

EXPERIENCE OF MANAGEMENT AND STUDY OF THE JOINT MASTER DEGREE STUDY PROGRAMME “INNOVATIVE SOLUTIONS IN GEOMATICS”

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Abstract

The purpose of this research is to present the experiences of preparation, development and management of joint study programme of two universities.

Cooperation Agreement of joint study programme between Riga Technical University (RTU) and Vilnius Gediminas Technical University (Vilnius Tech) was signed on 17 March, 2014. The aim of the Agreement was to create the master's degree level programme “Innovation solutions in Geomatics”. Study programme was developed according to requirements both RTU and Vilnius Tech and European Union (EU) higher education standards regarding the European Credit Transfer and Accumulation System (ECTS) as well. All courses of this programme were developed based on the Bologna framework. The programme was evaluated by external EU experts and by Latvian and Lithuanian groups of experts separately. Finally, the new joint study programme was approved by Study Evaluation Commissions of Lithuania (2014) and Latvia (2016). The program was started in 2016 by integrating it into educational systems of RTU and Vilnius Tech. By winter of 2020/2021 29 master degree students graduated this study programme. Students' participation in an international program helps them in their professional careers and personal development. They gain a higher level of general competence and recognition in the labor market. Studying at two universities is more difficult than at one, but the experience gained is invaluable. The winners are both students and their teachers, which provide recognition and strengthen the direction of our education branch.

Keywords: Higher education, joint study programme, geomatics, ECTS.

1 INTRODUCTION

The Bologna document “THE EUROPEAN HIGHER EDUCATION AREA” provide for promotion of the European dimensions in higher education. The one of purpose was study modules, courses and degree curricula offered in partnership by institutions from different countries and leading to a recognized joint degree [1, 2]. Institutions of higher education may offer joint study programs leading to a joint qualification, as well as programs leading to a double degree. A joint qualification is awarded when the study program is pursued by at least two higher education institutions, usually from different countries. A double qualification degree is awarded when the study program, in addition to the requirements of the main field of study, also meets the minimum requirements of another field of study. The Ministry of Education and Science set the general requirements for these programs in the Baltic States [3, 4]. The importance of joint degree programmes are [5]: greater collaboration between faculties at the home institution and partner institution; increased international visibility of the institutions; increased internationalization of the campus.

Cooperation Agreement of joint study programme between Riga Technical University (RTU) and Vilnius Gediminas Technical University (Vilnius Tech) was signed on 17 March 2014. The aim of the agreement was to create together and elaborate the joint master's degree programme “Innovative solution in geomatics”. The agreement established the principles and conditions of cooperation in delivering the joint master's degree programme. Before the programme was started the partners institution (Vilnius Tech and RTU) established a Joint Programme Council consisting of at least three members from each university. The Council was responsible for the curriculum design and structure of the programme, supervised the quality of the programme, fulfilling agreements on the programme delivery budget and amendments. Firstly, the study programme must be approved/accredited by Study Evaluation Commissions (SEC) of Lithuania and Latvia.

The study programme “Innovative Solutions in Geomatics” was developed considering:

- The provisions of National Sustainable Development Strategy and provisions of Strategy of Lithuanian Regional Policy until 2013 (especially “promote development of human resources” and “promote the focus of university higher education on demand of highly qualified specialists in the regional centres”);
- The major documents of the development of the European higher education area (“The Bologna process – The European higher education area in the new decade” and “A framework for qualifications of the European higher education area”);
- Order of the Minister of Education and Science “On approval of external assessment and accreditation procedures of study programmes”, issued 24 July 2009, amendment No. V1487 from 29 July 2011, approval of study cycles’ descriptions (21 November 2011, No. V2212), approval of the intended study programme description development, its external assessment and accreditation methodologies (November 28 2011, No. 1-01-157);
- Vilnius Tech internal documents: Description of General Requirements for the Second Cycle Degree and Integrated Studies Study Programme Development, Description of the Full-time and Part-time Modes of Studies; Description of the Study Programme Reorganization Procedures. VGTU Rector’s order No. 57-1.10 issued on 29 May 2012 and VGTU Study Provisions;
- Methodology for Assessing Implemented Study Programmes, Order of the Director of SKVC No. 1-01-162, issued on 20 December 2010;
- UNESCO, OECD UNESCO, OECD Guidelines for Quality Provision in Cross-border Higher Education, 2005;
- EFMD Recommendations for Quality Assurance in Higher Education Business Schools, 2011 EQUIS – European Quality Improvement System, The EFMD accreditation for International Business schools. www.efmd.org).

The new joint study programme was approved by SEC of Lithuania (2014) and Latvia (2016). The program was started in 2016 by integrating it into educational systems of RTU and Vilnius Tech and is intended to train specialists in measurement engineering and geomatics. Goals are:

- to prepare the professionals of measurement engineering and geomatics, who are capable of understanding and analysing the interactions between the knowledge in the different areas of geomatics;
- to raise problematic and scientific issues, using their acquired knowledge for their decisions; to be able to optimize acquisition of data and modelling;
- to adopt of the most innovative solutions in the complex industrial activities;
- to improve the scientific analysis and research skills which is necessary to maintain and improve the acquired competencies to work in the constantly changing technology environment, research institutions, and doctoral studies.

Expected results and knowledge [6]: the possibilities of the modern remote sensing methods and the newest geomatics developments in engineering fields; the methodologies and principal theoretical solutions in the remote sensing, building modelling, development methodologies, and current methods of investigating of geodynamic processes as well as their creative application.

The authors would like to share experiences work with students, management, and challenger in a joint study programme “Innovation solution in geomatics”.

2 METHODOLOGY: STUDY PROGRAMME MANAGEMENT AND PROCESSES

2.1 Study programme management

The agreement was signed on a joint master’s degree program execution between the Vilnius Tech and RTU in the 2014 03 17. The study programme managed the study programme Council from both university staff. The study programme Council is subordinate and accountable to the Deans of the faculties and faculty study committees. All responsible members systematically cooperates with University department’s witch responsible about joint study programme too. The Geodesy and Cadastre department (Vilnius Tech) and Geomatics department (RTU) to implement the programme: ensures the

quality of studies, cares about teaching staff, ensures that the study program meets the study requirements of Vilnius Tech and RTU. The department offers to the Faculty study committee the structure of the study programme Council. The Faculty study committee to reconcile it with Dean of faculty. The study program Council approves the Universities study committee. The structure is shown in the Figure 1.

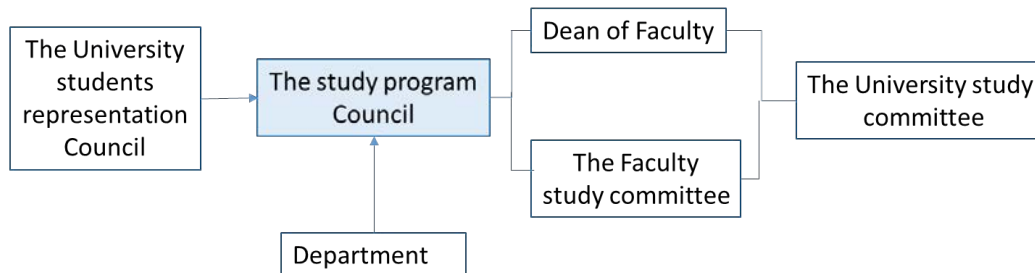


Figure 1. Management bodies of the study programme.

Student's opinion about the study programme, its implementation and update are expressed through the University Students Representation Council and its representatives on the Council of study program, Faculty study committee, University study committee and Senate of University. Therefore the student's representatives of social partners and take parts in the Faculty study committee decision-making process, also the execution and development of the study programme is performed considering the comments and requests of all the parties involved in the processes.

The internal university study quality assurance system and the documents according to which it is regulated are based on the provisions of the European Higher Education Study Quality Assurance, the Law on Science and Studies and the orders of the Minister of Education and Science.

The study program Committee, the Faculty study committee and the University study committee assure the study programme quality maintenance. The internal study quality assurance is executed by controlling various study processes, monitoring, assessing and applying feedback and self-assessment methods.

The Departments of Geodesy and Cadastre (Vilnius Tech) and Geomatics (RTU) cooperates closely with various Lithuanian, Latvian and other foreign science and educational institutions, as well as other institutions and industrial organizations. During the meetings with social co-partners, study quality and student theoretical and practical preparation issues are discussed. The social co-partners comments are very useful for the development of the contents in separate module of the study programme, expanding the contents of each module by supplementing time with topics related to the industry.

The Departments organizes every year Career days and invites their social co-partners to give lectures and practical demonstrations at the Faculties. A considerable number of graduates of the Departments, their employers and partners from foreign countries participate in annual international conferences organized in the Faculty. The regular contacts with governmental, scientific, private companies help to form and develop innovative study programme. Also departments is active member of International Federation of Surveyors – FIG, Latvian and Lithuanian surveying societies.

The social co-partners regularly suggest current and worthwhile topics related to modern geodesy and cadastre for the theses of basic academic studies. By the Rector's order, master's degree-granting commissions, chaired by social co-partners, are formed for thesis defence and evaluation. The social co-partners' comments on the themes, contents and defence of theses contribute to thesis quality improvement.

The close cooperation with social co-partners completely extends its benefits in the implementation and development of the study programme, as well as the improvement of the study and the prospective specialists' quality. The quality of the study programme execution corresponds to the provisions of the European Higher Education Area.

2.2 Study programme content

The admission of students started from year 2016. The graduates (bachelor's level) from the following fields were admitted to the "Innovative Solutions in Geomatics" programme: Measurement Engineering, Geography, Landscape Management, Forestry, Land Management and Geology. Compulsory Bachelor's level subjects and their minimal volume in credits is foreseen for students, who have completed a Bachelor's programme similar to the intended study programme.

Core subjects: Mathematics 13 European credits (ECTS), Physics 6 ECTS, Information technology 4 ECTS; Programme-specific subjects: Geodesy, Advanced Geodesy, Geodetical Measurements Processing, Cartography, Photogrammetry, Geographic Information Systems, Global Positioning systems, Digital Maps, Land Management, Land Cadastre - 21 ECTS [7]. To enter the program is necessary to have good knowledge of English language. Anyone wishing to study in the program may apply in one of the partner institutions online (Vilnius Tech or RTU). Application form is available and can be completed in English, Lithuanian and Latvian languages. Student admission is authorized by national accreditation bodies approved the procedures and rules governing the admission to the Master's programs. Students will be registered by the original university, which applied for and was accepted, but later will be registered for the period of the second mobile partner institution. Each university students undertake to register, create and manage their personal files and information about other university students' achievements. The student can apply to joint study programme by web:

- From Vilnius Tech web site [8];
- From RTU web site [9].

The study programme profile in the Table 1.

Table 1. Profile of the study programme "Innovation solution in Geomatics"

<i>Name</i>	<i>Data</i>
1. Programme title	Innovative Solutions in Geomatics
2. Study field	Technological science study field
3. Study field (code)	<i>General Engineering H100</i>
4. Study programme branch	Measurement Engineering H140
5. Type of studies	University studies
6. Cycle of studies	Second
7. Mode and duration of studies (in years)	Full-time studies (1.5)
8. Implementation language	<i>English</i>
9. Scope of programme in credits	90
10. Intended degree and qualification	Measurement Engineering Master
11. Minimum education requirements	University bachelor's qualification degree in measurement engineering, geography, landscape management, forestry, land management, geology field of studies.

The studies consist of 3 semesters, each following 30 ECTS. First and second semester provides 15 weeks of lectures, 4-week exam time and one week of self-learning. In the third semester 3 weeks of lectures provided (one selected module), 1-week exam time and the remaining 16 weeks are the thesis preparation and defence. First semester classroom hours will be held in RTU second in Vilnius Tech, and the third, depending on the student's chosen module Vilnius Tech or RTU (Figure 2). The students travel to Vilnius Tech or RTU from ERASMUS project funds. The students preparing agreements between Universities and choose the modules for learning.

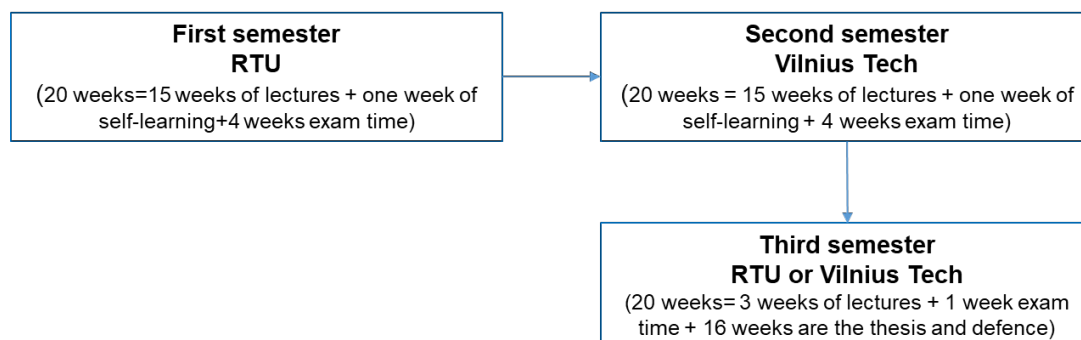


Figure 2. The study program process.

Lectures, practical works, laboratory works and other classes are evenly distributed through the semester - it is expected that graduate students acquire theoretical knowledge in order to conduct practical and course works. The workload should be distributed in a rational manner. The examination session's timetables are saved in the University's information system's database. The Vice-Dean for Education has the right to change the examination date, time and place, settled between students and lecturers, notifying lecturers and students about the changes. Timetables of lectures, practise work, exams and consultation hours are published on the Universities website.

The study programme modules (subjects) were corrected in the 2016-2021 years period. And the newest (last) study programme presented in the Table 2.

Table 2. Study programme "Innovation solution in Geomatics" modules

<i>Title of module</i>	<i>ECTS</i>	<i>Evaluation</i>
1 semester (30 ECTS), RTU		
Local geodetic networks	3	E*
Digital Terrain Model	3	E
Computer graphic in Geomatics	6	E
Scientific research and Innovation	3	C**
Global Positioning System	6	E
Fundamentals of Land management	3	E
Optional subject:		
Thematic Cartography	6	E1***
Apply programme in Geomatics	6	E1
Architectural photogrammetry	6	E1
2 semester (30 ECTS), Vilnius Tech		
Master thesis 1	6	C
Remote Sensing	6	E
Real Estate Cadastre	6	E
Geodetic laser scanning technology	6	E
Optional subject:		
Building Information modelling	6	E1
Geoformation system technology		E1
3 semester (30 ECTS), Vilnius Tech or RTU		
Master thesis 2	24	GT****
Optional subject:		
Geoformation system in Web	6	E
Theory of Cartography	6	E

*- evaluation is exam; ** - evaluation is credits; *** - evaluation is exam one week until exam time; **** - final master thesis/project evaluation.

Criteria for students' achievement evaluation depend on the programme's intended learning outcomes. Evaluation criteria are traits that prove the achievement of estimated results. A link between evaluation criteria and estimated learning outcomes is relevant for the entire study programme. The evaluation of the students' knowledge is regulated by the Universities student knowledge evaluation procedures description, approved by the Senate's. The knowledge assessment system is criteria- proportionate, according to which the students' knowledge level is evaluated according to the module's criteria and each grade accounts for achieved learning outcomes. A decimal evaluation scale is used in order to

evaluate students' knowledge; the obtained knowledge is evaluated according to the ECTS scale. Every module ends with a knowledge assessment test or exam. The test is evaluated by a grade or a Pass/Fail. Such methods of knowledge assessment are foreseen in the programme: exam (E), course project (CP), course work (CW), final master thesis/project (GT). Information on the learning outcomes' evaluation criteria and procedures is published on the Universities website.

The examination grade can be composed from three or two parts, example:

$$FE = E * 0.50 + IC * 0.30 + L * 0.20,$$

where FE – final evaluation; E – exam evaluation; IC - intermediate colloquium; L – laboratory (practise) work evaluation (could be from average of evaluation of exercises); 0.20, 0.30, ..., 0.70 – weight ratio values coefficient. It is the value of parts evaluation. The sum of weight ratio values coefficient should be 1.

The teacher chooses himself the value of weight ratio coefficient. University recommends for teachers that the students to select 50-60 % of all grade. Students can access and see evaluation results in the website. The student is not allowed to participate in the examination session's exams, if he has not completed the assignments provided in the module card.

The master thesis 1 is graded for the submitted and defended research paper's report. The final master thesis/project 2 is graded for the prepared final thesis or project that have been defended in front of the degree awarding commission. The specified grade composition is adequate for thorough and objective assessment of the student's achievements. The process of writing the Master's theses begins in the second semester. The Dean approves topics and academic advisors for the final theses before the due date provided in the study plan. When preparing the thesis, the student analyses a particular technical problem and applies the deepened knowledge and skills acquired during the studies. The final thesis is defended only after accounting for the tests (exam) provided in the study programme modules. Defence of final theses is organised simultaneously in Vilnius Tech and RTU. The choice of place for the defence of final thesis depends on which department supervises the student's final thesis. The defence commission consists of 4 members from the institution where the thesis is defended and 2 delegated members from the program's associate institution.

The graduate students get two diplomas: Measurement engineering (Vilnius Tech) and Geomatics (RTU). The diploma allows the graduates to apply for doctoral degree programmes or to join to the market and work at state institutions, as well as for private companies or even find their working places abroad.

3 RESULTS

3.1 Study programme staff and students statistics

Innovative Solutions in Geomatics study programme staff consists of university teachers from Vilnius Tech Department of Geodesy and Cadastre, Vilnius Tech Department of Hydraulics and Riga Technical University Department of Geomatics and one guest-professor from United Kingdom. Besides, the teachers are constantly improving their skills and qualification by participating in various national and international conferences and exhibitions, as well as working on international projects together with foreign experts in the fields of their interests. Therefore, when they are preparing for their lectures, the teachers can constantly develop and update their teaching resources, which makes a direct positive impact on the level of students' knowledge and the quality of studies.

In the period from 2015-2021. The publications of the teaching staff of the academic master's study program "Innovative Solutions in Geomatics" contributed to the development of 65 thematic areas (41 thematic clusters). The dynamics of changes in the number of publications by years is given in the figure below (Figure 3).

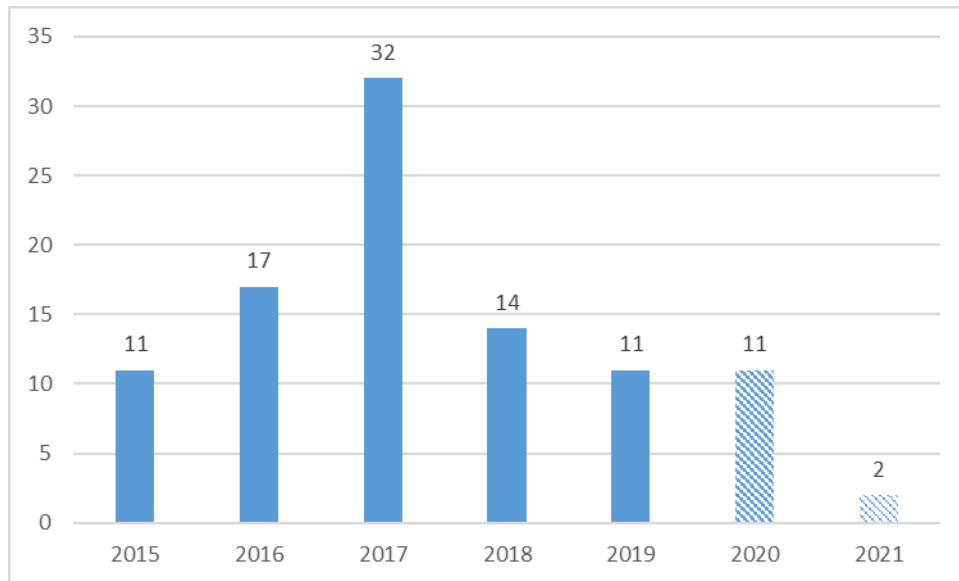


Figure 3. The number of the staff publications.

Number of publications of academic articles of the academic master's study program "Innovative Solutions in Geomatics" by years (data for 2020 and 2021 are not complete).

In the period from 2015 to 2021, 98 publications have been cited 388 times, with an average of 4.0 citations per publication. And 3.1% of publications are among the 10% most cited publications in the world and 9.0% of scientific articles (6 publications) have been published in CiteScore top 10% journals (Figure 4).

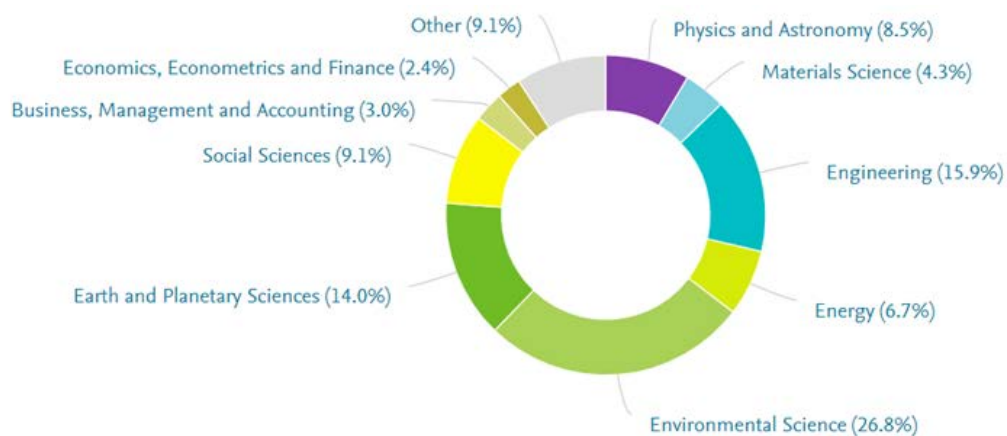


Figure 4. The citation of the staff publications.

Based on the data of the SciVal database shown in the graph above, the main areas in which the faculty of the academic master's study program "Innovative Solutions in Geomatics" published SCOPUS indexed articles in 2015 - 2021 (98 publications in total) are Environmental Sciences (26.8%), Engineering (15.9%), Earth and Planetary Sciences (14.0%) and many more (Figure 4).

The main research areas of Department of Geodesy and Cartography (Vilnius Tech) are:

- 1 GIS technology and its application;
- 2 Geodetic measurements of theoretical and experimental research and applications.

The main directions of scientific research of the Department of Geomatics (RTU) are the following:

- 1 Cadastral, topographical surveying and land management systems;
- 2 Geographic information systems and open-source software;
- 3 Geodetic networks adjustment and with use of GNSS, evaluation;

- 4 Research on earth gravity field, geoid modelling and earth tides;
- 5 Deformation monitoring of historical buildings.

Research activities of departments have a positive influence on implementation of the academic programme. First, it gives an opportunity for students to participate in different projects as well as to familiarize themselves with a modern equipment, software and testing knowledge on fieldworks. The students participating in the young scientist's conference named 'Civil Engineering and Geodesy' which is held every year at the end of October. The titles of student's articles shows the variety of topics:

- From topography to virtual reality;
- Latvian road and street budget management with GIS tools;
- 3D laser scanners operation principles and their comparison;
- Investigation of the Urkis lake using Sentinel-2 images;
- Formation of building cadastre data file in Vilnius city;
- Etc.

Statistics of incoming students of the study programme "Innovation solution in Geomatics" (Table 3) [10]. Vilnius Tech requirement is to form the students group no smaller than 6. The Ministry of Science takes the grant if group is 6 and more. The number of students in the joint study programme dependant on the number of bachelor students.

Table 3. Number of students in the study programme "Innovation solution in Geomatics"

<i>Year</i>	<i>Vilnius Tech</i>	<i>RTU</i>	<i>Total number</i>
2016	-	7	7
2017	2	4	6
2018	2	6	8
2019	4	2	6
2020	2	-	2
Total			29

In 2020 number of student's was affected by Covid-19 virus pandemic. Students did not have guaranty that they will be allowed to visit the RTU or Vilnius Tech. The on-line study form was new and it might not looked appealing at the time.

In the future, the study program will be offered to students from the other countries as well.

4 CONCLUSIONS

- Joint master degree programme "Innovation solutions in Geomatics" was developed according to requirements both Riga Technical University, Vilnius Gediminas Technical University and European Union (EU) higher education standards regarding the European credit transfer and accumulation system as well.
- All courses of this programme were developed based on the Bologna framework that includes 49 European countries and a number of European organisations. Main purpose of this organization is to enhance the quality and recognition of European higher education systems and to improve the conditions for exchange and collaboration within Europe, as well as internationally.
- We receive very good feedback on the joint study program from both students and employers. Several graduates continue their growth with doctoral studies.
- The programme "Innovation solutions in Geomatics" was evaluated by external EU experts and by Latvia and Lithuania groups of experts separately. Finally, the new master joint study programme was approved by study evaluation commissions of Lithuania (2014) and Latvia

(2016). The program was started in 2016 by integrating it into educational system of RTU and Vilnius Tech.

- At present the study program is offered to students from all countries.

ACKNOWLEDGEMENTS

Thanks to everyone who contributed to the development of the joint master degree program “Innovation solutions in Geomatics” and taking care about apply the new students and study processes.

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