Development of Advanced Education in Geoinformatics for Enabling Sustainable Development in Uzbekistan

Odil AKBAROV, Uzbekistan
Bela MARKUS and Andrea PODOR, Hungary

Key words: Geoinformation, GIS, Education

SUMMARY

The economy of information society is based on the creation, dissemination and exploitation of data, information and knowledge. This will be one of the dominant features of this century, and will play a fundamental role in generating a recovery in growth and an increase in employment. The TEMPUS GE-UZ project is dealing with the development and implementation of a new university program in Geoinformatics. Geoinformation is used in almost every field where spatial information must be used, like civil engineering, construction of roads and railways, rural and urban planning, environmental monitoring, land management, mining, natural resource management and sustainable agricultural development. Geographical Information System is a very important tool in decision making for sustainable development, because it can provide decision makers with useful information by means of analysis and assessment of spatial data. The project was started in October 2012 and will last for 36 months. The paper aims to present a general overview regarding GE-UZ project. The authors will briefly introduce aims and objectives, activities and expected results.

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1. INTRODUCTION

Although, Uzbekistan is not signed for Bologna process it actively participate in Tempus and Erasmus Mundus programs. Participation in Tempus program projects strengthens linkages between Bologna process and national higher education system of Uzbekistan. This is mostly done through Curriculum Development activities of Joint Projects. On other hand, current three-cycle higher education system gives opportunity for cooperation and follows some of Bologna objectives, such as strengthening of mobility and attraction of European education through various Erasmus Mundus projects. However, there are a number of challenges which have to be addressed in next few years by national agencies.

The EU considers ways to help the non-EU and peripheral countries to keep pace with the most development parts of the world in terms of education system. It is a priority for the EU to promote and modernize the education system of these countries in line with international standards and Bologna process.

Geoinformatics as a science and its technology GIS is infiltrated into every field of our life where geographical data is used. Geoinfomatics with its theoretical background give the possibility to store, handle, analyze, and model our world. It has determinative role in the management of land, energy resources, water resources, disasters, soil degradation, and urban ecology etc.

2. BACKGROUND

Uzbekistan is a young independent country facing several challenges including environmental pollution, severe drought, inadequate land and water management etc. These issues would be manageable very efficiently by applying GIS technology. In Uzbekistan the curriculum and the educational infrastructure in Geoinformatics are also needed to be modernized therefore it is a key point to supply the partner universities with the necessary equipment. All in all, Uzbekistan needs to be developed regarding Geoinformatics in order to manage properly the challenges.

In Uzbekistan (like in European or other countries) many environmental, economic and engineering problems need solutions. Geoinformatics and the modern GNSS and laser scanning technologies can provide technical solutions to these problems. Therefore today the graduates have to possess modern knowledge with application of advanced computer technologies skills and be able to implement GIS applications. Teaching GIS is very important, although this field in Uzbekistan suffers from several problems:

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1. The spatial data related technologies are in an on-going development. For teaching these subjects and to address the market needs, from one side highly educated teaching staff is needed and from the other side within the learning environment the most recent developed data acquisition equipments and GIS softwareare vital. These equipments are very expensive, but partner institutions in Uzbekistan will develop a shared usage of these equipments to fully exploit their capacity.
2. During Soviet period, higher education in geodesy and mapping in Uzbekistan was centrally supervised from external universities.The GE-UZ project will help to develop a new MSc course in GIS because as an independent country, Uzbekistan needs its own up-to-date higher education on these topics.
3. Highly educated specialists are expected to contribute to national economy using their skills and research abilities.
4. In GIS education it is evident that teaching staff is not familiar with new methods and advanced technologies due to lack of modern geomatic equipment. Education has to be reoriented towards meeting the modern requirement of the society and ensuring competitiveness of graduates in the world market. Moreover, the educational curriculum shall be developed in line with development of global educational process based on Bologna Declaration of 1999.
5. Geospatial data are poorly maintained, maps and statistics are out of date, data and information are inaccurate, there is no modern data retrieval service, and there is no data sharing between different institutions. Uzbek geomatic engineering and technology is late in turning to be international and it has not come to terms with internationalization yet.

The GE-UZ project is intended to answer the above mentioned problems. It will reinforce both human resources (teacher trainings) and the technical capacity with learning infrastructure, GIS labs and the latest data acquisition technology.

3. TEMPUS GE-UZ PROJECT

The project aims to ensure that partner universities in Uzbekistan will have the capacity to offer a Master program in Geoinformatics that meet Bologna process, international academic quality standards, and job market needs. As such the project addresses three important issues. First issue is modernizing GIS education the second is to match the priorities in Uzbek education reform and the third one is to implement the requirements of the Bologna process.

3.1 Project Objectives

The specific objectives of the project are:
- to develop a successful MSc in Geoinformatics,
- to ensure that there will be qualified staff available for course delivery by organizing train-the-teachers;
- to ensure the universities are adequate equipment for GIS/geodesy teaching by buying geodetic equipment and GIS laboratories;
- to ensure the sustainability of the educational environment with building a sustainable

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educational network.

3.2 Project Partners

The University of West Hungary (UWH) is responsible for the project management and administration. Other partners from the EU are the Paris-Lodron Universität Salzburg (AT), the Royal Institute of Technology Stockholm (SE) and the University of Greenwich London (UK).

The partners from the target country (Uzbekistan) including the National University of Uzbekistan named after Mirzo Ulug'bek (NUU),Tashkent, the Karakalpak State University (KSU) Nukus, the Tashkent Architecture Building Institute (TABI) Tashkent, the Tashkent Institute of Irrigation and Melioration (TIIM) Tashkent, the Ministry of Higher and Secondary Specialized Education (MHSSE) Tashkent, the National Center of Geodesy and Cartography (NCGC) Tashkent and the State Unitary Enterprise (Geoinformkadastr) Tashkent.
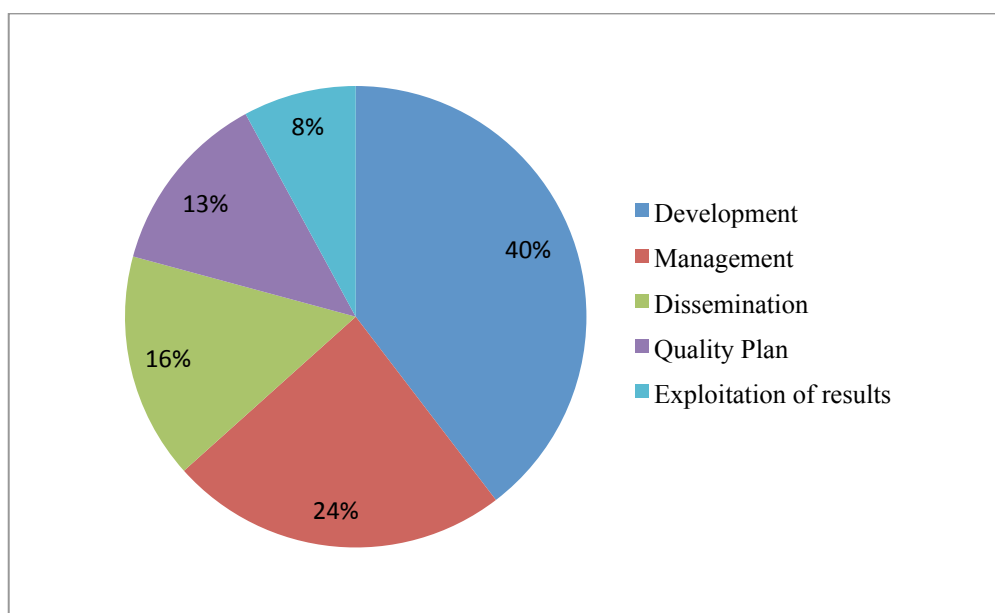
3.3 Project Outcomes

GE-UZ has and will have a plenty of outcomes. First of all, as is analysis report was made after the evaluation of the questionnaires of needs analysis. Based on this survey and cooperation with partners in Uzbekistan a new modernized MSc curriculum and syllabus is under preparation and compilation in Geoinformatics. Teaching materials will be developed and published in line with international standards and Bologna Treaty. The project also includes updating the bachelor program in Geodesy, Cartography and Cadastre. New master courses (8 modules and summer school) will be launched in the field of Geoinformatics by retrained staff. Modern established centers will be created including 4 GIS labs, new software, GIS/surveying equipment and website/network portal. Due to the launching of new MSc course in Geoinformatics, trained students will be placed on the labor market with the most up-to-date skills in line with company's needs. The dissemination activity brings the results of the project much closer to other institutions. The business plans will ensure the sustainability of the project in the long run.

3.4 Work Packages

The workplan of this project is designed in terms of work packages. Project activities included in this project grouped in work packages according to the 5 types illustrated below in Figure 1.

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Fig. 1. Work packages grouped by activity types

This paper is only cover activities related to Development, Quality Planning and Dissemination. Activities under Exploitation are forthcomming. The descriptions of project acitivity grouping are given below and all work packages are listed in Table 1.

- **Development** (DEV): The substance of the work planned including production, testing etc;
- **Quality Plan** (QPLN): Quality control and monitoring, internal and external evaluation;
- **Dissemination** (DISS): Provision of information and awareness raising about the project and its achievements;
- **Exploitation of results** (EXP): Sustainability of the project results used by end-beneficiaries during and beyond the project lifetime;
- **Management** (MNGT): Activities ensuring the sound management of the project.

Table 1. List of project work packages

Management	Development
WP 1. Project Management	WP 2. Curriculum development
Quality Plan	WP 3. Development of learning materials
WP 7. Quality Management	WP 4. Train-the-teachers
Exploitation of Results	WP 5. Development of learning environment
WP 8. Pilot courseimplementation	WP 6. Educational network development
Dissemination	
WP 9. Dissemination and awareness	

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4. DEVELOPMENT ACTIVITIES

4.1 Curriculum Development (WP 2)

This work package has two objectives: the creation of the new curriculum and the preparation of the necessary documentation for the accreditation.

At the beginning of the program a needsanalyses was accomplished and it is followed by curriculum development, which is based on the result of the analyses. The overall course definition is discussed by all the partners, and the general rules and templates are set for an elaborated description. The curriculum and syllabus development is followed by development of the learning materials by the Uzbek partners.

4.1.1   Needs (as is) analysis

The aim of the analysis was to make a survey and needs analysis concerning the design of a new MSc curriculum among the scientific and academic staff of Higher education (universities, institutes) and secondary specialized (colleges) institutions. Besides, this analysis has covered in some extent conditions at enterprises and research entities.

The questionnaires were designed and agreed by GE-UZ project partners. The survey was held in November 2012 within Uzbekistan with a total of 42 respondents. 76% of the questionnaires were filled in on paper copies by the GE-UZ project members, and 24% were filled in via e-mail. Thirteen respondents work at the universities and 29 responds received from enterprises / organizations. Twenty five of these organizations are governmental and four of them are private.

In the analysis the internal and external background of the project was investigated, an essential part was to reveal the required skills and competencies for a GIS expert in Uzbekistan.

4.1.2   Definition of new curriculum

The curriculum development uses the results of the needs analysis. The analysis was designed by the European and Uzbek partners. The questioners was developed by UWH and disseminated among the stakeholders by the local project partners.

The project proposes in its outline an approach for supporting spatial decision making in the different fields where GIS are used and by extension to ensure sustainability in Uzbekistan. The qualified academics who will attend the course will understand the spatial dimension of the different problems, learn how to collect relevant data how to store, how to analyze it. The modules and academic contents of the proposed program:

1. **Geoinformation Systems and Science**: fundamental theory concerning geographical information in our world.

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2. **Spatial Data Models**: understanding of data models which has geographic dimension as well.
3. **Data Acquisition and Data Integration**: the reliable usage of GNSS technology, laserscanner and photogrammetric workstation and geodetic equipments.
4. **(Geo-)Databases and Distributed Architectures**: building data bases to model spatially distributed objects. Conceiving various hardware and software architectures used for distributed computing.
5. **Cartography and Geovisualization**: acquiring set of tools and techniques supporting geospatial data analysis through the use of interactive visualization, learn to combine science, aesthetics, and technique, cartography builds on that reality is modeled in a way that it communicates spatial information effectively.
6. **Spatial Analysis**: Understanding techniques, algorithm, which are using the topological, geometric, or geographic properties of objects.
7. **Project Management and Organization**: economics and business environments from transactions to planning, balancing, pricing/costing and financing mechanisms.
8. **Remote Sensing**: data acquisition techniques of remote sensed data, different processing techniques (pixel based and segmentation).

4.2 Development of Learning Materials (WP 3)

The purpose of this work package is to implement the vision and main ideas of the project with development of a new Master speciality in Geoinformatics (develop new national standard, curricula and syllabuses). It is based on WP 2 as a starting point and goes further with the description of learning materials at lesson level (discussion within the partnership), meanwhile the bachelor level training materials have been reviewed and analyzed in order to define how can MSc built on it. After the lesson description has been completed, the Uzbek partners follow the description and produce the learning modules.

Lesson level descriptions in English will be discussed with all the project partners. The outcome of this activity will be a course syllabi which will describe in details the modules and will be used as a reference materialfor the development of the modules.This material will be assessed by the experts.

Module development will be in Uzbek language.Each academic partner in Uzbekistan will develop two modules. The modules will be shared through a network - Learning Management System (LMS).

Both the lesson level description and the Module development should be reviewed by external expert. External Reviewers outside of Uzbekistan are necessary for lesson levels, for reviewing the modules the project will involve experts from Uzbekistan. After the correction suggested by the reviewer the outcome will be a draft version of the curriculum, which should be accredited. After the accreditation the course will be implemented and taught in the partner institutions. Throughout this period the course materials will be tested and evaluated.

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After the pilot course and the refinement the final version of the course materials will be ready at the end of the project. 8 core modules will be available and shared through a Learning Management System (like Moodle) in Uzbek language.

4.3 Train-the-Teachers (WP 4)

One of objectives of this projectis to train teachers from the academic partner institutions in the discipline of GIS, Geodesy, and educational methods. GIS has made a lot of improvement in recent years. There are a lot of new technologies and methodologies which is important to know for the teachers. In the project, partners agreed that there will be 4 workshops or study courses designed for the teaching staff of the Uzbek academic partners. The goal of each course is to provide the most recent technological and methodological background to the teachers, make them capable to sustain Master program after the project will be finished, to teach them how to improve and sustain the quality and usefulness of the MSc course.

4.3.1   Workshop on educational methodology and ICT

As a starting activity of Train the teachers activity was an one week long workshop for 32 teaching staff at TIIM in participation of all EU partners. The aim of the workshop was to help in developing Uzbek partner universities (TIIM, TABI, NUU, KSU) the module level description and create the outline of the chapter level description.

During the workshop formed 4 working groups. These groups were working together during the workshop and each day they shared their findings and results with the others.These groups were: (1) Moodle Masters – The aim of the Moodle masters workshop was to train at least one responsible person per university in order to fulfil administrative tasks especially managing users and courses and to act as local contact person for questions from teachers and students regarding Moodle. (2) Guidelines – Participants were: module leader, who were responsible for the writing of the textbook in Uzbek and other module developers, their task was to introduce their module, the structure of the module and chapter level development was accepted. The proposed structure was: Aims, Keywords, Learning outcomes, Content, Literature, Teaching methods, Assessment/Assignment, Self-evaluation questions. (3) Hardware/Software – This group discussed the needs and requirements of the equipment needs of the partner universities. (4) Business plan – The group was working on the business plan rationale.

4.3.2   Studies in Data acquisition and GeoDBMS

Training for 16 teaching staff during 4 weeks is included as part of Train-the-teachers work package at the University of West Hungary. Training course included Geographical Information Systems, Remote Sensing, Project Management, Laser Scanning, Photogrammetry, GNSS Technologies, Cartography and Geovisualization and Database Management.

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4.3.3 Studies in Spatial Analysis

Another EU based intensive training course for 16 teaching staff during 4 weeks is included as part of Train-the-teachers work package at the University of Salzburg (PLUS), Department of Geoinformatics (Z_GIS), Austria. A well-balanced training program ranged from Teaching Methods, the Bologna framework and ECTS, Overview of Map Algebra, Distance Analysis, Interpolation using Geostatistics, visit of the Global GIS Day, a Field Trip "Urban Development in Salzburg" to GIScience Teaching Methods.

4.3.4 Study tour on quality assurance

The aim of this event is to train teaching staff from each academic partner institution from Uzbekistan in academic quality assurance procedures in order to ensure effective management of the proposed MSc programme. Responsible partner for the organisation and for giving the facilities is UoG. Representatives of all the EU partners will be present for a 1 week course. The training will include maintenance of programme specification documents, awareness of the procedures involving module monitoring and curriculum development, and effective execution of examination boards. A course will be implemented to train Uzbek academic partners in the day-to-day running of quality assurance procedures.

4.4 Development of a Learning Environment (WP 5)

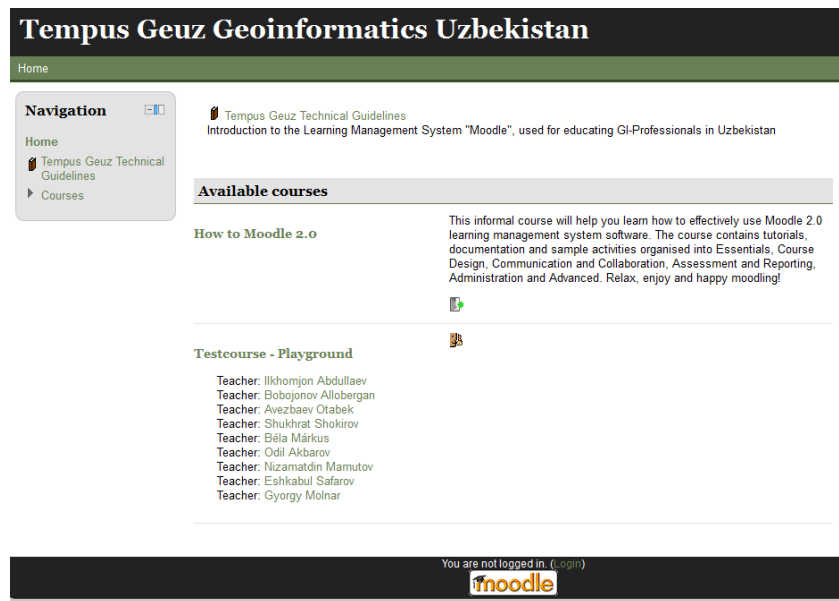### 4.4.1 Learning Management System (LMS)

This work package is dedicated to the design, development and the implementation of an online learning infrastructure as common platform for all project partners, including teachers and students.

Currently this learning infrastructure is based on a learning management system (Moodle) and two social networking tools. One is dedicated mainly to internal use (LinkedIn) and one for communication and representation to the interested public (Blogspot). In a later step, when regular studies are commencing and getting operative, additional tools will be installed.

The Moodle platform - currently in a test phase - is going to host all materials and resources used for teaching, structured by curriculum modules and used for instructor-led training. It is installed in the "Public Cloud", using Amazons Web service hosting and thus granting high availability, stability and ubiquitous accessibility - internet access assumed – at low cost and well scalable according to the intensity of service use.
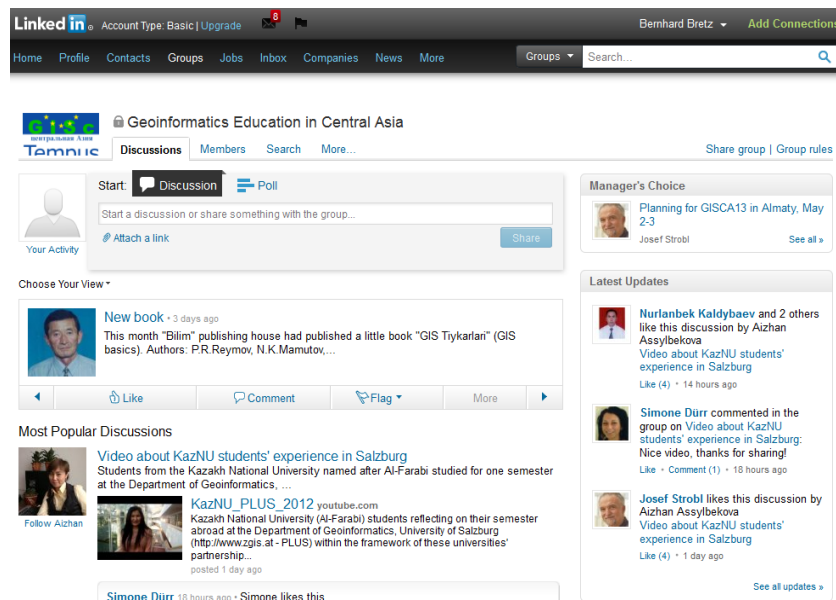
The Moodle system is available in English and Russian in order to ease usability for those who are unfamiliar with the handling of learning management systems (Figure 2).

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Fig 2. Screenshot of GE-UZ Moodle

LinkedIn is a social networking website initially attempting to ease connecting and communication between professionals. During its evolvement a comprehensive toolset of socially oriented, web-based activities has emerged. Within that, a dedicated group "Geoinformatics Education in Central Asia" has been set up (Figure 3). It offers a valuable platform for exchanging ideas, thoughts, news and information which might be relevant not only for the project participants but also for all those, who are engaged in educational matters within this rapidly developing region.

Fig 3. Screenshot of Linkedin group "Geoinformatics Education in Central Asia"

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An additional communication channel is the "ACA*GIScience News" public Blog at http://acagisc.blogspot.co.at/. This tool is mainly addressing the wider interested public, currently outside the project in order to document and inform the community interested in the progress and outcomes of the project activities. By filtering "Geuz" only the posts regarding the GE-UZ project are visible.

4.4.2   Installation of computer labs and purchase of data acquisition equipment

Besides capacity building and development of learning materials establishment of 4 computer labs is planned. The computer labs will be equipped with harware (PCs) and softwares (GIS related) for each student and research staff. In addition to these labs each partner university will be supplied with modern data acquisition equipment. The benificiary departments will create a library supplied with modern national and international literature. These newly established premises will be intensively used for teaching/studying of Master students.

5.   QUALITY PLANNING ACTIVTIES

5.1 Quality Management (WP 7)

Quality management work package aims to ensure an integrated quality assurance mechanism in the project. The main objective of this quality work package is to create a coherent system for quality control and improvement in order the project management received critical feedback element and is able to monitor the quality assurance with the project's deliverables.

5.1.1   Quality manual development

The quality manual is a methodology document; it is the reference for all the quality process of the project. For each quality process, the manual will specify the target of the quality process (activity, outcome or process, persons), the quality criteria or quality objectives related to it, the person responsible for quality implementation and the methodology for quality implementation (if any).

5.1.2   Guidelines for Quality Assurance of learning material development

This work package aims at producing standardised documentation to assist the quality assurance and learning material development within this project.

This activity will feed into various work packages as mentioned above. Initially, programme level documentation will be reviewed for quality purposes, leading into more detail scrutiny of module level specification. The main aim of the work package is to ensure the content of the module specifications are consistent with the learning outcome of the programme.

Various procedures will be set in place to ensure staff members abide by the quality assurance procedures. These procedures will be documented and staff will be trained to ensure complete

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awareness of the QA standards and regulations and ease of integration of these procedure in their native institutions.

5.1.3 Guidelines for Quality Assurance of course delivery

This activity aims at assuring the quality of the course delivery throughout the development and delivery process. The outputs of this process are QA procedures designed and implemented toward a successful course delivery, the collection of feedback gathered and the measures taken to improve the course delivery in response to feedback.

This work package involves ensuring that the modules are delivered to a high standard. This will require monitoring and reporting related to the delivery of the courses using the procedures previously described that will involve regular reporting and evaluation. It will be necessary to ensure that the lecturers follow the module specifications to deliver their content. Moreover, each lecture will clearly establish its expected learning outcomes so that students are aware of what they ought to know and be able to do as a result of completing the programme of academic learning and assessment. The academic content of the modules will be delivered via various traditional and innovative methods and the students' satisfaction will be assessed toward the end of each module using a module evaluation form. In addition to the informal evaluation, module coordinators will be required to submit a module monitoring report towards the end of each term.

5.1.4 External Evaluation by External Examiners

This work package requires initiating a sub contract for external examiners. The external experts will be responsible for monitoring the quality of the academic content and public deliverables, outcomes of the project corresponds to the needs of the target groups and to commonly accepted quality criteria. All the external reviews are made by the external independent experts. The experts will inspect key deliverables, also with respect to the overall goals as expressed in the proposal.

The independent external reviewers are required to inspect key deliverables, also with respect to the overall goals as expressed in the proposal. This will be achieved by making specification documents and evaluative reports available to external examiners. This will be achieved via an electronic portal. The quality assurance activities will involve all partners through project meetings, info-sessions, communications through email, self assessments and collecting feedback from students and industry. The results of quality monitoring will be presented in three external quality reviews and discussed at respective board meetings.

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6. DISSEMINATION ACTIVITIES

6.1 Dissemination and Awareness (WP 9)

Dissemination starts from the 1st day of the project with the information about the existence and idea of the project. The first step of the dissemination strategy will be the analysis of the possible interested people/organizations in the project idea and project results in EU and partner countries. Every partner of the project will be involved in the dissemination of information about the project and the project results:

1. within the organization itself;
2. within the partner group in the framework of the project;
3. within every partner country for target sector – students;
4. within every partner country for potential social partners - employer organizations, NGO's;
5. within the national level – policy making organizations;
6. within the international level – for target groups, sector and political project users and policy making organizations at the international level.

The dissemination strategy emphasizes free and efficient information exchange, delivering outcomes, and interaction with other external institutions associated with the activities of the project. Dissemination phase of the project consists of the following activities: development of PR materials, design and maintenance of the project website, social media, annual newsletters, the dissemination conference at TIIM in September 2015.

7. CONCLUSION

The success of the project will ensure Uzbekistan to develop a sustainable Master in Geoinformatics. This master enables the university to train academics in a field which will be inevitable for Uzbekistan to overcome environmental and socio-economical challenges.

Government of Uzbekistan gives priority to development of engineering and technology disciplines. In favor of developing Master Program recent government decided to create National Geographic Information System (Resolution of President from 25 September 2013). National GIS will become a main part of National E-government development strategy in Uzbekistan.

A new National GIS system will create additional demand for academia to provide highly educated specialists in this field. On the other hand academic institutions should consolidate capacities and cooperate designing and delivering advanced trainings to meet such demand. Upcoming activities and outcomes of GE-UZ project will become timely opportunity towards initial efforts. Based on project results national GE-UZ partners will have common ground for national and international cooperation projects (academic and research).

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REMARKS

BIOGRAPHICAL NOTES

Odil Akbarov is a head of Land Tenure Development Center at TIIM acting as a National coordinator of Tempus GE-UZ project. He got his Master of Science in Built Environment specialized in land management from Royal Institute of Technology (Sweden). He several years used to be teaching assistant and researcher at Surveying and Land Cadastre department. He is currently engaged in Erasmus Mundus PhD exchange program to Humboldt University in Berlin.

Bela Markus is a land surveyor, M.Sc., Ph.D., professor of Geoinformatics, and head of the Land and Geoinformation Knowledge Centre, Faculty of Geoinformatics, University of West Hungary. He has 40+ years teaching experience in surveying, 30 years in teaching GIS and 20 years in development and organization of open, distance learning professional courses for land administration.

Andrea Pődör is a cartographer, M.Sc., Ph.D., an associate professor teaching Geoinformatics. She is the head of the Institute of Land Management at Faculty of Geoinformatics, University of West Hungary. She has 15 years teaching experience in Cartography and 8 years in teaching Geoinformatics.

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CONTACTS

Mr. Odil AKBAROV
Land Tenure Development Center
Tashkent Institute of Irrigation and Melioration (TIIM)
Qori Niyoziy st. 39
Tashkent 100000
UZBEKISTAN
Tel. +998.71.2372560
Fax + 998.71.2371909
Email: o.akbarov@yahoo.com
Web site: www.tiim.uz

Prof. Dr. Béla Márkus
University of West Hungary
Faculty of Geoinformatics
Pirosalma u. 1-3
Szekesfehervar
HUNGARY
Tel. +36 22 945 252
Fax + 36 22 945 201
Email: mb@geo.info.hu
Web site: www.geo.info.hu

Dr. Andrea Pődör
University of West Hungary
Faculty of Geoinformatics
Pirosalma u. 1-3
Szekesfehervar
HUNGARY
Tel. +36 22 945 235
Fax + 36 22 945 201
Email: pa@geo.info.hu
Web site: www.geo.info.hu

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