is on a par with Western Europe. The quality of the work, however, is often only satisfactory.

■ Croatia:

Both the level of training and the quality of the work can be regarded as good.

■ Bosnia:

As a result of the brain drain associated with the recent war, the level of training at present is very poor. The quality of the work also suffers as a result and can only be regarded as satisfactory.

■ Romania:

An increase in terms of quality has been seen in all sectors of the Romanian market in the past three years. The quality of the work still leaves a lot to be desired in some cases. The personnel (particularly the younger ones) are, however, diligent and willing to work.

The importance of knowledge transfer is dependent on the relevant training situation.

5. Knowledge transfer: how can it be ensured that projects yield the desired results?

As mentioned above, the level of training and education in the field of surveying is generally high in Austria. University-based education in particular, especially at the Vienna University of Technology, compares well internationally according to the global ranking of natural sciences in 2008 [5]. This ensures that leading personnel continue to have the skills they need to meet the challenges of this profession.

More problematic, however, is the area of public-sector education for school leavers following the discontinuation of the surveying course at the technical college in Vienna. This is leading to a lack of adequately trained technicians in an industry which, to a great extent, is dependent on personnel with qualifications of this level. The only way of securing a practical qualification in this industry in Austria is to complete an apprenticeship. A surveying course is offered by the Chamber of Architects and Chartered Engineering Consultants to apprentices who have gained several years' practical experience as a means of completing their training.

This also presents a problem for employers in Austria's private sector. There are only limited educational possibilities at the level of surveying technicians. The only real option left in order to keep the skills of personnel updated and, ultimately, to underpin the profession's good reputation both at home and abroad, is to rely on in-company training.

Other European countries are also confronted with similar problems. In our experience, the engineering consultants are highly skilled, but it is difficult to find good technicians. One (part of the) solution can be knowledge transfer within partnerships.

Let's explore knowledge transfer further by means of an example:

An Austrian real estate investor commissions a survey of usable floor space in a shopping centre in Romania. Such assignments are still relatively rare in Romania, with the result that the personnel in this country are not up to performing such tasks. The situation in Austria in this respect is different. A wealth of appropriate requirement-specific knowledge has been established in the course of various past assignments of this nature. This experience can now be made available to the Romanian partner by means of knowledge transfer.

The first step in this case involved appointing a trained Austrian technician to work alongside the Romanian team during the initial project phase. When it was clear that the local team had understood what the task involved and was aware of the problems entailed, it was possible for the local personnel to complete the assignment.

The second step was the preparation of the plans. Although sample plans were made available, the first draft was not on a par with Austrian quality standards. This was followed by a week-long on-the-job training course in Vienna. The results of the training were very satisfactory and, consequently, not only had the necessary knowledge transfer taken place, but the local partner now has the skills necessary for further projects of this kind.

This is just one example of many, but highlights how knowledge transfer can work.

Last but not least, working in other countries is great fun since this constantly provides opportunities to broaden one's horizons and to meet people with completely different perspectives on life and radically different approaches to solving problems.

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On Computerising Geodetic Surveys in the Context of Higher Education

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Abstract

The external academic quality appraisal of Romanian higher education institutions in the fundamental subject area of Engineering Sciences and its respective study programmes is based on (reference) standards and performance indicators set by a number of documents. These are the methodology, the reference standards and the performance indicators list approved by the Government Decision no. 1418 of 11.10.2006, with which operates the Romanian Agency for Quality Assurance in Higher Education (ARACIS). There are also the specific standards applying to all fundamental subject areas, approved by ARACIS, in accordance with the Law no. 87/10 April 2006, Article 17.

Regarding of this Government Decision, the curricula must specify the volume in hours for teaching activities with students and the number of hours required for the student's individual training as well as the number of credits for each discipline, both for coursework and project work or other applied activities.

In order to analyse the quality of Romanian higher education for the "Geodetic Engineering" domain, in the field of *'Land surveying and Cadastre'* and the universities' role in training new experts in the field, we want to present the curriculum of a young university – 'December 1st 1918' University of Alba Iulia, in relation to a university with a long tradition of Romanian geodetic education – the Technical University of Civil Engineering, Bucharest.

Also, as computer technologies evolve rapidly, the training of future university graduates has to be tuned to the latest developments, so as to offer them better qualifications for the labour market. By this way, all the university including 'December 1st 1918' University of Alba Iulia and „The Technical University of Civil Engineering" of Bucharest through its Bachelor's degree programme "Territory measurements and cadastre", has included in the curricula a series of specialty disciplines that will help future geodetic engineers acquire competences in computerising geodetic surveys. The future graduates will also be able to adjust to the constant dynamics of this line of work.

The description of the curricula shows that surveying students, during the four years of study, acquire enough knowledge and practical skills to work with computers and specialized surveying software. These skills may increase the quality and productivity of the surveyor's work. They also become a huge advantage when using other computer software and other types of equipment in other surveying-related areas.

All these accomplishments are the result of the connection between theory and practice, of a syllabus that is competitive with the dynamics of development in the field of land measurement and cadastre and also of the ease in assimilating all new information in the field.

Trough the study of a wide range of topographic equipment and of computer software that are presently used in Romania and abroad, our young engineers are prepared to apply for jobs in Romania or in any member state of the European Union. They are familiar with or they can adjust very easily to the specific topographical and computer technology that they may be required to use.

As regards the access to further studies, the holders of a Bachelor's degree in Engineering will have access to Master studies and then to doctoral studies not only in Romania but also in the European Union or elsewhere.

1. The legislative framework for assuring the quality of Romanian higher education

The external academic quality appraisal of Romanian higher education institutions in the fundamental subject area of Engineering Sciences and its respective study programmes is based on (reference) standards and performance indicators set by a number of documents. These are the methodology, the reference standards and the performance indicators list approved by the Government Decision no. 1418 of 11.10.2006, with which operates the Romanian Agency for Quality Assurance in Higher Education (ARACIS). There are also the specific standards applying to all fundamental subject areas, approved by ARACIS, in accordance with the Law no. 87/10 April 2006, Article 17.

The following items of legislation were considered when the Specific standards were elaborated:

- Law 288/24 June 2004 on the organization of higher education;
- The Government Decision 1175/06 Sept. 2006 on the organization of undergraduate studies and on the approval of the list containing subject areas and undergraduate study programmes,
- The Government Decision 404/29 March 2006 on the organization of higher education;

Indicator	*Full-time courses, Distance education, Part-time courses*	*Evening classes*
Length of studies, of which:	8 sem.	10 sem.
Minimum semester length	14 weeks	14 weeks
Number of hours/ week	26 –28	21 – 22
Added length of practical activities	4 – 6 weeks	4 – 6 weeks
Length of practical activities dedicated to the preparation of the Thesis/Diploma project	2 – 3 weeks (during the last year of studies)	2 – 3 weeks (during the last year of studies)

Table 1: Length of studies and the volume of teaching activities.

- Law 87/10 Apr. 2006 on the approval of the Government Emergency Ordinance No. 75/ 2005 regarding the assurance of education quality.

2. Contents of education as a process

The educational contents in the fundamental area of Engineering Sciences contains the general standards common to all fundamental areas and forms of education approved by the ARACIS Council, to which the following specific standards are added.

The length of studies and the volume of teaching activities must be as shown in table 1.

The required total number of hours of activity organized according to the curriculum is between 3152 and 3376, for full-time courses, distance courses and part-time courses, to which the specialty practice is added. The minimum volume of practical activities is 240 hours.

The curricula must specify the volume in hours for teaching activities with students and the number of hours required for the student's individual training as well as the number of credits for each discipline, both for coursework and project work or other applied activities.

The curricula of the study programmes in the fields from the fundamental field of Engineering Sciences must contain the following categories of disciplines, with the following percentages (the percentages are calculated to the total volume of hours, the 240 hours of minimum practical activity included):

- fundamental disciplines, minimum 17%;
- disciplines of the study area minimum 38 %;
- specialty disciplines, minimum 25 %;
- complementary disciplines, maximum 8%.

3. A comparative curricula study

In order to analyse the quality of Romanian higher education in the field of 'Land surveying and Cadastre' and the universities' role in training new experts in the field, we would like to show the curriculum of a young university – 'December 1st 1918' University of Alba Iulia, in relation to a university with a long tradition of Romanian geodetic education– the Technical University of Civil Engineering, Bucharest.

'December 1st 1918' University of Alba Iulia, Romania was established in 1991. In 1997, the Bachelor's degree programme 'Cadastre' was introduced. In 2001, the long-term form of education for the same the programme was approved and in 2005, it changed according to the Bologna process, into a new programme called 'Land surveying and Cadastre', subject area: Geodetic engineering.

Currently, the approved curriculum for this study programme is shown in table 2.

Cr. No.	Designation of Disciplines	Type of Discipline	Tuition and individual study hours									Numberofcredits
			Number of weeks	Tuition hours						Individual study		
				Teaching activities				Totalhours/week	Totalhours/semester	Totalhours/week	Totalhours/semester	
				Course	Seminar	Laboratory	Project					
1st YEAR												
1ST SEMESTER												
1	Mathematical analysis	F	14	2	1	–	–	3	42	3	42	4
2	Linear algebra	F	14	1	1	–	–	2	28	3	42	3
3	Descriptive geometry	F	14	2	–	2	–	4	56	3	42	4
4	Physics	F	14	2	–	1	–	3	42	2	28	4
5	Topography 1	F	14	2	–	2	–	4	56	3	42	5
6	Chemistry	F	14	2	–	2	–	4	56	3	42	4
7	Geodetic instruments and surveying methods	D	14	2	–	2	–	4	56	3	42	4
COMPLEMENTARY DISCIPLINES												
8	Foreign language 1	C	14	–	2	–	–	2	28	1	14	2
9	Sport	C	14	–	2	–	–	2	28	0	0	–
	TOTAL – 1st semester	–	14	13	6	9	0	28	392	21	294	30
2ND SEMESTER												
1	Special mathematics	F	14	2	1	–	–	3	42	1.5	21	3
2	Differential and analytical geometry	F	14	2	1	–	–	3	42	1.5	21	3
3	Technical and map drawing	F	14	2	–	1	–	3	42	2	28	3
4	Topography 2	F	14	2	–	2	2	6	84	3	42	6
5	Measurements compensation and statistics 1	F	14	2	–	1	–	3	42	1.5	21	4
6	General geology	D	14	2	–	2	–	4	56	1.5	21	3
7	Geography	D	14	2	–	–	–	2	28	1.5	21	3
COMPLEMENTARY DISCIPLINES												
8	Foreign language 2	C	14	–	2	–	–	2	28	1.5	21	2
9	Sport	C	14		2	–	–	2	28			–
	TOTAL – 2nd semester (without the practical activities)	–	14	14	6	6	2	28	392	14	196	27
10	Practical activities 1 (Topography)	D	2	–	–	–	–	0	60	30	60	3
	TOTAL / YEAR	–	28	27	12	15	2	56	844	65	550	60

2ND YEAR												
1st SEMESTER												
1	Computer programming and numerical methods	F	14	2	–	2	–	4	56	3	42	5
2	Soil study	D	14	2	1	–	–	3	42	2.5	35	4
3	General course in Civil, Industrial and Agricultural Engineering	D	14	2	–	1	–	3	42	3	42	4
4	Geodesy I	S	14	2	–	2	–	4	56	3	42	5
5	Measurements compensation and statistics 2	F	14	2	2	–	–	4	56	3	42	5
ELECTIVE DISCIPLINES												
6	Geo-technique	D	14	2	–	2	–	4	56	2	28	5
	Tectonics											
COMPLEMENTARY DISCIPLINES												
7	Foreign language 3	C	14	–	2	–	–	2	28	1.5	21	2
8	Sport	C	14		2	–	–	2	28		0	
	TOTAL 1st Semester	–	14	12	7	7	0	26	364	18	252	30
2ND SEMESTER												
1	Land laws and cadastral legislation	D	14	2	2	–	–	4	56	3	42	4
2	Geodetic surveying by waves	S	14	2	–	2	–	4	56	3	42	5
3	Geodesy 2	S	14	2	–	2	2	6	84	3	42	6
4	Photogrammetry 1	S	14	2	2	–	–	4	56	3	42	5
5	Automatic processing of geodetic data	S	14	2	–	2	–	4	56	2	28	5
	Programme operation in topography and cadastre											
COMPLEMENTARY DISCIPLINES												
6	Foreign language 4	C	14	–	2	–	–	2	28	1.5	21	2
7	Sport	C	14		2	–	–	2	28		0	
	TOTAL – 2nd semester (without the practical activities)	–	14	10	8	6	2	26	364	15.5	217	27
8	Practical activities 1 (Topography)	D	2	–	–	–	–	–	60	30	60	3
	TOTAL / YEAR	–	28	22	15	13	2	52	788	63.5	529	60

3RD YEAR												
1ST SEMESTER												
1	Remote sensing and Photo interpretation	D	14	2	–	2	–	4	56	3	42	4
2	Mathematical cartography	D	14	2	–	2	–	4	56	2.5	35	4
3	Computer graphics for topography and cadastre	S	14	2	–	2	–	4	56	3	42	4
4	Cadastre 1	S	14	2	–	2	–	4	56	3	42	5
5	Photogrammetry 2	S	14	1	–	1	–	2	28	3	42	4
ELECTIVE DISCIPLINES												
6	Automation of the topographical and geodetic surveys	S	14	2	–	2	–	4	56	2	28	5
	Measurement and data processing techniques											
7	Archaeology	D	14	2	–	2	–	4	56	2	28	4
	Archaeological topography											
	TOTAL – 1st semester	–	14	13	0	13	0	26	364	18.5	259	30
2ND SEMESTER												
1	Engineering Photogrammetry	D	14	2	–	2	–	4	56	2	28	4
2	Satellite geodesy	S	14	2	–	2	–	4	56	3	42	4
3	Cadastre 2	S	14	2	–	1	2	5	70	3.5	49	5
4	Cartographic projections	D	14	1	–	1	–	2	28	2	28	3
5	Town planning	D	14	2	–	1	–	3	42	1	14	2
6	Land improvement	D	14	2	–	1	–	3	42	3	42	3
ELECTIVE DISCIPLINES												
7	General ecology	D	14	2	–	1	–	3	42	2	28	3
	Environment protection and sustainable development											
8	Cadastral rating	D	14	2	–	1	–	3	42	1	14	3
	Agro-chemistry											
	TOTAL – 2nd semester (without the practical activities)		14	15	0	10	2	27	378	16.5	231	27
9	Practical activities 1 (Topography)	D	2	–	–		–	–	60	30	60	3
	TOTAL / YEAR	–	28	28	0	23	2	53	802	–	490	60

4TH YEAR												
1ST SEMESTER												
1	Cadastre 3	S	14	2	–	1	–	3	42	2	28	5
2	Monitoring land and construction behaviour	S	14	2	–	2	–	4	56	3	42	4
3	Mining topography	S	14	2	–	1	–	3	42	3	42	4
4	The evaluation of fixed assets	D	14	2	–	2	–	4	56	3	42	4
5	Funding projects	C	14	1	–	1	–	2	28	3	42	3
ELECTIVE DISCIPLINES												
6	Engineering surveying for civil engineering and industry 1 *	S	14	2	–	2	2	6	84	3	42	6
	Engineering topography *											
7	Computer systems in Cadastre	S	14	2	–	2	-	4	56	3	42	4
	Geographic information systems											
	TOTAL – 1st semester	–	14	13	0	11	2	26	364	20	280	30
2ND SEMESTER												
1	Design and optimization of geodetic networks	S	12	2	–	1	–	3	36	3	36	4
2	Management of geodetic surveys	D	12	2	2	–	–	4	48	2	24	5
3	Land and town planning	S	12	2	–	2	–	4	48	3	36	4
4	Methods and techniques for project presentation	D	12	–	2	–	–	2	24	2	24	3
5	Career guidance	D	12	2	–	1	–	3	36	3	36	3
6	Core accounting	D	12	2	–	1	–	3	36	3	36	3
7	Hydrotechnical constructions	D	12	2	–	1	–	3	36	3	36	3
ELECTIVE DISCIPLINES												
8	Geoinformatics	S	12	2	–	2	–	4	48	3	36	5
	Computerized record keeping of the agricultural real estate											
	TOTAL – 2nd semester (without the practical activities)		12	14	4	8	0	26	312	22	264	30
9	Practical activities (drawing up the Diploma thesis)	D	2	–	–	–	–	0	60	3	6	4
	TOTAL / YEAR	–		–	–	–	–	–	736	–	544	60

SUMMARY:	
– Fundamental disciplines (F):	644 hours, 20.32%;
– Disciplines of the field (D):	1232 hours, 38.86%;
– Specialty disciplines (S):	1042 hours, 32.87%;
– Complementary disciplines (C):	252 hours, 7.95%;
– Elective disciplines (O):	496 hours, 15.65%.
Total hours –	3170

Table 2: The curriculum for 'Land surveying and Cadastre' – 'December 1st 1918' University of Alba Iulia.

The Technical University of Civil Engineering of Bucharest, and the Faculty of Geodesy has a rich history. It begins in the year 1813 with the first school of topographic engineers. Its current mission is to provide engineering education which favours the acquisition of skills for scientific research and computer-aided design.

The programme 'Land surveying and Cadastre' helps the students learn:

- The most recent and the most advanced techniques in the field of Geodesy, Engineering Topography, Photogrammetry and Remote sensing, Cadastre and Real estate evaluation;
- Develop increased scientific research abilities;
- Draw up studies and reports;
- Act on their own, in a creative manner, in approaching and solving specific engineering problems;
- To lead teams and communicate with official institutions in the field.

The curriculum for this specialty is presented in table 3.

Cr. No.	*Designation of Discipline*	*C*	*S*	*L*	*P*	*SI*	*TO*	*CR*	*Form of evaluation*
1st Semester									
1.	Higher Mathematics I	2	2	–	–	2	6	4	Written Examination
2.	Algebra	2	2	–	–	2	6	5	Written Examination
3.	Geometric representations of topographical surfaces	2	–	2	–	3	7	5	Written Examination
4.	Physics I	3	–	1	–	2	6	5	Written Examination
5.	Surveying instruments and methods I	2	–	2	–	3	7	5	Written Examination
6.	Physical geography	2	–	–	–	1	3	2	Oral examination
7.	Disciplines of the social sciences and humanities area	2	2	–	–	1	5	3	Oral examination
8.	Foreign Language I	–	(2)	–	–	(1)	(3)	1	Oral examination
9.	Sport I	–	(2)	–	–	–	–	–	–
	TOTAL 26	15	6	5	-	14	40	30	5 Written Examinations + 3 Oral examinations

2nd Semester									
1.	Higher Mathematics II	2	2	–	–	2	6	4	Written Examination
2.	Analytical and differential geometry	2	2	–	–	2	6	4	Written Examination
3.	Physics II	3	–	1	–	2	6	4	Written Examination
4.	Geometric bases of Photogrammetry (GBP)	2	–	1	–	1	4	2	Oral examination
5.	Surveying instruments and methods II	2	–	2	–	2	6	5	Written Examination
6.	Cartographic drawing	–	–	2	–	1	3	2	Oral examination
7.	The basics of physical geodesy I	2	–	–	–	2	4	3	Written Examination
8.	Geodetic astronomy	2	–	1	–	2	5	2	Oral examination
9.	Foreign languages II	–	(2)	–	–	(1)	(3)	1	–
10.	Sport II	–	(2)	–	–	–	–	–	Practical examination *
11.	Practical activities I	3 weeks x 30 hours	–	–	3	C			
	TOTAL 26	15	4	7	-	14	40	30	5 Written Examinations + 5 Oral examinations
3rd Semester									
1.	Higher Mathematics III	3	2	–	–	2	7	5	Written Examination
2.	Automatic processing of geodetic data	3	–	3	–	2	8	5	Oral examination
3.	Measurement compensation and statistics I	3	–	2	–	3	8	6	Written Examination
4.	The basics of Physical Geodesy II	2	–	1	–	3	6	4	Written Examination
5.	Mathematical Geodesy I	2	–	–	–	2	4	4	Written Examination
6.	Topography I	2	–	2	–	3	7	5	Written Examination
7.	Foreign language III	–	(2)	–	–	(1)	(3)	1	Oral examination
8.	Sport III	–	(2)	–	–	–	–	–	–
	TOTAL 25	15	2	8	-	15	40	30	5 Written Examinations + 2 Oral examinations

4th Semester									
1.	Measurement compensation and statistics II	3	–	2	–	2	7	5	Written Examination
2.	Topography II	2	–	–	2	3	7	3+2	Written Examination + Project work
3.	Planimetric Photogrammetry	2	–	1	–	2	5	3	Written Examination
4.	Computer systems in land surveying	3	–	2	–	2	7	5	Written Examination
5.	The basics of geodetic surveying by waves	2	–	1	–	1	4	2	Oral examination
6.	Mathematical Geodesy II	2	–	1	–	2	5	4	Written Examination
7.	General course in Civil, Industrial and Agricultural Engineering	2	–	2	–	1	5	2	Oral examination
8.	Foreign language IV	–	(2)	–	–	(1)	(3)	1	Oral examination
9.	Sport IV	–	(2)	–	–	–	–	–	Practical examination *
10.	Practical activities II	3 weeks x30 hours	–	–	3	C			
	TOTAL 27	16	-	9	2	13	40	30	5 Written Examination +5 Oral examinations + 1Project work
5th Semester									
1.	The basics of engineering surveying	2	–	2	–	2	6	5	Written Examination
2.	Mathematical Geodesy II	–	–	–	1	1	2	2	Project work
3.	Mathematical Geodesy III	2	–	–	–	1	3	4	Written Examination
4.	Map projections	2	–	1	–	3	6	4	Written Examination
5.	Electronic distance measurement	2	–	2	–	2	6	4	Written Examination
6.	Stereo-Photogrammetry and Photo-interpretation	2	–	1	–	2	5	4	Written Examination
7.	Roads and works of art	2	–	2	–	2	6	3	Oral examination
8.	Hydrotechnical constructions and public technical utility systems	2	–	2	–	2	6	3	Oral examination
9.	Foreign language V	–	(2)	–	–	(1)	(3)	1	Oral examination
	TOTAL 25	14	-	10	1	15	40	30	5 Written Examinations + 3 Oral examinations + 1Project work

6th Semester									
1.	Mathematical Geodesy III	–	–	–	2	1	3	2	Project work
2.	Cadastre I	2	–	1	–	1	4	3	Written Examination
3.	Map modelling I	2	–	2	–	2	6	3	Written Examination
4.	Engineering surveying for civil engineering and the industry I	3	–	–	2	3	8	3+ 2	Written Examination + Project work
5.	Analytical Photogrammetry	2	–	–	1	2	5	2+ 2	Written Examination + Project work
6.	Legal institutions and laws on the agricultural real estate and cadastre	3	–	2	–	2	7	3	Oral examination
7.	Practical activities III	3 weeks x 30 hours	–	–	4	C			
8.	Elective disciplines MODULE 1 (*)	1	–	1	–	1	3	2	Oral examination
		2	–	1	–	1	4	4	Written Examination
9.	Elective disciplines MODULE 2 (*)	2	–	–	–	1	3	2	Oral examination
		2	–	1	–	1	4	4	Written Examination
	TOTAL 27	15/16	-	7/6	5	13	40	30	5 Written Examinations + 3 Oral examinations +3Project work
7th Semester									
1.	Space Geodesy I	2	–	2	–	2	6	4	Written Examination
2.	Engineering Photogrammetry	3	–	1	–	3	7	6	Written Examination
3.	Engineering surveying for civil engineering and the industry II	2	–	2	–	2	6	6	Written Examination
4.	Cadastre II	3	–	2	–	3	8	5	Written Examination
5.	Accounting	2	1		–	1	4	3	Oral examination
6.	Elective disciplines MODULE 1 (*)	2	–	1	–	1	4	2	Oral examination
		2	–	–	2	1	5	4	Written Examination + Project work
7.	Elective disciplines MODULE 2 (*)	2	–	1	–	1	4	4	Written Examination
		2	–	2	–	1	5	2	Oral examination
	TOTAL 27	16	1	8/10	2/0	13	40	30	5 Written Examinations + 1 Oral examination +1 Oral examination /+ Project work

8th Semester									
1.	The design and optimization of geodetic networks	2	–	–	–	2	4	3	Written Examination
2.	Digital Photogrammetry	2	–	1	–	2	5	5	Written Examination
3.	Remote sensing	2	–	2	–	3	7	5	Written Examination
4.	Land improvement and town planning	2	–	1	–	1	4	3	Oral examination
5.	Monitoring the behaviour of lands and construction works	2	–	1	–	3	6	5	Written Examination
6.	Organizing geodetic works	2	–	2	–	1	5	3	Oral examination
7.	Elective disciplines MODULE 1 (*)	2	–	1	–	1	4	2	Oral examination
		2	–	1	–	2	5	4	Written Examination
8.	Elective disciplines MODULE 2 (*)	2	–	2	–	2	6	4	Written Examination
		1	–	1	–	1	3	2	Oral examination
	TOTAL	16/15	-	9/10	-	15	40	30	5 Written Examinations + 3 Oral examinations

Table 3: The curriculum for 'Land surveying and Cadastre' – the Technical University of Civil Engineering.

The analysis of the two curricula shows an almost 90% similarity of fundamental disciplines, as some of them have close designations and an identical content. The disciplines in the field and the specialty disciplines are almost identical from the point of view of designations and syllabi. The complementary disciplines and the specialty practical activities at the two Universities are identical.

From the point of view of study year structure and the number of hours for each semester, both programmes meet the Bologna requirements.

4. Automation of geodetic surveys in an educational context

As computer technologies evolve rapidly, the training of future university graduates has to be tuned to the latest developments, so as to offer them better qualifications for the labour market. In this context, 'December 1st 1918' University of Alba Iulia, Romania, through its Bachelor's degree programme 'Territory measurements and cadastre', has included in the curricula a series of specialty disciplines that will help future geodetic engineers acquire competences in computerising geodetic surveys. The future graduates will also be able to adjust to the constant dynamics of this line of work.

In order for students to become acquainted with the topographic technical equipment and software, the first year of studies includes courses such as 'General topography', 'Topographical tools and measurement methods' and 'Computer programming.' Thus, students in topography acquire abilities in using the topographic instruments, both in theory and in practice, as the courses and their practical applications include.

In the second year of studies, there is a gradual passage towards the use of the electronic equipment required by the course and laboratory activities of the discipline 'Geodetic surveys by waves'. The computerized processing of data is studied within software applications that are used both nationally and internationally (Caltop, Caltop8, Toposys).

The automation of topographic and geodetic surveys (third year of studies) is studied in the context of creating the link between geodetic equipment and computers. Thus, students are introduced to the software that allows data transfers from and to the memory of devices

and machines, to the facilities that they offer and to the possibilities of creating topographic applications in programming environments.

The computer design of a project's graphics is exemplified through drawing software used worldwide such as AutoCAD, Surfer etc., and also through national software that satisfies the requirements of the Romanian market, such as MapSys.

The last stage (the fourth year of study) in the training of future geodetic surveyors includes the study of satellite methods of surveying in view of creating a unitary geodetic network at the national level and which can be part of the European geodetic network. Also, Photogrammetry and its methods for point determination are considered, with examples of specific pieces of equipment. The purpose is to integrate the information specific to a project in a geographic system of information.

The description of the curricula shows that surveying students, during the four years of study, acquire enough knowledge and practical skills to work with computers and specialized surveying software. These skills may increase the quality and productivity of the surveyor's work. They also become a huge advantage when using other computer software and other types of equipment in other surveying-related areas.

5. Conclusion

All these accomplishments are the result of the connection between theory and practice, of a syllabus that is competitive with the dynamics of development in the field of land measurement and cadastre and also of the ease in assimilating all new information in the field.

Trough the study of a wide range of topographic equipment and of computer software that are presently used in Romania and abroad, our young engineers are prepared to apply for jobs in Romania or in any member state of the European Union. They are familiar with or they can adjust very easily to the specific topographical and computer technology that they may be required to use.

As regards the access to further studies, the holders of a Bachelor's degree in Engineering will have access to Master studies and then to doctoral studies not only in Romania but also in the European Union or elsewhere.

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Teaching GIS in Central Asia




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1. Introduction

In the year 2008 the Institute of Geoinformation, Graz University of Technology, Austria participated in two geo-information science related activities in Central Asia. The first activity was the international conference on "GIS for the future of Central Asia" in Bishkek, Kyrgyzstan and the second activity was a train the trainer workshop titled "Geo-Informatics for Mountain Environment Management" in Katmandu, Nepal.

These two events brought the authors to the local geo-information scientist community for a first reality check of teaching geo-information topics on-site. Furthermore the novices among the Austrian participants socialized with the experts and existing contacts got reacquainted. Based on these fruitful networking and on the various impressions of these events, new ideas according to teaching Geographic Information Systems (GIS) related to local needs in Central Asia are arising for future activities.

The main challenges for teaching activities are finding the right Geographic Information (GI) tools that are available for the local institutions and having access to regional geo-data so that the participants will develop a better relation to the lectures.

2. Teaching experiences in Central Asia

The contact to teaching activities in the Central Asian region of the Institute of Geoinformation at Graz University of Technology began in spring 2008 with the invitation of the Eurasia-Pacific Uninet to a symposium in Bishkek, Kyrgyzstan. The goal of the Eurasia-Pacific Uninet is to support contacts between universities, universities of applied sciences and other research facilities in Austria and member institutions in the Pacific, in East, Central and South Asia. At present there are approximately 100 member institutions in Bhutan, India, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Austria, Republic of Korea, Russian Federation, Tajikistan, Taiwan, Uzbekistan and the People's Republic of China. Financial support is given from the Ministry of education, science and culture and from the Austrian Exchange Service (ÖAD) (Eurasia-Pacific Uninet, 2008 [5]).

The first participation of the Institute within Eurasia-Pacific Uninet was a Geoinformation symposium in Bishkek under the topic "GIS for the Future of Central Asia" (GISCA'08, 2008 [6]). The main intention for holding this conference was the encouragement of international cooperation and exchange of knowledge in GIS education in Central Asia. In the course of the conference the Austria-Central Asian Centre for GIScience was inaugurated which is the point of contact for Austrian initiatives for supporting the development of advanced competence in GIScience. Further objectives of the centre are the support of education through teacher education and summer schools and the support of joint initiatives towards externally funded projects in research and education (Austrian-Central Asia Centre for GIScience, 2008). Based on contacts of this symposium the Institute was invited to a "Train-the-Trainer"-Workshop in Kathmandu, Nepal under the topic "Geoinformatics for Mountain Environment Management (mountainGIS)" organized by the International Centre for Integrated Mountain Development (ICIMOD). ICIMOD is an international independent mountain learning and knowledge centre committed to improving the sustainable livelihoods of mountain peoples in the extended Himalayan region (ICIMOD, 2008 [7]). The content presented by the Institute of Geoinformation covered the topics forest growth modelling and forest inventory with GIS in general.

Future activities will expand to Mongolia: During a visit of Khovd University in Western Mongolia, several ideas for organizing workshops and realizing ideas in the field of agriculture or landscape development were developed.

3. Teaching GIS

The idea of teaching GIS in Central Asia is an emerging topic in GI education. The driving factors for teaching Geoinformation in these

countries are explained in the following paragraph. First of all we want the Central Asian countries to benefit from the skills the students acquire. Thus the economy may develop further and through the application of GIS techniques a sustainable and ecologically worthwhile growth can be maintained. By supporting international or national Organisations within the scope of multilateral research projects as well as projects carried out by local GIS experts and institutions an ecological and economical balance may be found. Furthermore we can facilitate social networking (student exchange, etc.) to enhance the cultural exchange.

In order to have sustainable teaching "results" the Problem Based Learning approach (Kopp and Mandl 2002 [8], Car 2004 [4]) seems to be appropriate. In traditional instruction methods, the so-called instructional view, students are often trapped in a passive role (Mader and Stöckl, 1999 [9]), and we observe the phenomenon of inert knowledge (Artelt et. al., 2001 [1]; Arzberger and Brehm, 1994 [2]). This form of isolated knowledge can be reproduced by the student, but cannot be applied to any practical problem. This problem arises when theoretical information is presented based on the following assumptions (Kopp and Mandl, 2002 [8]):

- Knowledge is a consequence of learning both facts and routines.
- Knowledge can be transmitted from one person to another like products.
- Learners can bridge the gap between theory and practice themselves.

Mader and Stöckl (1999) [9] and Kopp and Mandl (2002) [8] proposed, that a certain learning approach, the constructivist approach in learning and teaching may overcome the creation of inert knowledge. According to this the learner has to be set in an active position, and the process of learning should be a social process. Thus the teaching itself does not have a prominent part, it has act in the sense of encouraging, supporting, as well as consulting.

To create a Problem-based learning environment, both the instructional and the constructivist view have to be combined in an appropriate and balanced manner. Thus, Reinmann-Rothmeier and Mandl (2001) [11] proposed four principles that have to be considered:

Authenticity and reference to application: Knowledge is presented using "real-world" examples and showcases that may originate from the professional field. With this "practical"-oriented presentation students are motivated to focus more on specific topics.

Multiple contexts and perspectives: Each topic should be presented from different contexts in order to avoid becoming trapped in one certain context. This results in a broader and flexible knowledge, which helps applying the latter in varying situations.

Social learning arrangements: Due to the fact that cooperation and communication is essential in every professional environment, learning has to pick up and facilitate that concept. Working in groups on certain tasks deepens the understanding of the gained knowledge and fosters the students' communication abilities.

Instructions, information and construction supply: Instructions are a way of supporting the students while they are working on tasks. The teacher has to maintain that the tasks are not too complex and thus avoid a cognitive overload. In addition the students should look for more detailed information for completing the task on their own, based on the instructions from the teacher.

Based on these assumptions, we want to work spatial problems and incorporate problems from the local countries/education institutions. Project/Problem input from students and local professors is very welcome, which intensifies the learning and teaching experience for both sides. A major part of the teaching material may be disseminated via the TUG TeachCenter – similar to the interactive learning portal geoinformation.net (Plümer and Quadt, 2009 [10]). Moreover this approach helps to have a sustainable impact on the students, due to the fact that they can go through the teaching material more often – even if the course is over.

Based on our experience open source software is appropriate for sustainable teaching, due to the following facts: minimum costs for licensing (mostly available for free), great community based support. For most GIS-related tasks there is an open source tool available that can be applied in the course of Problem Based Learning. Basically we provide "the way of thinking" during the short theoretical lectures which will be the basis for understanding GIS tools.

What our institution can provide are: highly skilled and motivated teaching personnel, a great number of students for exchange programs, a

pool of various geo-data, as well as several infrastructure facilities.

4. Workshop Participants Mentoring

Beside the primary content of a workshop that is focused on the knowledge transfer of technologies and methods in the area of GI in the connection with local needs, the basic infrastructure to support this intention should be kept clearly in mind. Furthermore this infrastructure should lead to a sustainable learning success.

For this purpose the mentoring phases of a workshop have to be identified considering the participant's needs, and link the necessities to the supporting teaching infrastructure.

4.1 Mentoring Phases

The phases where participants of a workshop need support or additional information can be divided into three temporally separated parts:

- Pre-workshop

In this phase the potential participant should receive general information about the structure of the workshop, links to useful documents and software tools to exercise a preparation independently and get fit for the workshop. Additionally a portal for participant – participant and participant – lecturer communication in the pre-workshop phase should be provided for shorter communication channels and better information flow.

- Workshop

During the workshop itself the presentation slides or e-books, concerning the theoretical part, and instructions for practical work during the lab sequences and their sample solutions should be available by the supporting teaching infrastructure.

- Post-workshop

Following the on-site workshop phase further mentoring of the participants might be necessitated. For example coaching a long time lab project, a knowledge evaluation for a workshop certificate, or just the facility to archive lecture documents and results arising from lab or project work.

4.2 Mentoring Infrastructure

The required functionality figured out afore can be found on several e-learning platforms. These platforms include a data exchange area and a forum for communication purposes as their basic modules. One exponent of e-learning platforms in the free and open-source software community is represented by moodle (http://moodle.org). As they propagate on their web site, moodle can be seen as a course management system, learning management system or as a virtual learning environment.

At the Graz, University of Technology the prime infrastructure for supporting educational needs for online and online-supported teaching is called TeachCenter (http://tugtc.tugraz.at). A second system, LearnLand, completes the infrastructure and focuses on the documentation and presentation of individual work (http://tugll.tugraz.at).

- TeachCenter

The function range of this infrastructure is adaptable to the needs of a course. The key tools include an administration area for general course information, time schedules or a grouping tool, a download area for lecture documents, a forum for communication and the possibility to take an examination (e.g. a multiple choice test). Moreover the course participants have the facility to upload their own documents arising from labs or project work for evaluation and exchange.

- LearnLand

Contrary to the TeachCenter, LearnLand provides an internet blogging framework including social networking facilities for participants and lecturers. Within a blog lab or project work can be recorded for the participants themselves, for a participant – lecturer communication or even for the whole LearnLand community to share ideas and collect new approaches.

5. Workshop concept "Solar energy potential in Central Asia 2009"

This workshop is planned for summer 2009 in Bishkek, Kyrgyzstan for students and lecturers of GIScience in Central Asia and will be founded by the Eurasia-Pacific Uninet. The workshop will create skills for the application of tools which can contribute a main part for the security in regional energy supply. The calculation of the theoretical, technical and economical potential of solar energy can be handled by GIS. This is the subject-specific aim of the workshop. To create practical qualifications for the implementation of solar energy in Central Asia is the strategic objective. Therefore the structure of the workshop is built in that way that 75 % will be focused on theoretical background for modelling solar (in addition wind and hydro) potentials in the region. Austrian experts from these scientific fields are

invited to communicate the participant ideas and concepts of solar, wind and hydro models which are implemented in the second part of the workshop with appropriate open-source GIS tools. This part will be about 25 % of the planned five days duration. We will offer several modules to meet requirements of the participants.

Practical applications will be the collection and spatial analysis of energy characteristics to document the actual state, the calculation of solar potential and the calculation of potential for micro hydro plants in Central Asia. For these tasks only for the participants available data will be used to ensure that they can implement the methods in their own workflows. The calculation of solar potential will be done by the free available r.sun model which is implemented in the GRASS GIS open source environment. The model is able to serve raster maps of selected components (beam, diffuse and reflected) of solar irradiance [W.m*], solar incident angle [°], the daily sum of solar irradiation [Wh.m-2] and duration of the beam irradiation [minutes] as output. The daily sum of solar irradiation and the duration of the beam irradiation computed as integration of irradiance values that are calculated in a selected time step from sunrise to sunset. Another open source geographic information system is SAGA GIS which is also able to calculate solar radiation coefficients within a very powerful terrain analysis. The decision which specific GIS tool will be chosen depends on the foreknowledge of the participants. Due to the fact that the workshop is modular built, we can teach these modules which fit best. Further worked out modules besides GRASS GIS or SAGA GIS are the UMN Mapserver for delivering calculation results, PostgreSQL/ PostGIS database, PHP &phpMapscript and the treatment of further open source GIS like QuantumGIS or gvSIG.

The workshop should not only be seen as knowledge transfer from Austrian universities to the counterparts in the Central Asia region, it should also be a starting point for further cooperation with Central Asian partners.

6. Eurasia-Pacific Uninet

Eurasia-Pacific Uninet is a network which aims at establishing contacts and scientific partnerships between Austrian universities, universities of applied sciences, other research institutions and member institutions in East Asia, Central Asia, South Asia and the Pacific region. The network was founded in the year 2000 by Prof. Dr. Brigitte Winklehner and is strongly supported by the Austrian Federal Ministry for Science and Research and the Austrian Exchange Service (ÖAD).

At present with a total of 115 member institutions in Austria, China, Mongolia, the Russian Federation, Korea, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Bhutan, Nepal and India, the network promotes multilateral scientific cooperation, joint research projects, conferences as well as faculty and student exchange.

Eurasia-Pacific Uninet is the largest sovereign university network of its kind within Europe.

The goal of Eurasia-Pacific Uninet is to support interdisciplinary scientific exchange between its member institutions through

- scholarships for Post Docs and Ph.D. students coming to Austria
- projects
- summer schools

Further Eurasia-Pacific Uninet supports scientific, economic and cultural relations between Austria and the target countries, R&D activities of multinational companies, visiting professorship and reciprocal acknowledgement of study degrees and programs. Eurasia-Pacific Uninet supplies contacts between government agencies, educational institutions and companies, intercultural expertise through intense programs and courses and initiates joint research centers, joint schools for teaching, research and training, the development of joint curricula and double-degree program and research activities by means of workshops, seminars and conferences and through the exchange of scientists among member institutions.

7. Outlook

Based on the impressive experiences in Kyrgyzstan and Nepal in 2008, the authors are highly motivated to intensify the existing contacts to Central Asian GI institutions and ideas for new GI workshops are arising. Additionally different Austrian GI institutions in close connection and sciences, which are not situated in the core area of GIS, have the chance to reactivate existing social networks or built up new links covering such teaching projects.

Furthermore, by creating lessons dealing with local circumstances the sensitivity rises for problems and challenges in Central Asia that are hardly known in the western world. This will

start at the technical infrastructure of communication networks, like internet, concern the configuration of teaching class rooms, like computers and software, and end up at the accessible geo-data.

Last but not least the importance of the Eurasia-Pacific Uninet as an institution for academic exchange should not remain unmentioned. This institution acts as base for scientific activities in Central Asia and provides the social infrastructure on-site which allows the participants to focus on contents but not on organizational work.

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Navigating the global consciousness: A Young Surveyor's Future

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Summary

The crisis of surveying continues to haunt the literature of Commission 2 – low young surveying numbers, low FIG (International Federation of Surveyors) awareness and a near-invisible surveying public profile. But what is being done?

This paper summarises key recent literature relating to this issue and the future of the profession – particularly with reference to future applications and marketing. It is suggested that a clear, concise surveying profile is developed both nationally and regionally to enhance the public profile. Borders across the European Union and Asia may be opening up, but unless the borders between surveying disciplines become similarly permeable, surveying professionals will find it difficult to evolve in the future marketplace. Ultimately an inclusive profession needs to be developed and marketed to all.

Young surveyors in particular will benefit from such a move. As a generation they have already progressed beyond such issues – having grown up with this international world of 'plug-and-play'. But as a profession, greater mentorship and communication – across borders, generations and cultures – is required to raise the public surveying profile, in addition to the FIG profile within the profession.

The Young Surveyors Working Group was developed from 2006 to address such issues, and is rapidly consolidating on achievements so far – notably a record student attendance at the FIG Working Week in Stockholm, 2008. On the eve of the group's development into an FIG network, this paper summarises the key opportunities its success will create.

Keywords: Young surveyors, capacity development, standards, professional development, skills shortage, education

1. Crisis? What Crisis?

The crisis of a surveying skills shortages across the majority of countries in the Western developed world has been well documented (e.g. Williamson (1998); Hannah (2006); O'Connell (2006); Mahoney et al. (2007); Hucker (2008)). These authors report a shortage of students, a shortage of graduates remaining in the surveying profession, and a shortage of young surveyors actively participating in the professional organisations.

In Asia and the developing world, the story is similar, however with increasing access to higher education and rapidly growing infrastructure it is not so much a problem of insufficient students as much as a lack of graduates and experienced professionals to lead the way. The Yildiz Technical University Department of Geodesy and Photogrammetry Engineering in Turkey is planning to downsize student numbers due to limited teaching resources (Aydin et al. 2006). Weigel and Svabensky (2006) (and also Meha (2008)) further introduce the Eastern European viewpoint – that the required numbers of students and graduates is in strong contrast to the demands of practical teaching which requires lower staff to student ratios. In many cases across the globe the number of students graduating is in no way indicative of the number of graduates looking for jobs in the surveying disciplines – many finding apparently more lucrative work in adjacent fields and/or more lucrative countries (Hucker, 2008).

Mahoney et al. (2007) reports:

"It has been clear for some time, at least from the evidence presented at a number of FIG events, that the surveying profession is heading for a global crisis. The profession is changing and the number of competencies in which surveyors are actively involved is over 200."

So the crisis is a "skills" crisis **and** a numbers crisis. Many developed countries are struggling to attract and retain students and graduates of surveying, whilst developing countries are desperate for cross-disciplinal surveying leaders to assist in education, developing infrastructure and setting up effective land management systems.

1.1 The crisis in other industries

Is the crisis unique to surveying? In the Australian and UK cases, skills shortages are also seen across the IT (Thomson, 2008), Agricultural (King, 2004), Engineering (HRM, 2007) and Construction (Dainty et al., 2005) sectors – namely, those very sectors in which surveying skills are essential. The

economy boom up until 2008 is likely to have been particularly key in this, with job growth now significantly stalling, however Hucker (2008) reports:

"The recent credit crisis in the UK and the downturn in new starts for housing and offices will have an impact, but the latest survey figures available (Q1, 2008) still show 30% companies in the UK reporting difficulties in recruiting quantity surveyors"

Certainly plans by federal governments to stimulate the market are unlikely to negatively impact surveying employment opportunities

1.2 Marketability?

So is it a question of marketing? Hannah (2006) says yes by contrasting the cases of New Zealand and Australia – the former exhibiting no problems in attracting students and reporting similar findings to the Norwegian example of Leiknes (2008) where a change of name in the surveying course to one more recognised by society improved student applications and enrolments (in the Norwegian case, from 'Land Consolidation' to 'Land Surveying and Management'). In this case then, the marketing was successful in that it was in the language of the customer – that is, the layperson had a greater understanding of what "Land Surveying" was in comparison with "Land Consolidation".

This may also be the case in developing countries, or those recovering from environmental and political upheaval. Meha (2008) reports the case of Kosovo, where student numbers are at (an albeit small) capacity. In this case, it is perhaps the rapid infrastructural changes and development opportunities that are marketing the need for surveyors. Ghana (Tenadu and Djaba, 2008), if taken simplistically, may be in a similar category.

In such new surveying establishments, however, it may also be a case of 'inclusivity' – that is, a broader definition of the label 'surveyor'. With fewer experienced professionals about, firms are more likely to be approached for a wider range of surveying tasks, rather than finding niches as may have happened in developed countries in the past. Individuals are more likely to develop a wider range of skills – 'jack-of-all-trades' so to speak.

In the case of Australia, Fryer (1996) says "In the 1970s ... about 90% of graduates were registered nationally, with this reducing to about 50% in the 1980s and about 30% in the 1990s..." Here Fryer is referring to the percentage of graduates registered with the Institute of Surveyors Australia – an organisation that has the image of predominantly supporting cadastral surveyors. With such an image, few graduates *outside of* the cadastral surveying and measurement fields would join, let alone actively participate. And yet the surveying profession has grown rapidly beyond cadastral surveying, if indeed it ever was restricted to such, and this has been a topic of debate for the last decade in not only Australia, but more recently Canada. A 2008 Canadian report (Statham et al., 2008) reports the problems of a profession fractured over regions and disciplines "without an efficient cohesive voice to respond to the profession's key users in government, industry and the public". Canada and Australia are now promoting more streamlined and inclusive professional organisations, although in the case of Australia at least this is proving difficult with respect to accreditation and general professional image and voice. These efforts are similar to the much documented Bologna process (see, for example, Steinkeller & Heine, 2005) which promotes a European-wide system for education.

2. Changing face of Surveyors

Such efforts taking place across Australia and the EU are the result of two major changes taking place across all professions – internationalisation and interoperability.

2.1 Internationalisation: The global Surveyor

The surveyors of today work in an increasingly global market. The latter half of the 20th Century saw the birth of the United Nations, the formation of the European Union, the World Trade Organisation and the WorldBank – and increasing collaboration between the FIG and such external bodies (in particular the UN). The Bologna Process is now in force, following on from exchange programs such as ERASMUS in opening up educational borders across Europe. In Asia the "soon to be ratified ASEAN [Association of South East Asian Nations] Framework Arrangement for the Mutual Recognition of Surveying Qualifications" (Teo, 2006) will further open up international benefits to the surveying community.

And so, with increasing internationalisation, rapid technological change and deregulation of the profession, the Surveying Profession could be undergoing a 'growth period' (as Teo (2007) puts it) now more so than ever "*especially conside-*

ring... the increasing and extensive application of surveying and mapping technologies in business sectors" (Teo, 2007).

Again, it is a question of inclusiveness. Surveying in the FIG all-encompassing definition is indeed rapidly growing – both globally and in application – however in a traditional sense, the many surveying disciplines can still be thought of as discrete, limited packages. Thus, as with generation Y, the profession is facing a new paradigm – that of the 'interoperable' surveyor

2.2 The interoperable "Plug-and-Play" Surveyor

"Technology and knowledge are now primary production factors. Technological advances allow information to be instantly transmitted across the world, and the primary competitive advantage a company possesses is its process of innovation and its ability to derive value from information."(-Bullard, 2005)

The equipment we use on a day today basis is increasingly 'plug and play'. So too will be (is?) the young professional of the future. Williamson (1997) wrote that "environmental degradation, sustainable development, the management of our cities and economic rationalism all present enormous opportunities for the surveyors of the 21st century". The importance of issues central to our profession, such as cadastral reform and spatial data infrastructures, is being realised by policy makers as they grapple with the changing economic climate, sustainable development and social stability (Williamson, 1997).

Prendergast (2006) wrote of the wide range of EU Directives existing at European level, for example, the Water Framework Directive, the Services Directive, INSPIRE, the re-emerging Public Services Information Directive, the Environmental Directives – all of which present significant opportunities to European surveyors.

Other initiatives such as Galileo (the European Global Navigation Satellite System), GMES (Global Monitoring and Environmental Systems) and eGovernment (to create an Information Society and Knowledge Economy) can be harnessed to positively promote surveying as the profession for future generations.

So with so many opportunities, and with governments and policy makers globally realising the capabilities of surveyors – how can there be a crisis? Fairlie (2008) largely attributes it to this issue of "inclusivity" – essentially a crisis of identity and the current industry paradigm of spatial versus surveying. Mahoney & Kavanagh (2006) state "One of the major challenges for the profession is whether or not it is able to capitalise upon this change…through the provision of added value services and fully engage with such diverse markets…" And it is a challenge – as Williamson (1997) states – "there are already other professions moving or ready to move into these traditional [and non-traditional] areas of the surveyor if we don't act" – in which case, surveying could end up as simply one professional branch on the Information Technology tree!

But back to the young surveyor, and the challenge of surveying versus spatial.

Hucker (2008) reports an increased number of students studying towards a UK surveying degree (in contrast to the crisis), however significant numbers do not continue to work as graduates in the UK – instead many take up positions in adjacent fields. From the Swedish viewpoint, Andersson et al. (2006) report the low commitment of graduates to continuing work with the national land authority (Lantmäteriet): *"Here [Sweden], the trainees think that prospects are poorer if one stays too long at any one place..."*. It is no longer considered enough to be a specialist in field – a more general knowledge across surveying thought and technology is required.

Enemark (2001) suggested that the educational profile of the future for surveyors should encompass the three areas of Measurement Science, Spatial Information Management, and Land Management – but the young surveyor's education in the future will surely engender much more than this, with few surveying courses stikking to just these fundamentals. The University of Calgary in Canada offers a geomatic engineering degree specializing also in biomedical engineering – utilizing spatial and measurement skills in the medical field. Meantime other universities are expanding beyond the traditional civil engineering or built environment/planning linkages to further combine surveying degrees with law, business, information technology, electrical engineering, software engineering and more.

However, with new disciplines seemingly developing every day, surveyors cannot expect a regulated and/or standardised market of geoinformatics and geo-services to evolve so rapidly (Prendergast, 2006). Tenadu and Djaba (2008) give examples of the need for having adequate standards in a national surveying market (in this case, Ghana) and the consequen-

ces a lack of adequate standards can have on growth and professional integrity. With developing countries experiencing the expansion of a surveying market (e.g. Kosovo – Meha (2008)) and the growing internationalisation of our profession (European Union, ASEAN, etc.) national and regional professional bodies will need assistance in developing and regulating new ethical principles and codes of professional conduct that not only suit the new roles surveying professionals will be working in, but the varying cultures across which they will be operating. The lack of surveying professionals and leaders in these developing countries makes this need even more critical – the young surveyors of the future will be dependent on the guidance of mentors and a reachable professional body.

In summary: the uncertain times we have begun to witness in 2008 – 'the credit crunch' – will further exacerbate the demand for multi-skilled 'plug-and-play' professionals – "levelling internal demand may be achieved by working a number of sectors and encouraging flexible movement across sectors" (Hucker, 2008). Clear and transparent benchmarking procedures will be necessary to evaluate performance, identify needs and develop best practice for the future. This will be particularly important to young surveyors experiencing the effects of the skills and age gap before them.

2.3 Key issues as presented by young surveyors at FIG Working Week 2008

So far young surveyor issues have been presented from a profession and societal viewpoint – what did the young surveyors themselves put forth as critical for the future?

In essence, papers presented during the Young Surveyor session at the FIG Working Week in Stockholm, Sweden 2008 had three key themes:

- The FIG Young Surveyors Working Group (Kivilcim & McAlister, 2008) and schemes to improve young surveyor involvement (Fairlie, 2008)
- Young Surveyor employment and professional development (Brazenor, Carter & Dalrymple, 2008; Hasova, Svabensky & Weigel, 2008)
- Surveying Education (Boder, 2008; Aranda et al., 2008)

Kivilcim & McAlister (2008) gave an overview of the FIG Young Surveyors Working Group, to be updated and reviewed in the following sections, whilst Fairlie (2008) outlined a key opportunity (the Young Surveyors Beyond Horizons Project, to be run at the FIG2010 World Surveying Congress) to address a lack of young surveyor awareness and a lack of young surveyor participation in the FIG. Brazenor, Carter & Dalrymple (2008) strengthened support for the FIG Young Surveyors Network by placing an onus on both young surveyors and employers to develop themselves and provoke development opportunities while Boder (2008) and Aranda et al. (2008) further outlined opportunities for young surveyors and young surveyor promotion in the education sector.

These then are the main issues that Young Surveyors are passionate about, and which should be addressed by the FIG Young Surveyors Working Group, which will soon become into a Young Surveyors Network: namely young surveyor involvement, across all surveying disciplines and markets, in the future of the profession

3. Young Surveyors Network

"Lower surveyor numbers has a circular effect: Anecdotal evidence from the UK indicates that a relatively high proportion of surveying students are encouraged into the profession by personal contact with a practising surveyor who is either a member of the family or a close family friend" (Mahoney et al. 2007).

Young surveyors are not only the future of the surveying profession, but also a key element of the 'now'. They have enormous potential that has not yet been harnessed – specifically in promoting the evolving identity of surveying, and in adapting to new modes of work. Lack of awareness and lack of involvement may be two key elements inhibiting the future of surveying but it is communication that is key. Issues of low student numbers, young surveyor shortages and societal awareness are interrelated (Fairlie, 2008) – students will choose surveying if they know about it and think of it as a challenging, interesting and 'wealth-creating' career; but they are not the only market. With traditional surveying disciplines opening up into a whole host of alternative applications, as a profession we need to maintain strong links with adjacent professions and markets. In short – **a stronger network across generations, across cultures and across disciplines** is absolutely mandatory for the future of our profession.

3.1 SWOT – Strengths, Weaknesses, Opportunities & Threats

See Table 1 for an overview of the SWOT analysis of the evolving FIG Young Surveyors Network.

Strengths	Weaknesses
■ Dedicated group of young professionals ■ Strong cross-generational and cross-discipline support internationally ■ Strong FIG support ■ Momentum: working group is now to become a network, strong momentum can be built on.	■ Face to face meetings: are rare and hindered by distance and financial costs of travel. ■ Budget: no funding as yet ■ FIG events are often costly and not within young surveyor budget
Opportunities	**Threats**
■ Establish regional and global networks to: ■ Address young surveyor marketing and industry involvement ■ Improve and evolve standards of best practice; particularly relevant to the developing world ■ Ensure and promote continuity across generations in national and existing organisations ■ Peer networking for benchmarking and improved context/understanding (see Culliver, 2008) ■ Liaise with other young surveyor bodies to improve the industry generally (e.g. Architects; Engineers; Scientists; etc.) ■ Ensure cross-cultural awareness for future generation of global surveyors: Slaboch (2006) says "people are on the move from country to country bringing with them new habits, new values and new ethics." ■ Improved employer feedback; YS input into educational standards ■ Improve the FIG awareness and access of young surveyors in the developing world	■ Volunteer burnout *Current volunteers are enthusiastic, but busy. Need to ensure effective management and delegation of workload to new members* ■ Progress required to continue enthusiasm *Scope out quick wins to ensure momentum and early, easy promotion within the FIG to encourage continued support. Don't go in too heavy without the necessary support networks* ■ Recreate the wheel *Much work has already been done on this topic, and there are many knowledgeable people willing to lend a hand. Need to utilise these resources!*

Table 1: A SWOT overview for the evolving FIG Young Surveyors Network

3.2 Shaping the Change: Overview of the Young Surveyors Network

3.2.1 Overview

From Young Surveyors Network Draft Terms of Reference, developed by the Young Surveyors Working Group 2009:

The FIG Young Surveyors Network is a continuation of the work the FIG Young Surveyors Working Group started after it was formed during the FIG Congress in Munich 2006. The Young Surveyors Working group was established in response to the low number of young surveyors participating at FIG Events and the fact that FIG was largely unknown amongst Young Surveyors. Further, many of FIG's member organizations are reporting difficulties in attracting and retaining young people to the profession of surveying.

*The FIG Young Surveyors Network goal is thus to increase the number of **active** young surveyors within FIG and to create connections between "wiser" and "younger" surveyors.*

The first work plan for this group was developed in Cairo in October 2007.

3.2.2 Aims

From Young Surveyors Network Draft Terms of Reference, developed by the Young Surveyors Working Group 2009:

Building and maintaining relationships between young surveyors and FIG by:

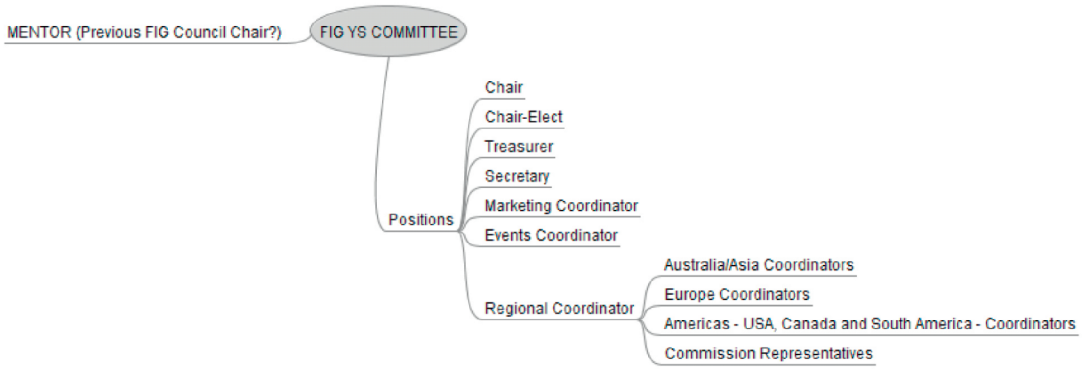

Fig. 1: Mind Map of FIG Young Surveyor Committee structure

- *Proposing and performing activities during FIG events to attract and promote FIG as an organisation for network and knowledge creation;*
- *Establish necessary Liaison relationships with other Young Surveyors organizations;*
- *Establishing and maintaining lead contacts to Commission Chairs etc are in place;*
- *Maintaining an information flow on the Young Surveyors Network to FIG members, including through the FIG website and FIG Bulletin, and more directly to relevant Commission Officers;*
- *Releasing the FIG Young Surveyors Newsletter quarterly with information about what's happening in the YS community.*

The Young Surveyors Network sees itself as at the hub of FIG Young Surveyors activities, making the necessary linkages and providing the necessary advice to commissions and others.

Specific performance indicators include achieving the following at or before the FIG2010 World Surveying Congress in Sydney, Australia:

Management structure firmly in place, including the positions as per Figure 1.

Increase awareness and active participation such that elections akin to the FIG Council can be held for the Young Surveyors Network

Incorporate all regional young surveyor networks that are currently known to exist, and establish regional coordinators and a set of tasks to manage regional expansion

3.2.3 Opportunities

Fairlie (2008) outlines the Young Surveyors Beyond Horizons Project that is the key opportunity and major project hosted jointly by the Young Surveyors Working Group and the FIG 2010 Young Ambassadors.

From Fairlie (2008):

The project will see a series of technical activities held throughout Australia, targeting the application of Surveying knowledge and technology. Attendance will be marketed towards young surveyors, adding value to the potentially long and expensive journey to Australia. A number of experienced and professional surveyors will be invited to attend, building on the mentorship program of the FIG1.2 Young Surveyors Working Group and fulfilling further networking aims of the FIG Congress.

Activities are intended to be either

- Real projects contributing to local communities
- Real projects derived from industry research and development foci
- Historical projects demonstrating the contributions of the surveying profession to Australia

This opportunity presented by this ambitious project is that it is essentially a testing ground for future activities like it which add value to Young Surveyor participation in FIG events, improve funding possibilities, and generally create media attention to the surveying profession. Finally, this project is a test of possible future revenue generation for Young Surveyor activities.

The ultimate, long-term opportunity is to grow the Young Surveyors Beyond Horizons project such that it fulfils a similar role as Engineer's Without Borders (www.ewb-international.org) and Architects Without Borders (www.awb.iohome.net/)/Architects Without Frontiers (www.archi-

tectswithoutfrontiers.com.au). Initially projects would be limited to increasing young surveyor networks and skill levels whilst profiting our own industry: for example, Tenadu & Djaba (2008) mention a lack of GPS baseline permanent reference stations in Ghana, limiting GPS calibration. The Young Surveyor's Network could challenge young surveyors to use this as an opportunity, not only improve the integrity of the profession in Ghana, but to improve the African regional network of young surveyors and international FIG participation. Such projects further improve cross-generational linkages, involving more experienced surveyors as consultants and mentors.

Ultimately there is scope for a future, ongoing "Surveyors Without Borders" skillpool – and promotion such that surveyors are the first to be called for where necessary.

4. Conclusion

"Engineering in the 21st C faces several challenges: firstly it is oriented towards global markets and products; secondly, the underlying knowledge quickly becomes obsolete; thirdly, it must operate within an increasingly stressed natural and social environment" (Enemark, S. 2006).

The crisis in surveying – skill shortages and low public awareness – is real, and unlikely to be overcome quickly or easily. However, it is as much a crisis of interpretation as anything else – the surveying tools and knowledge is there, it is simply a case communicating its existence, and ensuring the professional integrity of the industry.

Young Surveyors as a key element of the crisis are also a key solution. The Young Surveyor's Working Group has demonstrated the power and commitment of this generation, and a passion to overcome the challenges of the future. Mentoring and networking across generations and cultures will be key to continuing and expanding this group to encompass an international network of young surveyors. There are extensive opportunities, and the time is ripe for Young Surveyors to navigate this global consciousness.

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Biographical Notes

Kate Fairlie 0BEng(Surveying and Spatial Information Systems)

Kate Fairlie as a recent graduate of the University of New South Wales (UNSW) admits to being a Gen Y'er. She has a Bachelor of Engineering (Surveying and Spatial Information Systems). Throughout her university degree, Kate was awarded a number of awards and scholarships, including the UNSW Coop Scholarship which led her to work placements with the New South Wales Department of Lands and a Sydney cadastral surveying firm. Kate is about to embark on PhD studies with the University of Technology (Sydney), having most recently worked as a GeoInformation Analyst with Shell UK Exploration and Production.

Kate has been involved in a number of young surveyor and young engineer activities, including being an Engineering Ambassador for UNSW – promoting engineering as a career to high school students in Australia. She is a member of the FIG Commission 1.2 Young Surveyors Working Group, and has been active in the NSW division of the Institute of Surveyors Australia, the Spatial Sciences Institute of Australia and Young Engineers Australia. Kate has organized a number of New Professional and Student networking and development events within Shell – and is looking forward to Young Surveyors beyond Horizons!

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Training Young Romanian Land Surveyors in an International Context

Ioan Ienciu, Luciana Oprea, Romania

Abstract

The integration of Romania into an international context implies the harmonization of new requirements regarding cadastral activities and their organisation. New legislation has been issued regarding cadastral activity, of which we can mention the following: The Agricultural Real Estate Law on the retrocession of lands to the former owners or to their inheritors, the Cadastre and Land Registration Law tackling the provisions for all landed property to be registered in the Land Book ad the Forest Fund Law with the later additions on the system of retrocession of forests to their previous owners.

These laws are now in harmony with the European legislation through a generalised cadastral record keeping system for lands registered in the Land Book. The Romanian system is based on the Austrian system, which is at the basis of most cadastral systems in Europe.

We should remind you that Romania has until recently had two separate cadastral record keeping of real estates. One was based on the Austrian system and it was used in northern, western and central Romania. The other was based on the French system of Records Registries valid for the south and east of Romania. This situation lead to a series of discrepancies that caused problems in meeting deadlines, in the citizens – administration relationship and that was in the end, a waste of human and material efforts. There are also many cases in which different institutions store and use similar data on an administrative territory but they have their own means of data gathering and storing, which leads to different entries for the same record.

In this context of transition in the field of cadastre and land registration, the training of future specialists in cadastral record keeping organisation activities, such as The Owners' alphabetic index, the Registry of Parcels, the Registry of Property Items and etc allows the young degree holders of this field to work in an international context. They are also introduced into cadastral and land registration service providing and they are encouraged to acquire competences to manage a new cadastral database and a computerised system that records land books.

The software designed by the Romanian National Agency for Cadastre and Land Registration is also part of their curricula. Such software is the 'Property Item' that generates a database for each owner. This database will then be part of the general cadastre of Romania, materialized in 'E-Terra,' which has been designed to manage the cadastre and land registration activities in all Romanian regions.

The computerized record keeping system implies geodetic aids that can be included in the management of Land Books. Thus, CAD and similar software and Romanian cadastral software such as Mapsys are included in the students' curricula.

The practical training of students includes practical activities carried out in Romanian companies active in the field of land measurements and cadastre, in local public administrations and in the branches of the Romanian National Agency for Cadastre and Land Registration. The national Ministry of Education has issued a decision by which institutions and companies are required to receive students for practical activities so as to create the link between theory and practice. The Romanian companies are encouraged to give private study scholarships for the best students.

Another opportunity for students in higher education are student mobility programmes, which offer them the chance to study or to have practical, training in Universities or private companies or partnerships abroad. Thus, a future professional of a field that has specific characteristics in each country encourages experience sharing and contacts between the experts.

1. Introduction

"The general cadastre is the unitary and compulsory system of technique, economic and judicial evidence, through which the identification, registration description and representation on maps and cadastral plans of all lands is drawn, but also of other real estates from the territory of the entire country, no matter their destination and the owner."-Law no. 7/1996-"The Cadastre and Land Registration Law".

Starting from this statement, the main purpose of the general cadastre is that of giving in any moment, the real data to the juridical and fiscal organisms, concerning the quantitative part of the

real estate rights and also the economic data that establishes the qualitative part pf the estates from an administrative territory (village, town, and city).

2. The study of the cadastral legislation and of the organization of the territory

2.1 Law no. 18/1991

The year 1991 marked the beginning of vesting of possession and issuing title deeds of possession of land based on Law no. 18/1991. The concerned surface measured approximately 8 million hectares and it was the object of the constitution and reconstitution of property rights. By the constitution of the new surface parcelling, the old lines of parcelling were modified, thing that imposes the drawn of new cadastral plans on a scale of 1: 2000 for outside built-up areas and 1: 1000 or 1:500 for localities.

The Agricultural Real Estate Law no.18/1991 stipulates that "all kind of lands, no matter the destination, the title they are owned or the public or private domain they take part of constitute the Agricultural Real Estate Law of Romania."

2.2 Law no. 7/1996

Law no. 7/1996 stipulated the introduction of the general and modern cadastre and of land registration. It was in conformity with the demands of the legal rights of property. Land registration ensured the consolidation of the legal rights of property and the facility of land and property transfer in favour of the right beneficiaries. In this purpose, according to article 68, law 7/1996 that "In term of 90 days from the finalization of the cadastral work on an administrative territory, the evidence about the cadastral parties of all owners, must be transmitted to all Land Book Offices attached to the Courts of Law of the first instance in order to draw up land books for the real estate."

2.3 Law no. 1/2000

Law no. 1/2000 was adopted to regulate the reparatory measures that had to be taken after the analysis of the application of the Agricultural Real Estate Law no. 18/1991, Law no. 1/2000 deals with the reconstruction of the property right of lands and forest funds. This law also contains regulations concerning the legal situation of some real estates, the constitution of real usage rights and the juridical circulation of the lands exploited by associations that were established based on the stipulations of this Law.

2.4 Order no. 634/2006

The regulation of drawing the documents on different work categories was regulated and systematized by this order given by the National Agency for Cadastre and Land Registration.

In conformity with the regulation concerning the contents and the modality of drawing up the cadastral documentation in order to register a land in the Land Book, the documents will be drawn up as it follows:

a) Real estate that requires documentation for the first registration;

b) Real estate that requires documentation for detachment;

c) Real estate that requires documentation for attachment;

d) Real estate that requires documentation to register a final construction on a land already registered in the Land Book;

e) Real estate that requires documentation to modify the property limit;

f) Real estate that requires documentation to modify the surface;

g) Real estate that requires documentation to describe the dismemberments of the property right;

h) Real estate that requires documentation to reconstruct the lost, destroyed or stolen land book.

3. The study of cadastral evidence systems

3.1 The Austrian system

Land books, as they function nowadays, organized on a based of precise measurements and correct cadastral maps, were institutionalized for the Austro-Hungarian Empire in the Civil code in 1896 and a Law from 1897. They unified the land legislation under the next principles: the force of the registration, the constituent effect of rights of registrations, the solemnity of operations, legacy, and specialty, general and absolute registration. According to these principles, the registration can be made only for estates that can be precisely identified with the exact proof of rights given by the organisms determined by law, in a solemn form. These registers are public and their contents have force of evidence to a third party.

3.2 The French system

In France, the revolutionary laws (1790) were concerned with encouraging loans and with rendering alienation and attainments opposable to third parties. The legal solution was found to be transcriptions. They meant copying the legal document and mortgages in a register from the Court Clerk's Offices from the district where the estate was located, in order of appearance. The transcription in the registers was not compulsory, and their registration was personal, incomplete and imperfect, which required subsequent changes by the help of a Law from 1789 when the obligation of transcription of all property documents was introduced.

3.3 The Romanian land registration system using Land Books

Nowadays, the land registration system by land books is regulated by the Decree-Law no. 115/ 1938 in order to unify the dispositions concerning the land books, applied by law no. 241/1947.

The land books were introduced for the first time in Austria, from the order of the emperor Joseph II, in order to have a land tax based on real topographic data. In that time these taxes were the main income of the Austrian Empire and after that of other European countries. Nowadays, the land registration system is applied in Austria, Germany, Switzerland, Hungary, the Czech Republic, Slovakia, the former Yugoslavia, some territories from Poland, Italy, in the interwar period in England also, and in some of the British colonies.

On the territory of our country, the land books were introduced in Transylvania, Bukovina and gradually as it follows:

- 1794 – the old bordering regions;
- 1855 – in the territories where the Hungarian right was applied;
- 1870 – in the territories subjected to the Austrian Civil Code, including Bukovina.

In conclusion, in Transylvania, three-land book regimes were applied, although they were similar, they also had some particular regulations. They were valid even after the constitution of the Romanian state, until the coming into force of the Decree-Law no. 115/1938 (1947 in Transylvania and 1938 in Bukovina).

The land books from Transylvania were regulated by the Austrian legislation in some localities and by the Hungarian one in others. During this different regulation, the Leading Council from Sibiu, that administrated the territory of Transylvania between 2nd December 1918 and 2nd April1920, the institution of land books was kept even after the Leading Council was dissolved and after the Romanian Government took over on 2nd April 1920. The institution of land books survived as local land legislation and it lasted until the legitimization of the Decree-Law 115/1938.

4. Training young Romanian land surveyors in an international context

4.1 The system of the study credits

In a synthetic definition, the credits are numerical conventional values that measure and express the normal volume of work required from the student to learn the knowledge, skills and work capacities for the subjects that are present in the curriculum of the study programme that the student applied for. The main addition of study credits is based on the estimated time of work, necessary for the study activity and all its forms: courses, seminars, laboratories, individual study, essays, projects, practical work, field work, preparation for the current assessments, assessments from the exam sessions, papers and final exams of studies (bachelor's degree, dissertation, thesis, etc.).

A credit unit expresses a specific number of hours, and the number (package) of credits given to a subject, a compact period for studies (semester, year) or to a series of studies (bachelor's degree, master, doctorate) expresses the study time recognized as necessary for the learning of contents and the gaining of competences according to the subject, the period of time, the series of studies through the collective learning activities, that suppose the presence of the student in the class, but also through the individual and independent learning activities.

The system of study credits was originally created not as a standardization and recognition of studies system in the case of pupil and student mobility, as it was to evolve in Europe under the form of ECTS (European Credit Transfer System), but as a system of differentiation of studies based on the individual capacities and motivations of students (pupils). The credits appeared as a construction technique of the curriculum based on the principle that the essential requirement when designing a curriculum was to assure the correspondence between the contents and learning tasks, on one hand, and time and the learning possibilities of students (pupils), on the other hand.

With this significance, the system of the study credit was first applied in the USA, Canada and some European countries, as an internal organizational study system, based on assigning credits to each course (subject) taking into consideration the time for studying imposed by the educational curriculum. At the same time, through the possibilities of students (pupils) to choose between different levels of credits of the compulsory subjects and between the different packages of elective or optional subjects, the system of credits was a good practical solution for individualizing the time of learning by adapting them to the personal rhythm of learning for each student.

There was an imposed compatibility concerning the units of study programme because, usually, the mobility of students did not last for the whole period of studies but only for shorter periods, as most actions and scholarships took place for a period of three, six months or at most a year. Because of this situation, the necessity that the study programs should be divided into units with personal programmes appeared and also in order to be followed by students as a whole package of subjects and learning activities comparable and replaceable with the counterpart package from the study programme of the basic institution (the place from where the student leaves and where he/she returns to finish the studies).

Based on the experience of most European countries, ECTS recommends the semester as a fundamental unit of study programmes and the semester as a principle of drawing the curriculum. The length of a study programme is expressed in number of semesters and every semester is rated with a standard number of 30 credits. In this way, a program of study with a length of 3 years (6 semesters) will be credited with 180 credits, a programme of 4 years (8 semesters) will be credited with 240 credits and a programme of 5 years (10 semesters) will be credited with 300 credits and to those are also added a number of credits (15-30) to all final exams (bachelor's degree, dissertation).

For the recognition of credits and periods of study, the compatible system is necessary for the level of assessment and grading. It is obvious that the student that studied at a different university cannot benefit of the recognition of that period of time in the original university unless he/she promoted the forms of assessments practiced by the host university. This is why ECTS guarantees the academic recognition of studies by a system that allows to compare and transfer marks or appraisals obtained in different institutions and educational systems.

The ECTS grading scale has 5 levels of success (the letters A-E) and two levels for failure (the letters FX and F). The option for a scale with seven levels and for a grading with letters (not numbers) resulted from a pilot study on a group of 84 European universities. The main idea is that the

ECTS grades	Definitions and performances descriptors	Estimated weights	Grades in the Romanian system
A	**Excellent** – outstanding performance with only minor errors	10%	10
B	**Very good** – above the average standard but with some errors	25%	9
C	**Good** – generally good work with a number of notable errors	30%	8
D	**Satisfactory** – fair but with significant shortcomings	25%	7-6
E	**Sufficient** – passable performance, meeting the minimum criteria	10%	5
FX	**Fail** – some more work required before the credit can be awarded.	–	4
F	**Fail** – considerable further work is required.	–	3-1

Table 1: Grading scale

ECTS scale must be flexible and transparent enough to adapt to some of the different grading systems without interfering with any of them. In this purpose, every level of the scale is nominally defined (by appraisals) and by the synthetic description of performances. Also, the ECTS grading scale provides, with an approximate title, the normal distribution of students for every level under the form of estimated weights.

The correlation of the Romanian grading scale from 10 to 1 with the ECTS grading scale in order to recognize the credits for the students that participate in European mobility is set on a basis of correspondences from the following table. It must be mentioned that the weight for each level, or grade, is approximate and depends on the experience and practice of each university and faculty. For example, 9 can be assimilated to excellent (A) if the level of exigencies practiced at the university, faculty or the program of study places this grade at the level of remarkable results. Under these circumstances, level B will be the equivalent to 8, level C to 7 and level D to 6.

4.2 The students' practical training

The practical training of undergraduate students is organized according to Law 84/1995, Law 288/ 2004 and the Charter of "1st December 1918" University of Alba Iulia. The responsibility for the coordination, organisation and realization of the students' training belongs to:

a) At the university level -the vice-rector for education, strategy and quality;

b) At the faculty level – the vice-dean/the scientific secretary nominated by the Dean as responsible for students' training.

c) At the level of departments – the training responsible for each study program, nominated and reconfirmed at the beginning of each university year by the council of the faculty.

According to their specialty, the faculties can draw instructions with completions at the present statute, validated by the faculty council and communicated to the university, to the vice-rector for education, strategy and quality.

The training is compulsory and its length is regulated by the curriculum of each programme of study according to the laws in force.

The training takes place in institutions/ companies/ laboratories or compartments of the faculty. These must have a relevant domain of activity for the specialty of the students. Working students can receive training in the workplace, if the requirements for accumulating the competences set in the training subject data sheet are met.

The training periods are organised based on a training agreement (Annex 1), signed at the level of faculty/department. Based on the training agreement, the host company assures, for the whole training period, the guidance of students by designating a training coordinator.

The students have the possibility to choose between different ways of doing their training:

a) The training stage proposed by the student; the identification of the place where the training takes place is the student's obligation, it's also a challenge and a way of training in finding a job after graduating.

b) The training period organized by the faculty; the faculty and the department facilitates to find some training places for students.

In order to do the training in the host company proposed by the student, after finding a training place, the students files an application form to the coordinating department (Annex 2).

The student presents himself/herself at the training place based on an address issued by the Faculty Dean's Office to the host company (Annex 3). In the first day of training, the student presents to the host company the following documents:

a) The address issued by the Faculty Dean's Office (Annex 3);

b) The training subject data sheet;

c) The example certificate that is to be filled in by the host company at the end of the training stage.

The regulation of the training activity between student and the host company can be drawn as a training contract. The student takes the whole responsibility to respect the organization norms and labour safety specific to the host company for the whole period of the training period.

During the training period, the students have the obligation to do homework, a project with relevance for the domain/ specialty they follow, and their activity must apply the theoretical knowledge they achieved during the educational activities. The activities must be relevant for their specialty. The host company must designate a person responsible for the training activity of students and this person must assist them during the whole period of training.

At the end of the training period, the student must have the training project that must contain the following:

- The first name and name, the faculty, the specialty, the year of study;
- The name of the host company, the period of training, the total number of hours of training;
- The training coordinator designated by the host company;
- The training subject data sheet;
- The activities carried out, specific professional aspects;
- Other documents that were demanded by the coordinating department.

The host company evaluates the project (very good, good, satisfactory/unsatisfactory) and validates the training period by issuing a Training Certificate (Annex 4).

The recognition of the training period is finalized by giving the credits set in the curriculum. The evaluation of the achieved skills of the student during the training period takes place as oral examination, by a Training Evaluation Committee designated at the level of the coordinating department at the beginning of the academic year.

The training period will be recognized during the oral examination only if the following requirements are met:

- The Training agreement between the faculty and the host company is signed;
- The student works in a domain linked to his/her specialty, using and achieving relevant knowledge to practice profession he/she trains for, having as a reference the training subject datasheet;
- The training project was verified and countersigned by the training coordinator of the host company;
- The host company validated the training project by handing out the Training Certificate (Annex 4).

The assessment is based on the following elements:

- The analysis of the training project presented by the student; the relevance of the activities made for the professional training according to the training subject datasheet; the skills and achieved knowledge, the evaluation obtained from the host company;
- The assessment of the presentation performance of the training report in front of the Evaluation Commission;
- The presentation of the Training Certificate given by the host company.

Between	UNIVERSITY "1ST DECEMBER 1918" ALBA IULIA THE FACULTY OF SCIENCES
Dean (*name, address, phone, fax, e-mail)*	Prof. Sorin Briciu, Ph.D. 510009, Alba Iulia, 11-13 Nicolae Iorga street Phone: +40 258 806263 Fax: +40 258 806329 E-mail: secretariat_stiinte@uab.ro
Contact person (training responsible) *(name, address, phone, fax, e-mail)*	
The Company manager (*name, address, phone, fax, e-mail)*	
Contact person (training coordinator) *(name, address, phone, fax, e-mail)*	

*Table 2: Training Agreement for academic year 2008/2009.*The university binds itself to:

4.2.1 Annex 1

The above persons agree to cooperate in order to accomplish the students' training. The partner company binds itself to:

- Assure training places;
- Organize monitoring and assistance activities for students, including the briefing for work safety;
- To assure the carrying out of the training according to the initial plan, signed by both parties.
- Select the students;
- Organize the final assessment of the training activity;
- Disseminate the results of the students' training in agreement with the partner company.

The assessment of the training will be made by the university and also by the company, based on the training subject data sheet, annexed to the present agreement.

No.	Faculty	The field of undergraduate studies/Specialty	Year of study	Number of students	Period
1.	Sciences	Geodetic engineering/ Land surveying and Cadastre			

Table 3: The students' training.

University "1st December 1918" Alba Iulia, The Faculty of Sciences	The name of the company
Dean: Prof. Sorin Briciu, Ph.D. Signature: Training coordinator at the level of faculty: Signature	General Manager: Signature:
Date:	Date:

Table 4: Signatures of the authorized representatives.

4.2.2 Annex 2

FACULTY OF: _____
DEPARTMENT OF: _____

Approved
Training responsible

APPLICATION

I, the undersigned, ……student in year of study……specialty…….field of studies……. hereby apply for a training period within the company/institution ……..located in (address)…….

My reasons for the application are……. I would like to add that the area of activity of the company is…… and the requirements for the acquisition of competences mentioned in the training subject data sheet are met.

Date, Signature,

4.2.3 Annex 3

FACULTY OF:_____
DEPARTMENT OF: _____

To,…….
(the host company of the training)
to the General manager…….

Based on the training agreement for students, signed between the Faculty ……., from the University "1st December 1918" of Alba Iulia and ……(name of the company), we inform you that the students:
1.
2.
were assigned for practical training within your company. The coordinators for the training period of the students from our Faculty are:
1.
2.
The training period lasts for 2/3 weeks, between……, with an average of 6 hours a day. The daily and weekly program of the training are decided by the training coordinators of the faculty, the training coordinator of the company and the students, according to the schedule and the nature of activity of the company.
The students have the obligation to follow the training programme exactly as well as the rules and norms of behaviour established by the internal regulations of the company and of the working place where the training takes place. The students are responsible for any violation of these regulations and for the prejudices brought to the company.
In this respect, please appoint a training coordinator from your company.
Thank you!

Training responsible
Dean,

4.2.4 Annex 4

INSTITUTION
Address:

CERTIFICATE
For training period

We hereby certify that ……, student at the Faculty……., specialty……..year…….of study, undertook in the period……..-practical training in the specialty in……..(the name of the company), department…….. The training coordinator appointed by the company was Mr./Mrs.……
The training project of the student was assessed in our company according to the training subject data sheet, receiving the evaluation……
The present CERTIFICATE was issued to serve for the student's recognition of the training period during the oral examination.

Date General Manager,

4.3 The study of applications drawn by ANCPI for the management of the cadastral services

4.3.1 The modules of the "GENERARE CP" application

In the process of preparing the documents for special papers in the field of cadastre, we need to get some standard files for storing the information in the estate chart and for storing the coordinates according to the outline of the estate.

The modules of the "GENERARE CP 1.0.17" application facilitate receiving these files in a standard format, which should allow their storing and validation by the inspectors of the Cadastre and Land Registration Offices.

The GenerareCP.msi application is for the physical/judicial persons authorized to execute special works in the field of cadastre in Romania.

These files obtained through the present application have to be handed in to the Cadastre and Land Registration Offices, together with the documents prepared for the real estates, whose owners requested that cadastre work should be done (Figure 1).

The application allows the introduction of the cadastre information regarding the land and constructions in a window programme conceived for this purpose, but it also allows saving them in the same file with their coordinates, necessary for their import into the cadastre database by the Cadastre and Land Registration Offices.

As the chart of the estate item is separately created for lands and apartments, the application offers the possibility to select the type of land the chart is made for: apartment or land.

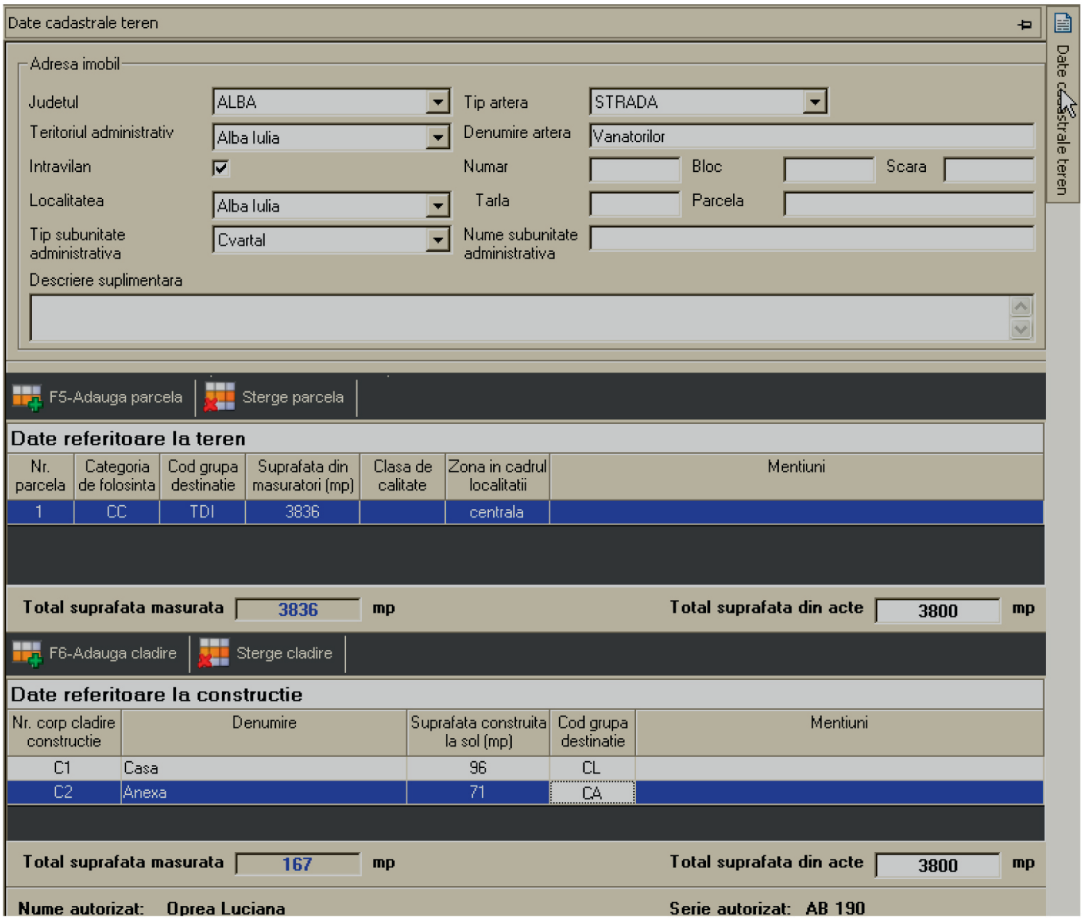

Fig. 1: The estate item chart filled in completely for a construction land.

4.3.2 The management of the cadastre and land registration services in Romania – "e-Terra"

The "Registry" (RGI) module is one of the three main modules of the integrated Cadastre and Land Registration "e-Terra" System, the purpose of which is to computerize, automate and optimize the registration flow of applications in the Cadastre and Land Registration offices.

The Registry module accomplishes a management of the applications addressed for supplying cadastre and land registration. The applications that are introduced in the system receive a number and a registration date, and their resolutions are further observed in the system.

The RGI module implies the following process:

- Attestation;
- Application registration;
- Establishing the date when then they can be resolved;
- Allocating applications so that they can be resolved;
- Reallocating applications;
- Establishing unavailability intervals;
- Fill-in paper;
- Searching;
- Resolving/finding solutions;
- Analysing the application after the solution has been found;
- Administration;
- Generating Registry reports.

The special staff of the National Agency of Cadastre and Land Registration, respectively the ones of the Cadastre and Land registration Offices that participate in the RGI module are as it follows:

- Public Relations Advisor;
- Assistant registration officer;
- Registration officer;
- Chief Registration officer
- Inspector;
- Chief Engineer;
- System administrator.

The main menu of the RGI application has the following submenus:

- Registration: allows the introduction of the data related to a certain application and saving them in the database;
- Searching: allows searching for the applications that respect certain criteria;
- Finding multiple solutions (assistants): allows finding solutions for more applications at the same time (only for registry assistants);
- Reallocating LB;
- Reallocating CAD;
- Processing: allows observing the applications after a solution has been found or filling in papers.

What is very important is the fact that the application offers security on an access level; thus, the submenus are active (available) for users, according to the rights established for the type of function it has. Searching for information can be done according to one or more searching criteria:

- The number of criteria;
- The time when the application was introduced;
- The person who applied;
- The solicitor;
- Authorization;
- The Land Book Office list;
- The land arrangement unit;
- The position of the person to whom the application was given;
- The people hired in Cadastre and Land Book Office;
- The number of the land book;
- The state of the application (the solutions of which have been found at the beginning of the search, with an exceeded term).

After one or more searching criteria have been selected, the "Search" button should be pressed. For a new search the "Delete filter" should be pressed (Figure 2).

5. Conclusions and suggestions

The economic activity of a country cannot take place without a solid cadastral background that certifies the right of property for the investors.

The introduction of the general cadastre in Romania is a necessity that challenges people to find the best technical solutions. The solution for this problem is difficult. On the one hand because the introduction of the general cadastre was carried out in different stages, with the help of different methods because of the dynamics of the legislation, and on the other hand, because

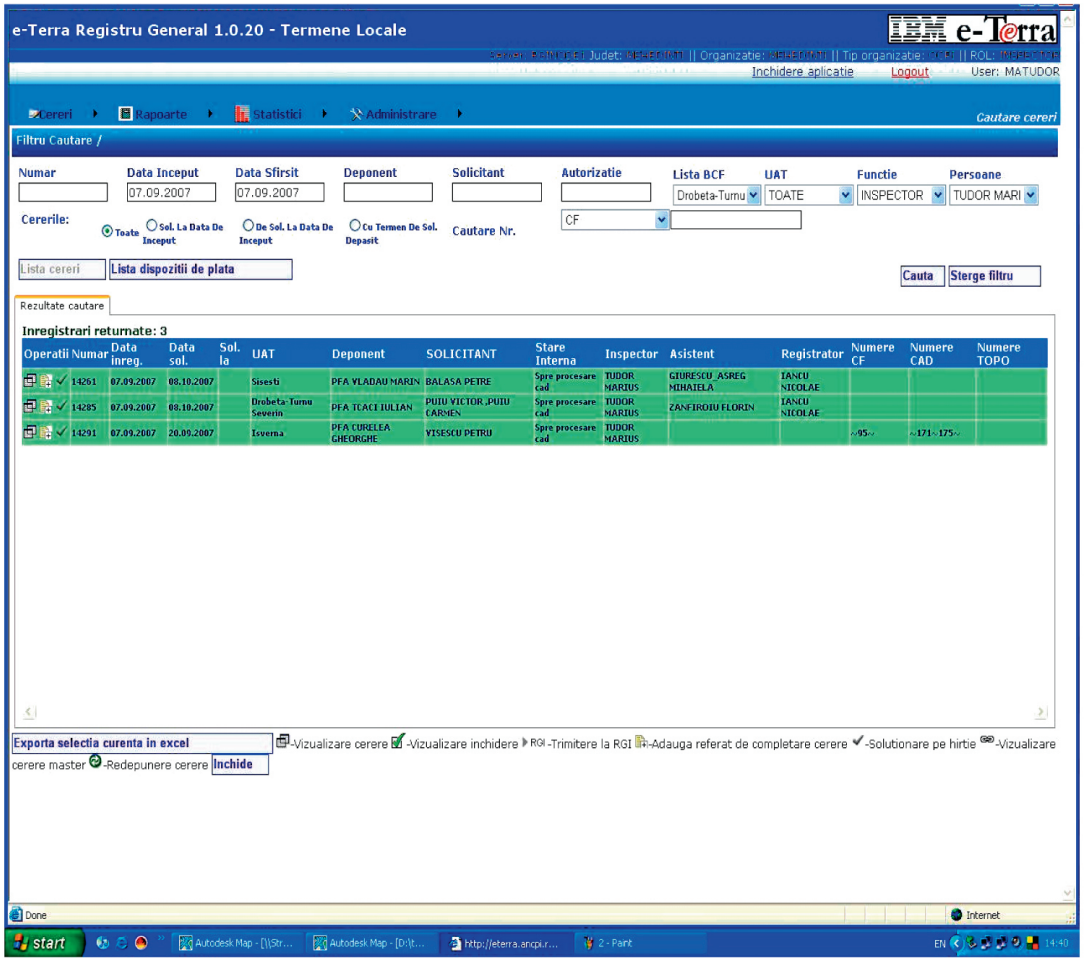

Fig. 2: Searching information regarding the cadastre documents filed in.

homogeneity was required even if the demands came before achievements.

In approaching this work, the general objective was to find efficient solutions about the optimization of the cadastral work, work that represent the basis of the introduction of the general cadastre optimizing of the cadastral work, work that represent the basis of the introduction of the general cadastre and that make possible the achievement of the most existing problems in this domain on a short period of time.

In this context, the training of young Romanian land surveyors implies the presentation and implementation of some technical topographical-land surveying solutions according to the demands of the Romanian Agency for Cadastre and Land Registration. These were stipulated in the Order no. 634/2006 for Romania, and also any other legislative act that regulates the cadastral activity in a certain country.

In this context, the training activity of the specialty "Land surveying and cadastre" from the field "Geodesy Engineering" is structured as follows, in three important directions:

- A first direction that shows the stages of a cadastral work;
- The second direction is given by the legislation that governs the means of drawing up the cadastral documents;
- The last concerns the means of drawing up documents, pinpointing the main documents that are drawn by a land surveyor.

The multilateral connections between the different means of drawing up cadastral documents have singularities of manipulation and transformation of

the data that could be solved only by specialized knowledge corroborated with IT knowledge and a big effort from the students, future graduates, during the whole educational activity in the four undergraduate study years.

At the same time, the educational activity and the training for the specialty proves a continuous interest to combine theoretical knowledge and practical training. Several papers prove this that students wrote which were strongly anchored in the geodesic reality.

Working for the Offices of Cadastre and Land Registration and Town Halls cadastral Offices, or for sole proprietors or for surveying companies, students can benefit from a significant decrease of the study time as information is given together as a package, their projects have a higher execution precision and the students can access the necessary information to complete their assignments more easily and in due time. This way, the main purpose of the learning process is achieved.

At the same time, the interest of the students and teaching staff in ensuring a quality higher education and also a modern one from the point of view of the methodology and of the contents, benefits academic education as university methodology is connected to the current practical training.

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On Student Assessment in Technical Distance Education

Nicolae Luduşan, Levente Dimén, Romania

Abstract

In order to make a more efficient assessment of students enrolled in technical distance education programmes, we believe that an alternative form of assessment is necessary. This would change the standard test-based assessment to a practical assessment, where students can exercise their abilities through project work and judgement can replace mechanical repetition of information.

Assessment techniques to be used in technical education must meet specific requirements in this field, such as:

- students have to prove the competences that they have acquired during a degree programme; they do not just have to choose an answer from a list of possible answers;
- competences have to be tested by project work where students can prove their learning abilities and their practical application skills;
- the assessment has to highlight the students' creativity, the extent to which they understand the knowledge they have acquired and how they use it in solving practical issues.

The assessment that best meets these requirements is based on a 'student's portfolio' that contains, in a logical structure, all the materials that a student uses during a cycle of education: abstracts, analyses, problem solving, diagrams, syntheses, reading notes, bibliographical lists etc. Some of these materials are mandatory work tasks, required by professors and others produced by students during their studies.

When studying, each student creates their own portfolio, even if some of the assignments require teamwork. Every student will add to their portfolio the documents containing the final results of the teamwork. Elaborated in this manner, portfolios create the possibility of a more complex and more correct assessment. The assessors can identify the students' practical abilities, when they have applicative work for which they have sufficient time and resources at their disposal.

Portfolio-based assessment raises several issues that can be formulated through the following questions: "What should a portfolio contain?", "What special techniques have to be used to make an objective assessment of a portfolio's content?", "What standards have to be applied in assessing the students' activity?"

The two assessment techniques, the test-based and the portfolio-based, have their own supporters. The partisans of portfolio-based assessment suggested that it should completely replace standard test-based assessment. However, there is the risk that the problem is approached by different procedures and standards, which leads to a decrease of the degree of objectivity for the assessment.

The paper shows the results of a pilot test applied to a group of students enrolled in 'Land Measurements and Cadastre,' a Bachelor's Degree programme of 'December 1st 1918' University of Alba Iulia.

The aim of the pilot test was to tackle two specific issues raised by portfolio-based assessment:

1. clarifying the aspects connected to the way in which this method of assessment is used and the manner in which it is applied, based on a survey applied to a group of professors;
2. the outcomes that this means of assessment have on the students' performances.

The conclusions of this test led to some interesting aspects:

- the portfolio-based assessment is rather used by the young professors, keen on teaching and aiming for self-improvement;
- the results of the assessment are sometimes contested by students;
- most students prefer portfolio-based assessment.

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Current Situation in Ukraine of Urban and Rural Land Development (Practice and Education)

Olga Petrakovska, Ukraine

1. New social and economic conditions demand the Reorganization of the education system

Land reform is continuing in Ukraine. It is accompanied by a transformation of property rights, development of the land market, formation and improvement of the cadastre systems. That generates a need for radical reforms in land management.

The fundamental changes which induce a necessity for improvement and adjustment in the practise of the approaches towards land management for variable conditions are:

- The new conception of property right declares various kinds of rights for land ownership and land use.
- Substitution of the only one owner by means of production to unlimited number of owners both public and private;
- Develop small-scale and middle-scale business and an appearance of a large quantity of entrepreneurs;
- Monopolistic centralized system of financing of land development from state budget orientated towards a greater number of independent investors;
- Declaration of local self-government rights transferred management mechanisms to local level and has made relations between different levels of authority more complicated.

Furthermore land use right and the right to build are separated. It produces supplementary problems and claims for land management and development.

The land policy reorganization and land reform are closely connected with land market formation and development. In spite of land ownership being established in 1991, the reality is that the market started to form and develop at the beginning of this century after the adoption of a series of statutes. The most important key to efficient development of property markets is adequate provision by qualified specialists. Those specialists have to be able to solve complicated comprehensive tasks both technical and juridical concerning land transformation. Moreover functioning of land markets requires the creation of updated land registration systems. These systems have to indicate clearly various kinds of legal land ownership and keep information about land and different improvements.

It necessitates training for new professions in the fields of land management and real estate development under the influence of new circumstances. One of those trades is cadastre specialist.

2. Particularities of The educational system

The land reform which was executed in Ukraine and the new conditions are the cause of changes of the higher education system. Ukraine has a complicated system of higher education. This system has remnants of soviet heritage and changes under the influence of the present-day demands of labour market. Those demands are changing very fast. It could be explained by a retrospective review of land reform and the modification of legislation during the last ten years. Heritage of soviet times is evident in the strict standards of education. These standards regulate the structure of curricula and percentage of different disciplines for various specialties and must be approved by the Ministry of Education and Science, further “Ministry”. Approximately 70% disciplines are obligatory and can’t be changed without Ministry agreement. For technical specialties, obligatory disciplines include next modules: the humanities, social and economic studies, nature and science, profession and practice studies for concrete professional spheres. Other disciplines are determined by university decision. It influences the making and changing of curricula greatly.

From 2004, education in Ukraine is realized according to fixed educational fields which are accepted and approved by Ministry. Each of these educational fields combines specialities of a similar nature. For example, educational field “Construction” combines specialities like “industrial and civil engineering”, “sanitary engineering” etc. Cadastre activity is a part of education field “Geodesy, Cartography, Surveying’. Curriculum

for different specialities within the field must have an equal obligatory part. That makes an impact on the curriculum structure very greatly as well and restricts the possibility of its transformation.

Education institutions accrue a right of teaching activities for different qualification levels and education fields and specialities in accordance with domestic accreditation and licensing. The accreditation and licensing is implemented according to claims of education standards and state requirements for staff, scientific, methodical, material support.

3. Adaptation to Bologna process

Worldwide globalization of education and integration of Ukraine with the world community requires that the educational system should be adapted to new social and economic conditions. At the beginning this century Ukraine accepted Bologna model of education. Adoption of this model has demanded essential reorganization of Ukraine's system of education and science. By now ESTC has been put into practice at Ukrainian universities and teaching is carried out in agreed modular units.

Before acceptance of the Bologna model of education we had the qualification levels engineer or specialist. By the law "About higher education" (2002) there are qualification levels bachelor, specialist, master. Thus degree of specialist has been kept from previous system and degrees of bachelor and master have been taken according to the European experience. As a result there is unawareness about what kind of expert students who have different diplomas are. According to law, the degree of bachelor corresponds to "basic higher education". The degrees of specialist and master are declared as levels of "complete higher education". The teaching of bachelors has been realised for ten years but the population has not understood and has not given credence to this degree till now. The same attitude exists from employers. It is difficult for graduates who have a bachelor diploma to get a job. As a rule they get a job under the condition that they will continue their education and will get a degree as a specialist or a master. It is a tricky question of also what is the difference between a specialist and a master. In this situation some universities turn to teaching bachelor and master degrees without the specialist degree. This approach keeps up to date inasmuch as it corresponds to long-rate government plans. But factually that decision leaves still more uncertainty about the specialist degree which is accepted by legislation.

Specialist teaching can be received only after a bachelor degree and takes one year. A Master's program takes from one to two years at different universities. Students can be accepted for a master's program if she/he has a bachelor or a specialist degree. Teaching of specialist and master implementation is parallel at some universities. Their programs don't have very big differences. So in the last few years more and more students want to get a master's degree without going to the trouble of a specialist one.

Comparative analyses of the different approaches have to be done for the successful transformation of the existing educational system. The necessary changes and the ways to realize them could be defined and appreciated only after this comprehensive analysis. All new methods should be applied consecutively and after preliminary discussion and substantiation.

4. Teaching of surveying and cadastre specialists

The training for surveying and cadastre specialists started in the middle of the 90s and the first of them were introduced into the labour market at the beginning of this century. The teaching of these specialists began at both technical and agricultural universities. The program for geodesy training formed the basis of this speciality at technical universities and teaching has focused towards engineering sciences. The education at agricultural universities has been oriented towards solving problems and tasks of agricultural land management. The leading technical universities in Ukraine which realize this teaching are Kiev National University of Architecture and Construction, Donetsk National Technical University, Lviv Polytechnic University. The agricultural ones are Kiev National University of Biological Resource and Nature Recourse Use, Lviv National Agriculture University, Kharkov National University of Agriculture, National University of Water Management and Nature Recourse Use (Rivne). By now the departments which have put into practice the teaching of new specialists have a unified name "department of surveying and cadastre" at both technical and agriculture universities. But this name doesn't correspond with education tasks which are decided in full measure.

The standards for cadastre education have been established for the bachelor degree. Curricula have been transformed to European

credit transfer and accumulation system (ECTS). All disciplines which are oriented to professional education (profession and practice studies for concrete professional field) aggregate approximately 100 European credits in the curriculum. This part of the curriculum can be divided into five modules: technical, GIS, economical, juridical and planning. The technical module is the biggest part (50%) and geodesy disciplines average almost 80 %. In second place is the GIS module (28%) and then economical (14%), juridical (6%) and planning (2%). These figures speak for themselves. In other words sometimes the graduates of surveying and cadastre could be named "modernized geodesist". In practical situations each of them could work as a geodesist if she/he wants.

Such a situation has been amended by means of disciplines which are determined by a university's decision in practice. The teaching in the surveying and cadastre department at Kiev National University of Architecture and Construction is oriented towards urban land and in practical situations includes land management and development. So disciplines which are determined by the university enlarge the knowledge in urban legislation and planning, formation territory infrastructure, land and improvements valuation, engineering services etc. There is the same situation at other technical universities. Agriculture universities focus on teaching about soil conservation, protection of natural resources etc.

Cadastre activities have been determined by new Land Code in 2001. In according with that, the important points are: property delimitation, formation and juridical registration, property valuation, state control and preservation. That has defined new qualitative demands for cadastre specialists. As a result the curriculum has been corrected. However geodesic disciplines take the greater part of them until now.

Surveying and cadastre is the new scope of activity for Ukraine. We don't have the necessary and sufficient experience to make decisions about land problems which are natural for market connections and cooperation. Teaching such experts was not realized until the end of the 90s. Consequently, teaching staff are formed from experts from adjoining professional areas who extend and improve their knowledge in the new field. This is problematic for new trades and creates extra problems in education. In addition the former academic degree system is kept: candidate of science and doctor of science.

One more problem creates troubles for teaching in this field. This is a deficit of some forms of teaching materials. Practice methods and mechanism of land management and registration are closely connected with domestic legislation. So some kind of teaching materials have to be modified very often according to land, registration, planning and other policies.

5. Demands of present-day labour-market

Demands of the labour market have been changing permanently for the last seventeen years. There are some reasons and explanations for it. When the cadastre speciality was established the main tasks for the economy were land unit delimitation and land registration for taxation. So it defined the needs of market. At first university graduates worked mainly at state bodies.

At the beginning of this decade, about 50% of the built-up land had been transferred to private property. Formation and development of urban land market has determined new requests. New tasks have to be solved: land and construction valuation for selling and mortgage, improvement of the cadastre system for guarantee of title and insurance, determination of more effective land use under existing juridical and technical conditions. Subsequent evolution of the land market brings up questions like compulsory purchase, entitlement payment, division of right in time and space. Land disputes emerge more frequently and are more complex. All those points could be joined into one trade – land management. But there isn't such a speciality in academic education in Ukraine till now.

University graduates generally work at both state and private bodies in the present day. State institutions usually are cadastre, land and urban planning committees and bodies at national, region and local levels. Private organizations are: survey services, property sale and valuation agencies, insurance companies, mortgage bank and development companies. They work also at other bodies which are responsible for land management and development.

It is the entrepreneur's opinion today that determination of more effective land use, search of juridical and technical implementation methods are the most prevalent and the most intricate question today. Public employers focus on the development and improvement of the structure registration system, provision for their reliability and credibility. So it is evident that the current situation where there is a need for land market and

land management requests specialist, who is able to solve problems on basis of complex interdisciplinary approaches, is approaching. Analysis of practice tasks which cadastre specialist now has to solve proves a necessity of knowledge extending into the fields of urban planning, economy, legislation (civil, land, urban, construction, environmental law) and modern GIS technology. An increase in part of these disciplines can be implemented at the expense of the decrease of geodesy disciplines. As it is obvious from the foregoing improvement, the surveying and cadastre curriculum should be based on integration with humanities, economy, juridical and engineering sciences taking into account European standards for specialists in this area.

6. Conclusions and Propositions

The reasons for the main problems which exist in the Ukrainian education system can be determined both general for education system as a whole and for the surveying and cadastre field in particular.

The general problems are:

1. Transformation of the curriculum is very difficult in connection with existing standards and Ministry obligatory agreement.
2. Lack of understanding and recognition of the bachelor's degree as a qualification level of expert and non-claiming of them by the domestic industry. As a rule an open admission to university is put into practice according to specialities.
3. The similarity between the teaching program of specialist and master and the result unwarrantable confusion with comprehension of those degrees.
4. The system of scientific degrees awarding is more complicated than in Europe. It makes preparation for scientific and teaching staff very difficult.
5. The weakening of cooperation between academic institutes with scientific and industrial ones.

The problem of the surveying and cadastre field are:

1. Plenty of geodesy disciplines and shortage of planning, economy and jurisprudence disciplines in the curriculum.
2. Provision by qualified teaching staff is difficult because of multidisciplinary approach of education.
3. Formation of Master program for surveying and cadastre field is difficult in connection with permanently changing of legislation and labour market demands.
4. Necessity of permanent modification of teaching material and their deficit.

Take into account foresaid the nearest improvement of surveying and cadastre education could be achieved by next methods:

1. There should be a defined difference between bachelor and specialist and between specialist and master. It should be made by introducing a difference in the curriculum in such a way that if the specialist degree is denied, the bachelor and master curriculum could be easily transferred.
2. The percentage should be amended for different disciplines in the curriculum. To increase planning, economy and jurisprudence disciplines and decrease geodesy ones. Fundamental knowledge of classic academic science to give an opportunity for grounded decision making under permanently changing social and economy conditions.
3. A system of retraining and raising the level of professional skills should be developed for teaching staff in base industrial organisations.

More long-term methods are connected with the transformation of the system of education and science, and stabilisation of the political and economical situation in the country.

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Contemporary Education and Quality Assurance in the Geodesy and Geoinformation Programs at the Vienna University of Technology


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Abstract

This paper provides some general remarks on the education programs in the domain of Geodesy and Geoinformation at the Vienna University of Technology. Currently one bachelor and three master programs are offered. A special focus point will be attempts for quality assurance.

1. Education and Teaching at the Vienna University of Technology

The education offered by the Vienna University of Technology is rewarded by high international and domestic recognition. The chances of graduates for getting an attractive employment are very prosperous. The high demand on graduates of the Vienna University of Technology from economy and industry, governmental as well as research institutions is evidence for this.

The content of the provided courses is actualized continuously and adjusted to the requirements by industry and economy. Students of the Vienna University of Technology are very flexible because of their solid know-how in technical and natural science. This knowledge is complemented by an offer of courses covering the areas personality development and the so-called "soft skills" (e.g. foreign languages, management know-how, etc.). They receive a solid basic knowledge accompanied with individual tasks to be chosen by each student subject to their personal interests. Great emphasis is also put on the participation of students in current research projects.

Students of the Vienna University of Technology can choose between several curricula. They are offered without one exception (teacher training programme) as bachelor and master programmes. Bachelor programmes last for 6 semesters. Master programmes can be completed within further 3 or 4 semesters following a bachelor programme or equivalent postgraduate degree.

According to its status, the Vienna University of Technology offers postgraduate doctoral programmes as a follow up to all master programmes. Besides the already well established doctoral programmes of Technical Sciences and Natural Sciences the new doctoral programme of Science of Social and Economic Affairs has been introduced in 2004.

More emphasis is at the moment and will in the future be put on at the following three important accents: internationalization of education, e-learning and continuing education. These tasks are fulfilled by the approved Department for International Relations, the E-Learning and the Continuing Education Center.

2. The Geodesy and Geoinformation Departments of Vienna University of Technology

The aim of the research and education programs of the Geodesy and Geoinformation departments is based on international leading programs. This is visible in the acceptance and attractiveness of the education programs to students from beyond the region of Vienna and surrounding areas. It is also visible by the fact, that the research groups of Geodesy and Geoinformation are heavily linked to leading international institutions.

The research activities of the research groups in Geodesy and Geoinformation are noticed all over the world, which is documented in invited presentations and proceedings of international conferences, awards for scientific contributions but also by elections in executive committees of

international scientific organisations, editorial boards and program committees.

The area of Geodesy and Geoinformation is administratively represented by three departments, which are divided into seven research groups:

- Institute of Photogrammetry and Remote Sensing
  - Research Group on Photogrammetry and Laser Scanning
  - Research Group on Remote Sensing and Data Assimilation
- Institute of Geoinformation and Cartography
  - Research Group on Geoinformation
  - Research Group on Cartography
- Institute of Geodesy and Geophysics
  - Research Group on Advanced Geodesy
  - Research Group on Applied Geodesy
  - Research Group on Geophysics

Within the focus of the Institute of Photogrammetry and Remote Sensing the main areas of expertise and research include especially issues of deriving Spatial Data from Laser Scanning and Remote Sensing. The research group "Photogrammetry and Laser Scanning" mainly deals with geometrical aspects of object reconstruction, whereas the research group "Remote Sensing and Data Assimilation" focuses on physical problems of remote sensing as well as on advanced methods of data interpretation.

The Research Group Geoinformation of the Institute of Geoinformation and Cartography traditionally deals with fundamental research within the scope of spatial data handling. Ontological approaches for the acquisition and representation of the importance of spatial data are the main focus of information system research. Activities include the utilisation of functional aspects and new mathematical modelling of spatio-temporal processes. Among social and physical geo data especially data which describe properties (or other rights) are in the focus of research.

The Research Group Cartography focuses in their research especially on new ways of communicating spatial information by cartographic means. In this context the role of new media, especially within the domain of mobile systems, is a main area of research. Special fields of fundamental and applied research are situated in the domain of Location Based Services and Ubiquitous Cartography, where fundamental questions of efficient cartographic communication processes are tackled and proved by applied developments.

The three research groups of the Institute of Geodesy and Geophysics cover a wide area of expertise. The research can be generally related to the research focus "Integrated Geodesy and Geodynamics". Main research activities cover the domains of Navigation and Positioning by means of satellite geodesy (GPS, Glonass, Galileo, SLR), the implementation of radio-interferometry on long basic lines for geodesy and astrometry (VLBI), the integration of geodetic space processes and combination of geodetic parameters in the frame of Global Geodetic Observing Systems (GGOS), the analysis of interactions of the system earth by means of variations of the earth rotation parameters and the gravity field, the observation of global changes on the earth by means of Global Monitoring Earth Observing Systems (GMES), the analysis of geodynamic processes at regional and local scale by means of geophysical methods of exploration, monitoring and modelling, for example in the alpine area (geodynamics of Eastern Alps, structure and genesis of alpine valleys, stability of valley edges).

3. Education Programs in Geodesy and Geoinformation

As mentioned above the Vienna University of Technology offers within the branch of Surveying and Geoinformation (Faculty of Mathematics and Geoinformation) one bachelor program (since 2005) and three master programs (since 2008). Major goal of the courses is provision of key competences in engineering geodesy as well as in administration and visualization of spatial data. There is in addition a broad offer of courses dealing with topics like satellite navigation, Earth observation, geophysical exploration and monitoring of hazardous regions. This broad basis of competences opens successful students a wide range of job opportunities.

The programs are in detail

- Bachelor program "Geodesy and Geoinformation"
- Master program "Surveying and Cadastre"
- Master program "Geodesy and Geophysics"
- Master program "Geoinformation and Cartography"

The bachelor program provides within the first semesters basic knowledge in mathematics, physics, informatics as well as geodetic coordi-

nate systems and coordinate transformations. Introductory lectures in engineering geodesy, photogrammetry, airborne and terrestrial laser-scanning, cartography, geophysics, and satellite navigation are accompanied by a number field courses to practice. Starting with semester three one out of two modules (30 ECTS-points each) has to be selected to locate the students main focus. One module concentrates on modern geodesy, the other one on informatics and handling of spatial data. Nevertheless an overlap of at least 30% of the courses still ensures that students of both modules graduate with the same Bachelor degree and may switch later between the fields. Both modules cover, for example, lectures in legal rights, land administration and economics. Bachelor graduates usually proceed in one of the offered master courses but a small percentage also looks for immediate employment.

Since the start of the bachelor program the number of new students per year has increased from approximately 25 to about 50. A first evaluation end of 2008 shows that out of around 35 of them still in the program at the begin of the second year about 70% are able to receive their bachelor degree within 7 semester.

All master programs are intended for native and foreign students who have achieved a bachelor's degree and aim working as decision makers or leading scientists in geoinformatics, geodesy and navigation, engineering surveying, data adjustment, computer vision or remote sensing. Students are confronted with 'state of the art' science and instructed how to provide high quality and efficient solutions in a permanently changing environment. Consequently, besides the technical skills, a number of courses deal with presentation techniques and communication in foreign languages.

The master program "Surveying and Cadastre" focuses on engineering geodesy and land management. This includes for example courses on precise surveying techniques, machine guidance and control, indoor- and outdoor navigation, monitoring of potentially hazardous motions of artificial monuments or natural objects like land slides. Besides, special attention is paid to legal and economic competences which are indispensable skills to become a successful civil engineer.

The master program "Geodesy and Geophysics" deals primarily with Earth observation, Global Change monitoring and exploration techniques. Focal points are Reference Systems, observation and modelling of the Earth Rotation and Earth Gravity Field, satellite based Earth Observing Systems as well as seismic and gravimetric exploration techniques. Closely linked are the tasks of precise positioning techniques by means of satellite navigation systems like GPS.

The master program "Geoinformation and Cartography" consists of theoretical and applied coursed to contemporary topics of Geoinformation and Cartography. In detail the master program deals with the acquisition, modelling, analysis, visualization and communication of geodata. Specific tasks include the combination of data from different sources, the integration into spatial information systems, and the establishing of user-adequate visualization techniques.

Based on a master degree the admission to a program of Doctoral Studies can be achieved as well. International students of many countries have already joined the Geodesy and Geoinformation institutes to successfully gain a Doctoral degree from Vienna University of Technology.

4. Quality Assurance

The quality assurance within all education programs of Vienna University of Technology basically focuses on three main points:

- Selection of teachers with professional competence and adequate didactic qualification
- Continuous evaluation of courses by students
- Obligatory reporting to the Dean of Academic Affairs in case of remarkable evaluation results

For further developing an effective system of monitoring and assuring the quality of education programs a couple of activities are necessary that should complement one another. Therefore the Geodesy and Geoinformation programs develop further steps of quality assurance, based on the fundamental goals of the whole university. An indispensable basic element of quality assurance is hereby the evaluation of courses. Furthermore, accompanying methods are necessary like incentive systems, mentoring strategies, institutionalized offers for improving teaching skills and an institutionalized monitoring and comparison of international developments.

4.1 Evaluation of courses

The instrument of evaluation of courses is a key element of quality assurance in education at the faculty of mathematics and geoinformation. A general increase in the acceptance of this elements by all participating parties (students, teachers) is a key goal, as it is a precondition for a

more precise and qualitative implementation of this instrument. Such an increase is aspired by

- optimisation of processes in evaluation of courses by means of optional usage of internet-based questionnaires resp. printed questionnaires
- improvement of questionnaires for students by means of stronger individualisation concerning course type
- implementation of modul parts of questionnaires which allow quicker answering by those students who do not want to expand on detailed statements
- the increase of communication between the involved groups in evaluation of courses (students, teachers, dean for study affairs) by means of increased and partly more transparent reactions. As further progression it is planned to confront students with the instrument "evaluation of courses" and its processes within the first semester
- more transparent publication of relevant results of evaluations of courses in various adequate panels
- Optional possibilities of comprehension of collegiate critiques like Wikis, Blogs should be proved concerning their applicability

4.2 Incentive systems

Geoinformation education programs have adopted an incentive system for test purposes. As a direct result of evaluation of courses a "Best-of-education Award" has been tested. Based on the positive experiences this will be developed iteratively by defining a mix of quantitative and qualitative measures. Based on those measures a selection of classes being evaluated remarkably positive will be discussed and finally decided by a board consisting of student union members and the dean of academic affairs and the chair of the commission of academic affairs. For the time being this concept of a two-stage method (quantitative and qualitative ranking based on evaluation results resp. a jury) is used for various categories (compulsory lectures, applied classes, seminars, special courses).

4.3 Mentoring concepts

Within the Vienna University of Technology tutoring and mentoring programs are offered and available. A special focus has to be given to dedicated information about offered courses via up-to-date communication media. A dedicated system of help, consultation and guidance through the very first steps of beginners is offered currently and is monitored permanently with the goal of further improvement. Finally, dedicated information to those students starting their study not in a regular way (Summer Semester instead of Winter Semester; Foreign and Exchange Students) are offered and are also further developed, if necessary.

4.4 Teaching competence and e-learning

As a key element of quality assurance within education programs of Geodesy and Geoinformation the Vienna University of Technology offers courses to improve teaching and didactical skills. Currently there are a few offers on dedicated workshops dealing with teaching competence, which are available to all members of the University. As a matter of fact more offers focused on the needs of specific teaching situations will have to be given. The final goal is to have more precise instruments for helping teachers to be able to make excellent classes and courses.

Under the acronym 'E-learning' a special electronic tool supplementing the regular lectures has been introduced at TU-Vienna recently. E-Learning is a web-based new concept to prepare the subject contents for interactive use. One advantage of e-learning is of course the possibility to provide additional material and tests which allow the students to jointly study and control their understanding of the lecture content. This is predominately impossible in large classes of a few hundred students. There are of course a number of still unresolved problems linked with E-learning like quality-assurance of the provided material, how to improve the acceptance by the teaching stuff and last but not least how to motivate students to watch the lectures even if the subject matter is already provided in digital form. In summary e-learning is clearly not a perfect substitute of the lecturer but it may have advantages in case of huge classes which prohibit keeping contact with the lecturer. It helps students to check steadily their knowledge by running automated tests and answering provided questionnaires and of course these platforms are indispensable tools in remote education and postgraduate programs.

4.5 Further instruments for quality assurance

Beside the described key elements of quality assurance further instruments apply. Those include

- assignment of international reviewers/examiners
- conducting of complementary time tables and examination schedules to ensure concise study process
- additional questionnaires for all graduates at the end of their study and approx. 3 – 5 years after final degree in order to gain additional insights on the evaluation of the study program
- monitoring and matching with course schemes of comparable foreign universities

5. Further Developments

The further development of the profile of the Geodesy and Geoinformation group at Vienna University of Technology is based on the fundamental goal of scientific excellence in research and education applied to the offered education programs. One consequence is that all courses and classes should aim at including aspects and results of recent research processes. A permanent system of quality evaluation and assurance, consisting of a mix of instruments, is offered and applied in order to follow the main goal of Vienna University of Technology on ensuring high quality programs instead of mass education programs and aiming on producing students which are able to "compete" on an international level.

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