

# IMPROVING THE QUALITY OF EDUCATION THROUGH THE IMPLEMENTATION OF THE DIPLOMAS AND GROUP PROJECTS DURING ENGINEERING STUDIES IN COOPERATION WITH EMPLOYERS

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## Abstract

The quality of education is one of the most important factors determining the job opportunity for graduates. The authors present the possibility of carrying out the diplomas in cooperation with employers and institutions interested in employment of students who graduated Gdansk University of Technology, Faculty of Civil and Environmental Engineering and University of Warmia and Mazury, Faculty of Geodesy and Land Management (major: engineering geodesy and cartography). Based on experiences it was possible to present problems which appeared during work on diplomas in cooperation with potential employers. There was also a situation of undoubted advantages for students towards gaining experience and employment prospects.

In this study, the authors cite interesting solutions for better competitiveness in European labour market carried out by students. Problems associated with exclusion of young people from the labour market as well as suggestions to prevent such exclusion by the closer cooperation with potential employers are also indicated.

Keywords: engineering's thesis, cooperation with companies, group projects.

## 1 INTRODUCTION

In accordance with the Bologna Declaration, signed on the 19th of June 1999 by the ministers and representatives of higher education of the European countries, including Poland, some steps have been taken to create a European Higher Education Area [1]. Realization of this initiative is seen primarily in the change of the studies organization into studies of I, II and III stage or uniform Master's studies in selected areas. A system of comparable degrees and academic titles was implemented and also the system of ECTS (European Credit Transfer System) was established. Intensive promotion of inter-university cooperation programs and student exchange were started. At the same time in the education of young engineers and masters a strong emphasis is put on the use of different models of cooperation between universities and external partner (businesses company, public authorities). The realization of these models is achieved by performing research and development works, making expertise and cooperation within the framework of the circles or associations of students and teachers in cooperation with the external unit.

Efforts in these relations are aimed at the increase of the attractiveness of the higher education system in Europe and they have to ensure the mobility of citizens and adapt the education system to the needs of the labour market.

Improving the quality of education can be realized, among others through the collaboration with external partner when realizing:

- Team projects within the framework of trainings and subjects,
- Team projects within the operation of scientific circles,
- Diploma works.

These actions allow you to familiarize with the real requirements of the market, direct your knowledge and gain practical skills for the requirements of future employers or business partners. It also means more efficient tracking (by teachers) market changes, technological innovations and implementing

them in the teaching process, which is then translated into the continuous verification of educational programs, content of individual subjects and requirements for students.

In this paper, the authors present actions which were taken up at faculties of two Polish universities: Gdansk University of Technology (Faculty of Civil and Environmental Engineering, FCEE) and at the University of Warmia and Mazury in Olsztyn (Faculty of Geodesy and Land Management, FGLM) in order to improve quality of education, especially in regards to course of geodesy and cartography.

## **2 IMPROVING THE QUALITY OF EDUCATION**

Both the Gdansk University of Technology (GUT) and the University of Warmia and Masuria in Olsztyn (UWM) lead programs and strategies aimed at improving conditions of education and acquiring knowledge and skills needed in the future professional life of university graduates.

UWM realizes the development programme. Its main points concern implementation of high standard of education, suited to the needs of society, especially in the region of Warmia nad Mazury. Graduates and scientific staff should participate in research programs in Poland and abroad, with focus on innovative economy. Process of education is becoming more practical by expanding cooperation with the socioeconomic environment. There is also a possibility of development and educational offer "upon request" [2].

To guarantee the quality of education at GUT FCEE, each faculty prepared a "Book of Quality". This document presents main directions of faculty development. FCEE mission is to educate highly qualified engineering staff for the development of the wide technical infrastructure, in close connection with developed scientific researches and implementations and in cooperation with the social and economic environment [3]. FCEE is trying to maintain relationships with companies and implement the employers' remarks into the education program. Since the 26th of May 2010 at FCEE, the Advisory Board operates and it includes representatives of employers. Within the period of 2012-2016 it is created by 12 representatives of the largest Pomeranian companies associated with the profile of education carried out by FCEE. The Faculty has also signed agreements on economic cooperation with numerous companies of engineering branch, also closely associated with surveying (including Leica Geosystems, TOPCON, Pomeranian DIAZ company) and cooperates with the Polish Chamber of Civil Engineers and the Association of Polish Surveyors (there is a local circle at GUT FCEE). Thanks to this, students have facilitated ability to search work and trainings and in the teaching process it is possible to present the hardware and technology solutions, used nowadays by the companies.

Both universities emphasize the acquisition of professional experience abroad. This is possible thanks to IAESTE program (The International Association for the Exchange of Students for Technical Experience) [4] [5]), in which both GUT and UWM have been participating for many years. This program is an association founded in London's Imperial College in 1948. Since 1959, that is since the moment Poland became an official member of IAESTE, the program benefited more than 25,000 Polish students. A similar number of students came to Poland from other countries.

Group projects and developing diplomas at engineering courses are examples of how quality of education can be improved, with benefits for students, teaching staff, external partners. The base of the concept of group projects realization is the interest of an external partner, so that every action in this format of cooperation subjects to the supervision by the potential employer. Finally, this is translated into students' better understanding of the teamwork importance, responsibility for own work and awareness of costs of doing business, and this also gives an additional experience and knowledge.

### **2.1 Group Projects within Scientific Circle**

Scientific Circles are an examples of activities for students who want to expand their academic knowledge through self-education and participation in scientific projects. At GUT, there is a Geodetic Circle Hevelius (GC Hevelius). It was founded in 2008. The association name comes from surname of the astronomer Johannes Hevelius, who lived and conducted researches in Gdańsk in the XVII century. At the beginning, the club consociated the Civil and Environmental Engineering students interested in developing their skills in land and buildings measurements. When course of Geodesy and Cartography started off at the Gdańsk University of Technology, a lot of young people who had chosen this direction of career joined the association. Average member joins GC Hevelius mostly because of noticing the opportunity to spend time on improving practical skills. Participation in projects

follows full access to geodetic instruments such as GPS (Global Positioning System) receivers, digital levels or laser scanner. It is one of the benefits that entails active participation in extra-curricular activities. The Circle Statute allows for participation not only students but also academics and teaching staff. This bequest brings bilateral benefits for teacher and student. Collaboration between Circle, geodetic companies and equipment producers had been established in the beginning of association existence. Those agreements help in searching project sponsors, holiday internships and future employment.

Each implemented task is related to the practical surveying problems. Every year, there are 3-4 big projects and few smaller ones. Monitoring and modernization of the control network at GUT campus is executed constantly as well as administration of GNSS (Global Navigation Satellite System) reference station.

The GC Hevelius members participate in some interesting tasks in the area of Tri-City (Gdańsk, Gdynia, Sopot) including defining agglomeration centre, scanning of the sea cliff or measurements during test loading of the bridge near PGE Arena stadium. The association cooperates with the monuments restorer for the protection of cultural heritage of Gdańsk through the participation in researches on the Royal Chapel and the Forge in Gdańsk Orunia [6].

### *2.1.1 Establishment of control network at GUT*

One of the first surveying tasks of carried out by GC Hevelius was the installation of the measurement matrix on the area of the university. This task allowed to get a practical look at the problems associated with this type of geodetic works. Thanks to the financial support of the Department of Geodesy and aid of academy teachers it was possible to obtain the product used and modernized on the annual basis at dedicated student projects and within the cyclic didactic process [7].

### *2.1.2 Monitoring of Royal Chapel in Gdańsk*

The interesting example of the impact of undertaken group project on the development of social consciousness of students is the monitoring of the Royal Chapel in Gdańsk. Concerned about the cultural heritage, the members of GC Hevelius continue a project carried out since the 90's by employees of the Department of Geodesy at FCEE GUT consisting in monitoring (by precise leveling) of subsidence of datum points, installed in the walls of the Baroque sacred object. During the measurements, it was found a significant subsidence of the east wall, located in the immediate vicinity of the square where 12 years ago never unfinished construction work were started. The results have become one of the arguments for the conservator of St. Mary's Basilica in Gdansk in a dispute with a private investor and they helped to backfill the dangerous excavation. Here, the green square was created and Royal Chapel gained stabilized environment [8].

### *2.1.3 Scanning of Clif in Orlowo*

Another project carried out by GC Hevelius was to study the stability of the sea cliff after a violent incident which was the drop of bunker located on its top [9]. Thanks to the cooperation with the company producing geodetic equipment (Leica Geosystems) and a public institution (Maritime Authority) it was possible to record the event using the modern technology of measurement. Thanks to the slope stability assessment, the public safety was confirmed.

## **2.2 Group Projects within internships and modules**

Within the frames of cooperation with the Spatial Planning Office in Gdynia – SPOG students realize the group projects. Guidance for students are determined in cooperation with SPOG for further use of the results for planning works. Projects are realized within the subject of Spatial Planning on the 6th semester and within the framework of student trainings after the 4th semester as one of several tasks. As part of the project, students perform inventories in urban areas, using the technology of surveying and the results are presented in the form of updated base maps, thematic maps and summaries of key indicators of urban planning.

Office provides current maps available and provides content support, while students learn the real needs of the planners within the frames of data collection concerning the area and they resolve problems associated with the development of thematic maps.

As a result of this cooperation, SPOG also offers several places for students of geodesy for the annual summer trainings which are often used by them willingly.

Participation in these activities is also reflected in the choice of the direction of further education of students of who a few percent decide to continue their education at the major of "Spatial management" or realize their passions and interests related to spatial planning in the context of diploma thesis where the subject is the meet of geodesy and spatial planning, for example:

"Analysis of the functional and spatial structure in WMS services of Gdańsk Kokoszeki Przemysłowe district", "Geodetic studies in spatial planning", "Development of Digital Terrain Model for the part of the Nowa Karczma – Grabowo Kościerskie commune and on the basis of selected materials for the purpose of spatial planning".

## **2.3 Diplomas (engineering's thesis)**

The development of the thesis for many students is an opportunity to use the knowledge and skills acquired during their studies, as well to present themselves to a prospective employer, especially in case of the selection of the subject requiring contact with relevant institutions or companies, or within the frames of the research projects realization.

### *2.3.1 Cooperation with an external partner*

One of the examples of co-operation between students from GUT and representative of the Municipal Property Management of Gdansk and representatives of companies was the Forge project. Students from GC Hevelius with academics from Faculty and employees from Leica Geosystems and I-NET.PL performed scanning measurement of the Forge for its inventory. The Forge is an object located in Gdansk-Orunia. It has a historical value as an smallest example of local arcaded house. The project involved the whole building and its surroundings. Measurements included the inside of the building: the ground floor apartment with preserved relics of the furnace, the forge and the attic with the room above the arcade and the oldest part in the form of brick-earth basement. The object was prepared for demolition which caused technical difficulties in locating the positions of the scanner (partial lack of flooring, ceiling with limited capacity, vibration of the object) [10]. Obtained data were used as a basic material for two diplomas: "The use of laser scanning for the inventory of historic wooden object on the example of the Forge in Gdansk Orunia" and "Realization of a real 3D model of historic forge in Gdansk Orunia, based on the received data". Collected datasets allowed students to expand their ability of using point clouds to create 3D model of the engineering objects and their technical documentation. In addition, students interacted with geodetic companies, municipal units like The Municipal Property Management of Gdansk.

Other diploma based on using laser scanning measurement focused on modeling point clouds. It was an effect of co-operation between students and employees of Shipyard in Gdynia. Knowledge about problems with ship construction resulted in diploma entitled: "The use of terrestrial laser scanning in the process of hulls real modelling". Also the diploma thesis entitled: "The monitoring system of roof construction in Forest Opera in Sopot. Design, implementation and analysis of the geodetic measurements accuracy" was prepared. Effect of this thesis were reflected in the real realization of the monitoring across the entire object.

There is no doubt that students are very aware of the necessity of co-operation with geodetic companies and administrative units. It gives them possibility to get familiar with the reality of chosen profession during studies. Universities which sustain such contacts guarantee students the constant improvement in education quality.

### *2.3.2 Participation in researches*

Students also participate in research projects such as works connected with the new technology of building flood banks [11], measurements of the geometry of railway or tramway track [12] [13], synchronous photogrammetric measurements and flow analysis [14] [15], the availability and reliability of satellite measurements in the cities and the use of spatial information systems [16] [17], measurements of engineering structures and structural elements [18], [19], analyses and modelling with the use of LIDAR data and photogrammetric measurements [20-26].

Another interesting example of the project is also the virtual reconstruction of the palace in Gładysze. The project was executed within the framework of the Scientific Circle of Surveyors SCITUS activity with the support of the Polish-German Foundation of Cultural Heritage of Warmia Protection [27].

In addition to projects related to laser scanning, students also have the opportunity to cooperate with Leica - Geosystems company in the field of modern measuring technology and the use of a network of SmartNET reference stations, in which FCEE GUT is an active participant.

Form of cooperation was based on the students participation in the measuring cycles or the use of selected results in their work for further analysis. The experience gained by the students in collaboration with scientists is reflected in the realization of diploma projects affecting the current engineering problems, often with reference to new methods and technologies of surveying.

### 3 CONCLUSIONS

Engineering courses like geodesy and cartography have been conducted at GUT as well as at UWM. Students are being prepared to work in following fields: digital photogrammetry and Internet photogrammetry, close range photogrammetry, engineering geodesy, satellite geodesy, higher geodesy, geomatics and spatial information systems, land management, numerical cartography, cadastral survey and common appraisal, positioning and navigation systems, remote sensing and photointerpretation. To enhance their chances in labour market, during the studies the group projects are being organized in co-operation with companies and units of local government. Additionally, within the diplomas, students are encouraged to prepare subjects which will indicate their interest, skills and knowledge in selected area.

Universities through a collaboration with companies, local government units and other external units allow their students to gain valuable professional experience. When performing projects in the field of the activity of scientific circles or during the preparation of diploma thesis, students become familiar with the reality of their future profession and they also learn of how to work together.

High quality of education is one of the many factors ensuring a well-paid and satisfying work. However, an important element is the student's or graduate's involvement in the performed task and also the predisposition to do a specific job.

Regardless of the choice of cooperation method, every action means measurable benefits for the participants (students, teachers, teaching and commercial entities) of the process. For students, it is primarily the acquisition of skills and knowledge expected in the economy. Ability to work on real data and solving current problems of a scientific and technical nature. Student also learns about the labor market and the principle of conducting business, he establishes contacts in the environment of future employers or partners. In case of further education, it is easier for students to make decisions about the direction of further education or directly this is an asset when applying for Doctoral studies (third degree). Whereas teachers enrich their subject knowledge and have the ability to adjust the teaching course to the needs of the market. Often these changes are small, requiring a small amount of work but they can be translated into real profits for the students.

Such activities are also important for entrepreneurs. While they are interested in participating in the education of young engineers, they are reluctant to participate in modifying the entire syllabus and study programs due to the complexity of such an action. In contrast, they willingly support the activities discussed in the article that are easy to correct and focus on new needs, because they depend on the teacher and business. This is because within the subject and specific effects of education, the leading teacher decides on the scope and used technologies and teaching methods. Entrepreneur who invests his time and potential (which can not be found at the university) gains the ability to recruit the employee with the skills already acquired in the course of engineering studies.

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