Geoinformatics: enabling sustainable development in Uzbekistan

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Tempus GE-UZ project

2012 - 2015

Tempus

No: 530808-TEMPUS-1-2012-1-HU-TEMPUS-JPCR Tempus IV
Sopron - Tashkent - Nukus - Salzburg - Stockholm – Greenwich - Budapest

The aim of this brochure is to introduce Tempus GE-UZ project at-a-glance and to support the dissemination of its results. Further details can be find at http://www.ge-uz.eu in English and at http://www.geoinformatics.uz in Uzbek.

The work described here has been carried out within the framework of the Tempus programme (Ref. No. 530808-TEMPUS-1-2012-1-HU-TEMPUS-JPCR Tempus IV), partially funded by the European Commission. The project partners are grateful to the EU for the support.

Content

1 GE-UZ at-a-glance

1.1 Background

Uzbekistan faces many problems which can be more effectively handled with the help of GIS:

1. Educational system due to resource constraints and other transitional problems following the collapse of the Soviet Union, teaching methods, curricula, and educational institutions are restructuring and in transition phase. Although the government is concerned about this, resources remain tight.
2. Land degradation is widespread due to deteriorated irrigation and drainage infrastructure caused water logging and soil salinity. Addressing this requires speeding up environmentally sustainable rural development by supporting: improved land and water use management, and land administration reform; rural infrastructure and services etc.
3. In the past the heavily used agrochemicals, diversion of huge amounts of irrigation water from the two rivers (Amu Darya and Syr Darya) that feed the region, and the chronic lack of water treatment plants are among the factors that have caused health and environmental problems on an enormous scale. As an example we should mention the Aral Sea.
4. Urban areas: factories and auto emissions are a growing threat to air quality. High levels of heavy metals such as lead, nickel, zinc, copper, mercury, and manganese have been found in Uzbekistan's atmosphere, mainly from the burning of fossil fuels, waste materials, and ferrous and nonferrous metallurgy.

Geographical Information Systems (GIS) are used in almost every field where geospatial data must be defined, like civil engineering, construction of roads and railways, rural and urban planning, environmental monitoring, land management, mining, natural resource management and sustainable agricultural development. GIS is a tool of Geoinformation Science (Geoinformatics), which is based on the amalgamation of geodesy, surveying, geography, cartography in the information age. GIS 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 geospatial databases.

Today the graduates have to possess modern knowledge with application of advanced computer technologies skills and be able to implement GIS applications.

The new MSc course developed by GE-UZ partners addresses the following problems:

1. In land and real property management Geoinformatics support the computer based land registration. For this reason the GIS usage can enhance the reliability and actuality of the real properties. At present, land registration in Uzbekistan is done manually without using nationwide computer-based GIS, mainly due to lack of competent specialists in digital mapping and particularly lack of competence in GIS.
2. Due to excessive pressure on its land and water resources, Uzbekistan now faces environmental problems mainly represented by land degradation and water shortage which negatively affects food supply in the country. As INSPIRE shows Geoinformatics has an inevitable role in environmental protection, it can help to map soil erosion,

salinity and water logging progress, plan irrigation network for agriculture and water resource management.

3. As a developing country Uzbekistan faces with the problem of growing population in cities and towns. Therefore, understanding of the possible scenarios and environmental impacts of urban settlements is an increasingly important focus of attention in science and policy.
4. In municipality level GIS is powerful tool for decision making in national development and livelihood improvement strategies; a coordinated and effective response to natural hazards, epidemic; and protect vulnerable populations.

As it can be seen from the above list Geoinfomatics has an important role in the future development of the society. Teaching GIS is very important, although this field in Uzbekistan is also suffers from several problems:

1. The spatial data related technologies are in an ongoing development. For teaching these subjects and to address the market needs highly educated teacher staff and the most recent developed geodetic and other data acquisition equipment is vital to reach the success of the project. These equipment are very expensive, but the Uzbek partner institutions will develop a shared usage of these equipment to fully exploit their capacity.
2. During Soviet period, higher education in geodesy and mapping in Uzbekistan was centrally supervised by two Russian universities (MIIGAiK and NIIGAiK). The GE-UZ project will help to develop a new MSc course in Geoinformatics 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. Unfortunately very often, employers in Uzbekistan have first to retrain the newly graduated engineers before they can satisfactorily handle their jobs.
4. In GIS education it is evident that teaching staff is not familiar with new methods and advanced technologies due to lack of modern data acquisition (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 associated data 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 international and it has not come to terms with internationalization yet.

The GE-UZ project was intended to answer the above mentioned problems. It built the human capacity at UZ partner universities; a knowledge pool with learning infrastructure; the technical capacity with GIS labs and the precise geodetic equipment; a sustainable MSc programme, based on national and international cooperation.

1.2 Aim, objectives

The aim of the project is the development and implementation of a new university program in Geoinformatics to be offered on the second level (Masters) at Uzbek partner universities. The goal of the project is to ensure that Uzbek partner universities will have the capacity to offer a Master program in Geoinformatics that meets Bologna process, international academic quality standards, job market needs and support Uzbekistan in sustainable development.

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 educational network.

1.3 Consortium

P1 University of West Hungary (UWH), Sopron, HU
P2 National University of Uzbekistan named after Mirzo Ulug'bek (NUU), Tashkent, UZ
P3 Karakalpak State University (KSU) Nukus, UZ
P4 Tashkent Architecture Building Institute (TABI) Tashkent, UZ
P5 Tashkent Institute of Irrigation and Melioration (TIIM) Tashkent, UZ
P6 Ministry of Higher and Secondary Specialized Education (MHSSE) Tashkent, UZ
P7 National Center of Geodesy and Cartography (NCGC) Tashkent, UZ
P8 State Unitary Enterprise "Geoinformkadastr" (Geoinformkadastr) Tashkent, UZ
P9 Paris-Lodron Universität Salzburg (PLUS) Salzburg, AT
P10 Royal Institute of Technology (KTH) Stockholm, SE
P11 University of Greenwich (UoG) London, UK
P12 Óbuda University (OU), Budapest, HU

1.4 Workpackages and tasks

WP1	**Project administration (GEO)**
1.1.	Project administration
1.2.	Project meetings and management
1.3.	Budget management
WP2	**Curriculum development (GEO)**
2.1.	Needs (as-is) analysis
2.2.	Definition of new curriculum
2.3.	Accreditation/Licensing
WP3	**Development of learning materials (TIIM)**
3.1.	Description of general rules and templates
3.2.	Chapter level descriptions in English
3.3.	Module development in Uzbek
3.4.	Review
3.5.	Final draft
3.6	Lesson level descriptions in English
3.6.	Testing in a pilot course and refinement
3.7.	Final version in Uzbek
WP4	**Train-the-teachers (TIIM)**
4.1.	Workshop on educational methodology and ICT
4.2.	Studies in Data Acquisition and GeoDBMS
4.3.	Studies in Spatial Analyses
4.4.	Study tour on Quality Assurance
WP5	**Development of learning environment (PLUS)**
5.1.	Implementation of Learning Management System
5.2.	Installation of computer labs
5.3.	Purchase of data acquisition equipment
WP6	**Educational Network Development (PLUS)**
6.1.	National cooperation and agreements
6.2.	International cooperation and agreements
WP7	**Quality Plan (UoG)**
7.1.	Quality Manual development
7.2.	Quality Assurance of learning material development
7.3.	Quality Assurance of course delivery
7.4.	External evaluation by international experts
WP8	**Course implementation (KTH)**
8.1.	Business plan development
8.2.	Recruitment of MSc students
8.3.	Entry exam for MSc candidates
8.4.	Field course on use of new technologies
8.5.	Pilot course delivery
8.6.	Summer School
WP9	**Dissemination and awareness (TIIM)**
9.1.	Production of PR materials
9.2.	Development of project website
9.3.	Publication in social and professional media
9.4.	Production of project newsletters
9.5.	International dissemination conference

1.5 Activities

At the beginning of the program a needs-analyses was accomplished and the further curriculum development was based on the result of this analyses. The overall programme definition was discussed by all the partners, and general rules and templates were set for an elaborated description. The curriculum and syllabus development followed by development of the learning materials in Uzbek by UZ partners. The testing and reviewing of the modules ensured that they meet the standards and the needs of the stakeholders. Meanwhile a teacher training process guaranteed the quality and sustainability of the master programme. In the UZ partner universities the installation of GIS laboratories and the acquisition of geodetic and GIS equipment provided the Uzbek partners with up to date teaching / learning environment. Part of the equipment will be jointly used in order to build the basement of network among students and faculties. After its accreditation the master programme was started at TIIM in 2014/15 academic year. In this period (one third of the project lifetime) all the courses were tested by UZ partners. The MSc programme was continued at TIIM, introduced at NUU and TABI in 2015/16. The programme will qualify a new generation of highly employable students in Geoinformatics, and also contribute to structural and societal development.

1.6 Outcomes

The main outcomes of the project are as follows

1. Needs analysis
2. MSc curriculum
3. Core module specifications
4. Retrained staff
5. Established GIS centers with geomatic equipment
6. Business plan
7. Cooperation agreements
8. Summer school
9. Dissemination and awareness building

2 Learning material development

The main aim of GE-UZ was to implement the vision and main ideas of the partners with development of a new Master specialty in Geoinformatics (develop new national standard, curricula and syllabuses). It uses 2.1 Needs analysis as a starting point and goes further with the short description of learning materials first at module level and after discussions within the partnership to specify detailed at chapter level. Meanwhile the bachelor level learning materials were reviewed and analysed in order to define how can MSc built on it. Once the chapter description was completed, the Uzbek partners followed the description and produced the learning modules.

2.1 Needs analysis

The aim of the analysis was to make 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.

One of objectives was to define curriculum development of GE-UZ project considering current study programs, courses, teaching staff capacity as well as current state of enterprises and needs. Academic staff from selected universities, colleges and professional staff from enterprises were requested to answer to questionnaire, which would give insights into the curriculum of the new international educational master program in Geoinformatics. Respondent organizations were selected based on relevance to GI Science or possibility to apply in their work.

For our project it was important from initial phase to learn academic and non-academic experiences involved in GI Science related teaching and training, and to be informed about their views on teaching staff, student and specialist qualifications (amongst others also English language, general computer and GIS tool skills).

The report consists of 7 parts: after this general introduction, it starts with an overview of the general qualifications of the universities and companies as perceived by teaching staff and other GIS related specialists with a focus on the curriculum development and the English language and computer skills of the university professor and teachers.

The questionnaires were designed and agreed by GE-UZ project partners and translated into Uzbek for a survey. The questionnaires were disseminated 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 private. Size of enterprises can be grouped as following: companies with more than 100 employees comprise 11 companies, companies with 15-100 employees comprise 15, and companies with less than 15 employees comprise 3.

The internal environments in the universities of the project clearly indicate that there is a strong need for MSc in Geoinformatics. The student recruitment for this course would not mean a difficult task, because each academic year for GIS related study programs more than one thousand students were enrolled. This number increased in last three academic years 2,5 times. Also 85% of the respondent universities stated that students' computer literacy is „good" and 1 of the respondents indicated that their students are best in general computer literacy. Also seven universities indicated that their students don't have problem but four universities have problem with participation on foreign language workshops for their MSc students.

The internal infrastructure is quite differing in the participant universities. Concerning the computer labs 54% of universities indicated in the survey that they have enough computers for teaching and 46% of respondents indicate that they have not enough computers. AutoCAD and ArcGIS are widely used but remote sensing software usage is only mentioned in TIIM. Also open software is not used at all.

Concerning other equipment universities stated that having high quality data acquisition equipment is very important for the success of MSc course, but some universities have limited availability of traditional surveying equipment also, for instance some basic surveying equipment such as old total stations, levels and in some cases GPS. However, almost all universities indicated that purchasing of good quality data acquisition equipment would be difficult for them.

62% of the teachers and students have access to the internet the others have only limited access, which should be considered when establishing the Learning Management Environment of the GE-UZ project.

In the needs analyses also 29 enterprises were questioned about the situation. 25 of the enterprises are governmental and 4 of them private. 11 companies have more than 100 employees 15 have 15-100 employees and 3 have less than 15. There were firms with multiple affiliation towards GIS, Geodesy, Cartography, Photogrammetry etc. Recently there is a moderate level of connection between universities and enterprises. The successfulness in the labour market of the GE_UZ projects student would be lie on a good connection between universities and enterprises.

As the survey highlighted the need for GIS courses are needed in the enterprises, but mostly in the form of short courses, but 29% of the enterprises would favour MSc courses. Recently the staff of the enterprises attended to training courses in GIS software another most attended training is in computer use skills.

Also the need for MSc students in the labour market was investigated. Respondent enterprises expressed interest in employing MSc graduate in Geoinformatics and indicated that 41% of them might employ 1-2 graduates, 48% of the enterprises- 3-5 graduates, 10% of enterprises – 6 and more graduates. The survey suggests that in Uzbekistan the concept of spatial data infrastructure is not wide spread. It should have been clarified throughout of the GE-UZ project.

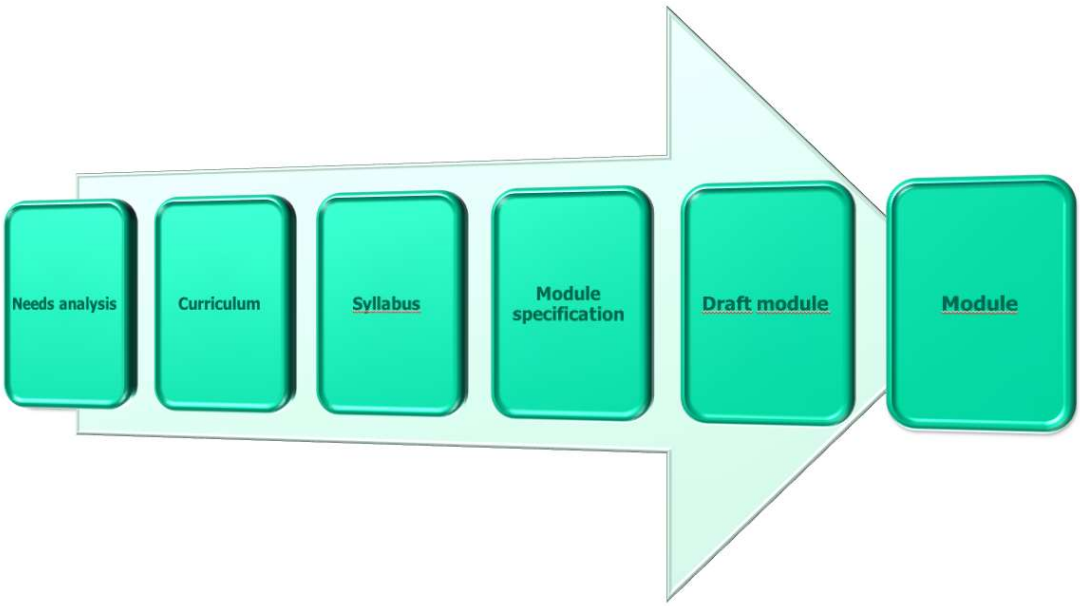
The external environment of the GE-UZ project is favourable towards the project, because as it was mentioned before there was no GIS master yet available. Also there are environmental and social problems in which GIS can be a good support for creating solutions. The supply of the technical background concerning computer labs and data acquisition equipment is quite diverse in the country. Considering the cultural background and the speciality of the country that teachers are frequently involved into non-academic activities, it can result into a possible decrease of interest or possible unwillingness for cooperation. There was no indicator detected in the survey that any ethical issue will occur during the project.

2.2 Core modules

Based on the needs analysis the following GE-UZ core modules were selected during the kick-off meeting:

- Geoinformation Systems and Science
- Remote Sensing
- Spatial Data Models
- Data Acquisition and Data Integration
- Geo-Databases and Distributed Architectures
- Cartography and Geovisualization
- Spatial Analysis
- Project Management and Organisation

2.3 Module development



The module development process

The curriculum is a crucial component of any education/training activities, it is a road map to knowledge, and it builds knowledge topology. Curriculum design includes consideration of

aims, intended learning outcomes, concise content, learning and teaching methods, and assessment. The curriculum must be based on the needs of stakeholders, founded on clearly defined skills and competences. The outcome will be a complex material about the new curriculum. It will contain all the required and necessary information for the accreditation.

The syllabus is the detailed content of the programme; the topics, issues or subjects that will be covered as it proceeds. In selecting content for inclusion, we should bear the following principles in mind:

- It should be relevant to the programme. An effective curriculum is clearly focused on the planned competences. The inclusion of irrelevant topics, however interesting in themselves, may confuse students.
- It should be appropriate to the level of the programme. An efficient curriculum is progressive, leading students onward and building on what has gone before. Material which is too basic or too advanced for the student in current stage erodes motivation to learn.
- It should be up to date and should reflect current trends.

In the module development a competency matrix based approach was introduced as a tool to fulfil the required competencies for graduates. It was used in a gap analysis for determining where critical overlaps between courses are or which skills/competencies are not taught deeply enough.

The learning material developers are working on their own module specification. This process needs of course a cross-functional implementation. In the design of detailed content the competency matrix can help to harmonize the work of the development team. The first column of competency matrix contains the name of modules; the competences are listed in the header. Identifying competencies was one of the most important issues in needs analysis. Filling the matrix needs a group meeting of module developers. The first step is to build a draft competency matrix revising and completing competencies.

After the matrix drafted each development team has to check their module against the competences and mark the relevant table cell. Creating the competency matrix will enable the development team to see at a glance, what competences their graduates will possess. The matrix is functioning as a gap analysis tool, and as a discovery instrument of unnecessary overlaps. Any development team can reconstruct their own row in competency matrix to increase cross-functionality and include competencies it might be lacking.

The resulting matrix contains a consensus between module developers. After creating it requires refinement of module specifications, which support the developers in writing harmonized learning materials. During the development phase the competency matrix may need periodical updating.

To regularize the workflow of the module development general guidelines are useful to ensure that all the partners are following the same schemes and ease the monitoring of the module development activity. In addition to the rules, templates can provide the common schemes for module specification.

MODULES	Geoinformation Systems and Science	Remote Sensing	Data Acquisition and Data Integration	Cartography and Geovisualization	Spatial Data Models	Spatial Analysis	Geodatabases and Distributed Architectures	Project Management and Organisation
COMPETENCES								
have knowledge of contemporary issues	x	x	x	x	x	x	x	x
understanding of management GIS projects								x
understanding of professional and ethical responsibility			x				x	x
originality in application of scientific knowledge	x	x		x	x	x		
apply remote sensing and photogrammetric knowledge		x	x					
apply cartographic knowledge				x		x		
apply GIS knowledge	x	x			x	x	x	
apply cadastre and land information knowledge			x					
ability to use data acquisition techniques, skills		x	x		x	x		
ability to analyze and interpret spatial data	x	x	x	x	x	x	x	
ability to integrate and manage spatial databases	x		x		x		x	
ability to design webGIS services				x			x	
ability to comprehend legal issues and standards in geographic information								
ability to solve complex spatial problems in global context	x	x		x		x		
ability to design GIS projects	x				x			x
ability to write simple computer programmes			x	x	x	x	x	
ability to work in multi-disciplinary teams	x	x	x	x		x		x
ability to communicate effectively	x	x						x
ability to engage in life-long learning	x	x	x	x	x	x	x	x
have critical awareness of current problems and/or new insights		x		x		x		x
comprehensive understanding of new techniques and technologies	x	x	x	x	x	x	x	x
ability to evaluate critically current researches	x	x		x	x	x		
ability to evaluate methods and propose new approaches	x	x	x	x	x	x	x	
ability to deal with complex issues creatively and systematically		x	x	x		x	x	
demonstrate self direction and originality in tackling and solving problems		x	x	x		x	x	
ability to act autonomously in planning and implementing tasks		x	x		x	x		x
ability to communicate to specialist and non specialist audiences					x	x		x
apply knowledge of economics								x

Competency matrix edited by Uzbek course developers.

2.4 Module specifications

Geoinformation Systems and Science

The module aims to teach Geoinformation Systems and Science subject in advanced level to master students; to strengthen the skills of master students who are familiar with this subject.

By completing the module, the student should:

- Be familiar with key GI concepts and terms
- Recognize spatial decision and spatial operation problems
- Discuss reasons why spatial perspective provides value added in many fields
- Identify major components of GIS as technical as well as organisational systems
- Understand aspects of integrating spatial information into general ICT
- Be familiar with Remote Sensing and integration with GIS

Content

- Geographic information principles, including spatial data structures their acquisition, pre-processing and analyses.
- GIS terminology and scope, definitions and explanations
- Spatial reference systems: coordinate reference systems and projections. Geometric Transformations
- Image processing methods. Raster and Vector, Models, Formats, Images, Spatial Analysis, Transformations
- Spatial data management and importance of metadata databases. Data Acquisition and processing
- GIS software, categories (desktop, mobile, server) and fields of application
- Integration with different software (ArcGIS)
- Geovisualization techniques, classifications, 3D analysis.
- Remote sensing. Sensors and platforms. Satellite Images, Spatial analysis
- Programming and customisation of remote sensing and GIS software
- Effective distributed deployment of spatial data using web technologies.
- Application of GIS outcomes and management of the system
- Current trends of GIS and further development

Remote Sensing

The module aims to introduce Remote Sensing and Image interpretation; to develop basic knowledge and comprehension. By completing the module, the student should:

- Be familiar with concepts and foundations of Remote sensing; Recognize Elements of photographic systems and image interpretation
- Be able to differentiate sensing systems in application to different fields such as environment, forestry, geography, land management and water resources management
- Choose appropriate technique for digital data integration and analysis
- Be able to classify earth surface features

Content

- Introduction to Remote Sensing and Arial photography; Structures of digital image data
- Remote sensing systems and platforms
- Spectral characteristics of vegetation, soil, rocks, forests and water
- RS software, categories and fields of application
- Image processing and classification
- RS in action: where, when and how RS solution are being used (case studies); Current trends

Spatial Data Models

The goal of this module is to enable students to develop a good understanding of the principles and concepts underlying spatial databases. By completing the module, the student should:

- Understand the general principles of data modelling
- Establish object-based and field-based views of the world
- Recognize problems and requirements for 3D and 4D
- Understand the fundamentals of representing spatial information in discrete structures
- Explore environments, design tools and different strategies towards model implementation

Content

- General principles of data modelling
- Identifying spatial objects; Entity-relationship modelling; Vector features (points, lines,
- polygons) and associated attributes; Vector features and associated topology
- Linear referencing
- Fields: continuous and discrete raster representation
- TIN surface modelling; From 2.5D to 3D
- Temporal data; Scale and resolution
- Rules and relations
- Implementing a data model

Data Acquisition and Data Integration

This module aims to introduce data acquisition and data integration methods. By completing the module, the student should:

- Know principles, foundations and basic techniques of Land surveying, Global Navigation Satellite Systems, Photogrammetry and remote sensing
- Understand approaches to and characteristics of secondary data acquisition
- Be able to compare acquisition methods and decide which method to apply
- Be able to establish processing workflows, assess accuracy results and applicability for tasks
- Understand the principles behind metadata

Content

- Terrestrial surveying: from triangulation to laserscanning
- Global Navigation Satellite Systems: GPS, GLONAS and Galileo.
- Stereo photogrammetry, orthophoto generation, and remote sensing imagery
- Digital elevation models, Practicals with acquiring and processing vector data, raster data, georeferencing
- Data Quality and Metadata
- Data integration: Catalogues and data sources
- Legal aspects and ethical issues

Geo-Databases and Distributed Architectures

The module aims to provide basic methods and techniques on geoDBMS. This module points out also the general goals for Spatial Data Infrastructures and shows the necessary processes to establish them. By completing the module, the student should:

- understand the principles and techniques of spatial databases; and apply these principles and techniques to design and build spatial databases; know how to make a DBMS operational
- appreciate the concept of geoportals; give examples of spatial data infrastructures (SDI) at the enterprise, national, regional and global levels
- define the requirements for open interoperability beyond direct access and industry standards

Content

- Elements of data organisation; RDBMS vs ORDBMS, object view vs relational structure
- Operating DBMS's: key concepts; Security, access control, locking, transaction processing
- Techniques and tools for DBMS design; Read UML diagrams and translate into designs
- SQL and Data Indexing Techniques in Relational Database
- Workflows and Transactions; Approach from enterprise and task management per-spectives; Process orientation, maintenance and database lifecycle; Data Mining and Warehousing;
- OGC and the OGC reference model ; OGC services; Geography Markup Language
- From Interactive Maps towards Web Map Services
- Architecture, standards, trends and applications of Spatial Data Infrastructure

Cartography and Geovisualization

The module aims at introducing basic cartographic and computer-based visualization tools; this module; it deals also with web mapping techniques. By completing the module, the student should:

- appreciate the role of visual communication throughout the workflow of a GIS projects
- understand how colours, classification and map symbols impact the visual message
- apply adequate strategies for effective visual communication

- demonstrate practical skills in visualization processes and create web-based maps

Content
- Visual communication
- Map design and visualization from a GIS viewpoint
- Cartographic abstraction and modelling; Colour schemes; Classification; Map symbols;
- Annotation and text
- Layout and map design
- Surface visualisation
- Dynamic visualisation; Virtual and augmented reality
- Web-based cartography
- Geovisualization as a decision support tool

Spatial Analysis

This module introduces students to advanced methods for spatial analysis.

Content
- Map algebra
- Shapes and patterns
- Distance-base analysis methods, spreading and diffusion
- Network analysis, allocation
- Spatial Interpolation
- Surface and DEM analysis
- Overlay Analysis
- Geosimulation
- Fuzzy Set Analysis
- Models for Spatial Decision Support

Project Management and Organisation

This module aims at introducing project management techniques and build management skills through GIS project planning in teamwork. This module takes a practical approach that may be used in operational settings, in public and private sector organizations to improve and maximize the efficiency of GIS projects.

Content
- Generating ideas and organizing thoughts
- Project management methodologies; Customer orientation
- Project planning: aims, objectives, outcomes; assigning resources, planning time and budget, criteria and metrics for project success; Project monitoring and controlling
- Responsibilities and communication in projects
- GIS in organisations; Organisational change; Leading innovation in a GI Economy

2.5 MSc curriculum

Organizing MSc program in Geoinformatics is one of the main objectives of GE-UZ project. Based on the short module specifications the harmonized learning materials were developed and the accreditation initiated. The State Educational Standard for MSc course on Geoinformatics was approved by the Ministry of Higher and Secondary Specialized Education. Curriculum consists of 6 specialized obligatory modules, 2 specialized elective modules, research activity and other common methodical courses.

Study plan schedule for the specialization 5A311502-Geodesy and Cartography (Geoinformatics)

	Study load of students, in hours									Distribution of hours by semesters and weeks				ECTS
			Auditoria classes, in hours							1 year		2 year		
										1*	2*	3*	4*	
	Total load									Number of weeks in semester				
Courses	hours	%	Total	Lecture	Exercise	Laboratory	Seminar	Term paper	Independent learning	20	20	20	18	
Common methodic courses	528	35,0%	360	130	220	10			168	11	4	3		18
Listed courses by MHSSE														
Specialized courses	756	50,0%	500	250	250	0	0	0	256	7	10	8	0	45
Geoinformation Systems and Science (incl. RS)	180		120	60	60				60	3	3			12
Spatial Data Models	150		80	40	40				70		4			9
Data Acquisition and Data Integration	122		80	40	40				42			4		6
Cartography and Geovisualization	182		140	70	70				42	4	3			12
Geodatabases and Distributed Architectures	122		80	40	40				42			4		6
Elective courses	228	15%	140	60	80				88		8	3		18
Methods of specialized modules teaching	90		40	20	20				50		4	3		6
Project Management and Organisation	89		60	30	30				29		2			6
Spatial Analysis	69		40	20	20				29		2			6
TOTAL	1512	100,0%	1 000	440	550	10	0	0	512	18	22	14	0	81
	0		0											
Scientific activity	2700	0	1808	0	0	0	0	0	892	0	0	0	0	36
Scientific-research work and Writing of Masters	1890		1260						630					30
Scientific-pedagogic work	378		260						118					0
Internship	432		288						144					6
Subtotal	4212		2808	440	550	10			1404	18	22	14	0	117
Attestations	324		216						108					3
TOTAL	4536		3 024						1512	18	22	14	0	120

The curriculum was accepted by the Ministry of Higher Education

From 1 June until 31 July of 2014 call for applications was opened at TIIM. Professors and doctors from Uzbek partner universities were chosen to teach at new MSc program in Geoinformatics at TIIM. From 2 September 2014, a new MSc program on Geoinformatics have been started at TIIM.

3 Staff development

Staff development aimed to ensure qualified teachers at UZ partner universities. There are many new technologies and methodologies which is important to know for the teachers. In the project 4 workshops or study courses designed for the staff of the Uzbek academic partners. The goal of each course was to provide the most recent technological and methodological background to the teachers, make them capable to sustain MSc course after the project is finished, to teach them how to improve and sustain the quality and usefulness of the MSc course.

3.1 Workshop on educational methodology and ICT

The first workshop was held at TIIM in June in 2013, in Tashkent, Uzbekistan. The duration of the training was one week. 32 teachers were trained, 8 teachers from each Uzbek partners.

Programme

Monday
9:00am Introduction and warming up – BM/AP
9:30am Terminology and Learning material development (from curriculum to textbooks) – MM
10am Learning Management System (Moodle) – Introduction and 'philosophy' – JS
11am Social media – JS
1 - 5pm Introduction to Moodle – BeB

Tuesday
9am Accreditation – Status and tasks – OA
10am Teaching / learning environment (computer labs, equipment) Hw/Sw – OA
11am Business plan / sustainability, Recruitment, Entry requirements, Course delivery – HF
1 - 5pm Working in teams
- Moodle masters – BeB
- Guidelines – MM
- Quality issues – FK
- Module harmonisation using competence matrix – BM/OA
- Business plan – HF

Wednesday
9am Quality issues, pedagogy – MM
10am Group presentations and discussion (4x30 minutes)
1 - 5pm Working in teams

Thursday
9am Module development (presentations by Uzbek authors)
1 - 5pm Module development (discussion between Uzbek authors and EU contributors)

Friday
9am Finalization of Guidelines – MM
10am Implementation of Quality plan – FK
11am Next actions in Social networking – BeB
1pm Closing AP/OA

AP – Andrea Podor
BeB – Bernhard Bretz
DB – Dagmar Baumgartner
BM – Bela Markus
FK – Fakhar Khalid
JS – Josef Strobl
MM – Michael McGibbon
OA – Odil Akbarov

Course teachers giving certification


Workshop participants

3.2 Studies in Data acquisition and GeoDBMS

The one-month training was organized by UWH in October, 2013 in Székesfehérvár, Hungary. Responsible partner for the organization was UWH. Representatives of PLUS supported the course for one week. The outcome was planned 16 trained teachers. There were selected 4 teachers from each academic partner institutions from Uzbekistan. Polat Reymov (KSU) did not receive the visa. He was replaced by Yakshimurad Khudajbergenov. (KSU) in June 2014.

The training course included topics on Geographical Information Systems, Remote Sensing, Project Management, Laser Scanning, Photogrammetry, GNSS Technologies, Cartography and Geovisualization and Database Management. The course was very interesting and intensive, because of the modern technologies and methods which can be used to develop textbooks for master program and can be applied to Uzbek education system.

Image Analysis was taught by Malgorzata Wojtaszek-Verone and Valeria Balazsik

Also the teachers collected a lot of literature and materials that will be helpful to develop master program and teach expected master students. There were several discussions about various topics and Uzbek teachers exchanged ideas related to teaching methods and skills with professors of the University of West Hungary and University of Salzburg. The module developers of master program had a chance to meet European colleagues and discuss module content, take comments and recommendations. The Uzbek teachers finalized the chapter level descriptions and started to write textbooks.

Mariana Belgiu (PLUS, Salzburg) lecturing

The participants also visited to the Land Office in Szekesfehervar which is responsible for land use and land cadastre of Fejer County. Members of the office presented their work process and databases which uses advanced technologies to store, analyse, control and retrieve spatial data. Land use management using internet was also introduced which is helpful for people to obtain data easily about specific land parcels through internet. On another day they visited the Institute of Geodesy and Remote Sensing (FOMI) to get acquainted with work process and modern technologies. FOMI colleagues presented the use of Laser Scanning, Remote Sensing and Photogrammetry at their office. There were lot of discussions and questions from both sides. Uzbek participants also visited Photogrammetric labs and map archives where they had a chance to get knowledge about the evolution of mapping technologies in Hungary.

Uzbek teachers with chief engineer of Geodezia and FÖMI head of departments


Farewell dinner in a wine cellar

3.3 Studies in Spatial Analysis

The one-month training was organized in Nov – Dec, 2013 in Salzburg, Austria. Responsible partner for the organization and for giving the facilities is PLUS. Representatives of UoG and UWH partner institutions supported the course for one week. The outcome was planned 16 trained teachers. There were selected 4 teachers from each academic partner institutions from Uzbekistan.

Meeting with PLUS staff

Closing ceremony

3.4 Study tour on quality assurance

The project planned trainings and workshops for Uzbek partners to give an inside into the practice of QA management. These trainings gave a very important practical background to Uzbek partners to measure the differences and similarities between EU and Uzbek systems.

A training was held by University of Greenwich, London from 13th April 2015 – 17th April 2015. The content of the training were designed by Dr Fakhar Khalid & Dr Mike McGibbon. The main goal of the training was to give highlights about the theory and practice of establishing and maintaining successful Master courses.

Some highlighted topics offered by the training were as follows:

1) Importance of Academic Quality Assurance in UK and EU:
   - Overview of Quality Assurance procedures in UK and EU
   - Role of a director of learning and quality in academia
   - Quality assurance key to enhancing student experience.
2) QA in practice:
   - QA life cycle of a typical academic programme
   - Roles and Responsibilities of a Programme Leader in programme development
3) Quality Assurance in Programme Development and Approval:
   - Roles and Responsibilities of a Course Leader in programme development.
   - Documentation associated with approval events
   - A walk through a typical programme approval event.
4) Running a Successful MSc Programme:
   - Course Evaluations
   - Programme and Course Monitoring Reports
   - Importance of Periodic Reviews (Exemplars and Good practices)

Dr Mike McGibbon lecturing

Consultation led by Dr Fakhar Khalid

Study tour at Greenwich campus

4 Equipment

The GE-UZ project designed, developed and implemented an online learning infrastructure firstly as a common platform for all project partners, including teachers and students. In the second phase 4 computer labs were installed and necessary geodetic equipment purchased. For immediate use of new resources a field course was organized, which ended with an open seminar.

4.1 Implementation of Learning Management System

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 is going to host all materials and resources used for teaching, structured by curriculum modules and used for instructor-led training. In the first phase it was installed in the "Public Cloud", using Amazons Web service hosting and thus granting high availability, stability and ubiquitous accessibility 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. By the end of the project Uzbek universities decided to install Moodle locally.

Moodle home page

4.2 Installation of computer labs

4 computer labs were installed. In each academic Uzbek partner received one labs. They will serve as a basis for face to face teaching and also for reaching all the materials available on the LMS. Computer labs were opened in March 2014. Premises were allocated; all required computers were delivered and ArcGIS software was successfully installed.

Opening the GIS laboratory at NUU

GIS laboratory with geodetic equipment

4.3 Data acquisition equipment

The Tempus project financed the purchasing of 8 Total Stations, 4 GNSS rovers and base stations, several handheld GPS, 1 laser scanner with joint usage, 8 automatic level and 8 laser distance measurer. Some of the equipment introduced below.

Trimble M3 Mechanical Total Stations:

- One of the most Reliable Crew Members, Lightweight, compact and streamlined, the Trimble® M3 Total Station provides everything one needs to get the job done right in demanding situations.
- Trimble Access Field Software Onboard combines trusted mechanical total station reliability with the powerful, functional and modular software that modern users need today. Familiar, easy-to-use interface. Powerful data collection and calculation tools for fast results in the field. The Optional roads module provides streamlined workflows. Import road definitions from third-party resources. Key in a complete road definition that includes horizontal and vertical alignments, templates, and widening records. Guides through fast offsets, slope staking, real-time design, and real-time quality control.
- Trimble DR Technology included in it: Save time by reducing instrument setups to reach the desired measurement points. High-accuracy EDM provides fast, reliable measurements.
- It has bright and colourful QVGA touchscreen.
- Runs Windows Embedded CE 6.0 operating system, optimizes graphical-rich features of Trimble Access. Improved readability and menu navigation and Ergonomic controls plus integrated screen and keyboard streamline inputs

GNSS rover - Trimble R4

- A Complete GNSS System
- Lightweight, convenient and cable free
- Dual-frequency antenna enhances tracking capacity
- Delivers sub-millimetre phase centre stability
- Internally powered with removable batteries
- Comes standard with GPS L1, L2, L2C and QZSS
- Choose the level of GNSS support you require with flexible upgrade options including GLONASS , Galileo and BeiDou (COMPASS)
- Advanced Trimble R-Track Technology
- Integrated in to the Trimble R6, Trimble R-Track technology delivers:
- Reliable, precise positioning performance

- Signal Prediction compensates for intermittent or marginal RTK correction signals
- CMRx communications protocol provides correction compression for optimized bandwidth and full utilization of all the satellites in view
- Functions as a VRS Rover, RTK Rover or Field Base Station
- Use as a lightweight rover for static surveying or RTK
- Compatible with Trimble VRS solutions
- Built-in 450 MHZ receive only radio or a fully integrated GSM/GPRS radio
- Integrated UHF transmit option

The Trimble® TX5 3D laser scanner is a revolutionary and highly versatile 3D scanning solution for a broad variety of scanning applications. The compact and lightweight design provides unmatched mobility at the job site, increasing field productivity. The intuitive and easy to use on-board interface allows new users to quickly get up to speed.

- Versatile and cost-effective
- Compact and portable
- Integrated colour camera for creating photorealistic scenes
- Intuitive touch screen interface ideal for new users
- The Trimble TX5 is a revolutionary versatile scanning solution applicable to a broad array of applications:
- *Surveying*: Capture high resolution data for topographical maps, generating 2D and 3D CAD views, measure distances, areas, and volumes
- *Building Information Modelling* - BIM: Efficiently capture As-built and As-Is conditions for MEP or Structures contractors working on virtual design and construction (BIM) projects
- *Industrial Facilities*: Capture accurate as-built documentation of a facility for redesign and revamp projects or for updating existing plant documentation in 3D
- *Inspection/Reverse Engineering*: Extract measurements and create 3D models when there is no existing CAD data available. Perform detailed inspections and comparisons to existing models, surfaces and point clouds
- *Tunnelling*: Capture tunnel profiles and centrelines for comparison with design, measuring undercut/overcut and volumes of extracted materials
- *Crime Scene & Forensic*: Quickly and thoroughly document accident and crime scenes including colour for real world visualization

The Trimble® TX5 3D laser scanner is the first 3D measurement equipment in Uzbekistan.

Equipment from data acquisition to analysis and visualization

4.4 Field course on use of new technologies

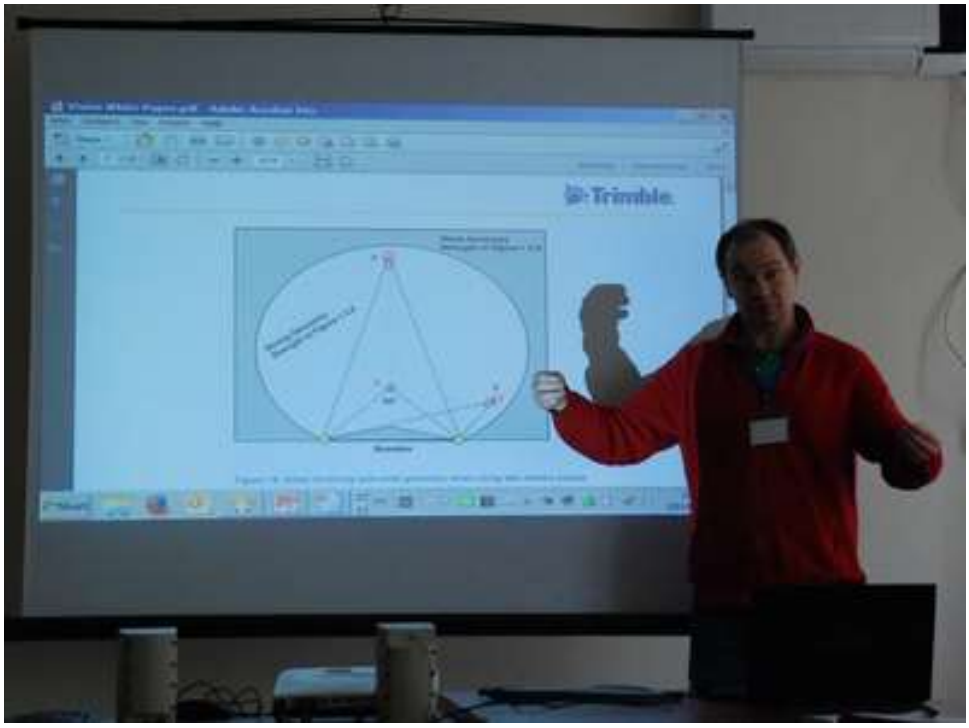
The training course was held at TIIM in March of 2014, in Tashkent, Uzbekistan and was prepared by Huaan Fan, KTH and his colleagues from Sweden. The aim of the training was to help teachers to acquire knowledge of new GNSS and GPS technology, usage of photogrammetric workstation and laser scanner. Sixteen teachers were trained. During the two-week training Uzbek colleagues have had the opportunity to learn and make experiences with the above outlined newly purchased equipment. Connecting to the equipment trainers gave lectures and practice on the following topics:

- Overview of new trends & new technologies in geodesy
- Laser scanning principle and applications
- Operation of a laser scanner
- Processing and visualization of laser scanning data
- GNSS systems, signals and atmospheric effects
- GNSS observables. DGPS. Real-Time kinematic (RTK) survey
- Post-processing of GPS data
- RTK survey using a base and a rover
- Processing of measurements from total stations and levels
- Geodetic reference systems: international and Uzbek systems
- Coordinate transformations

Throughout the training the Uzbek teachers participated in a project work called: Laser scanning and 3D modelling of a building in Tashkent. On a one-day field exercise they gained knowledge about operation of a GNSS receiver. They became familiar with field survey of a

small GPS network. Another field trip was about how to survey using modern total stations and do a survey with modern levels.

At the end of the training an open seminar was organized for the related companies, where the Uzbek colleagues presented the new technologies and made demonstrations about the usage of the new equipment and technologies for the public.



Milan Horemuz lecturing

Total station demonstration

Field survey

5 Quality plan

The development of the GE-UZ MSc programme in Uzbekistan has adopted an approach to academic quality assurance that is grounded in the European experience as guided by the Bologna agreement. To that end, the programme of study (the MSc award) will be described and explained by means of a programme specification that will express the overall programme aims, expected learning outcomes, approaches to teaching, learning and assessment designed to achieve the programme level aims, as well as a summary of the courses (modules) comprising the programme. A template for the production of a Programme Specification has been supplied to the Tempus project team. Individual courses (modules) were described in detail using course (module) specifications that specified the course (module) aim(s), expected learning outcomes, approaches to teaching and learning, indicative content, and approaches to assessment. A course specification template has also been supplied to the Tempus project team. A Programme Leader at Tashkent Institute of Irrigation and Melioration was delegated for production of the Programme Specification; course (module) specifications were the responsibility of local Course Coordinators, supported by the Tempus project members.

5.1 Quality manual

During the project lifecycle there were several QA activities. Each action and activities regulated by Quality Assurance, therefore on of the most important document became the Quality Manual prepared and shared with the project participants. The aim of this document was to provide a repository of various quality assurance (QA) activities within the GE-UZ project and beyond. This document includes reference to all learning and quality assurance procedures, quality objectives and persons responsible for these tasks. This manual was composed of agreed set of standards, procedures, list of learning and quality assurance forms, and guidelines on quality assurance.

All learning and quality assurance procedures noted in this document closely follow the guidelines of the Bologna Process. It is essential that personnel involved in the quality assurance process of the GE-UZ project have made themselves familiar with 'The Standards and Guidelines for Quality Assurance in the European Higher Education Area' report published by European Association for Quality Assurance in Higher Education.

To ensure the sustainability of the project the maintenance of quality of the Geoinformatics MSc programme, the project partners aimed at keeping the methods and actions taking during the project.

The Uzbek partners agreed that they will rely upon the actions made during the project. Several templates, documents and routines were designed for the usage in Uzbek universities.

The project quality assurance criteria included the following:

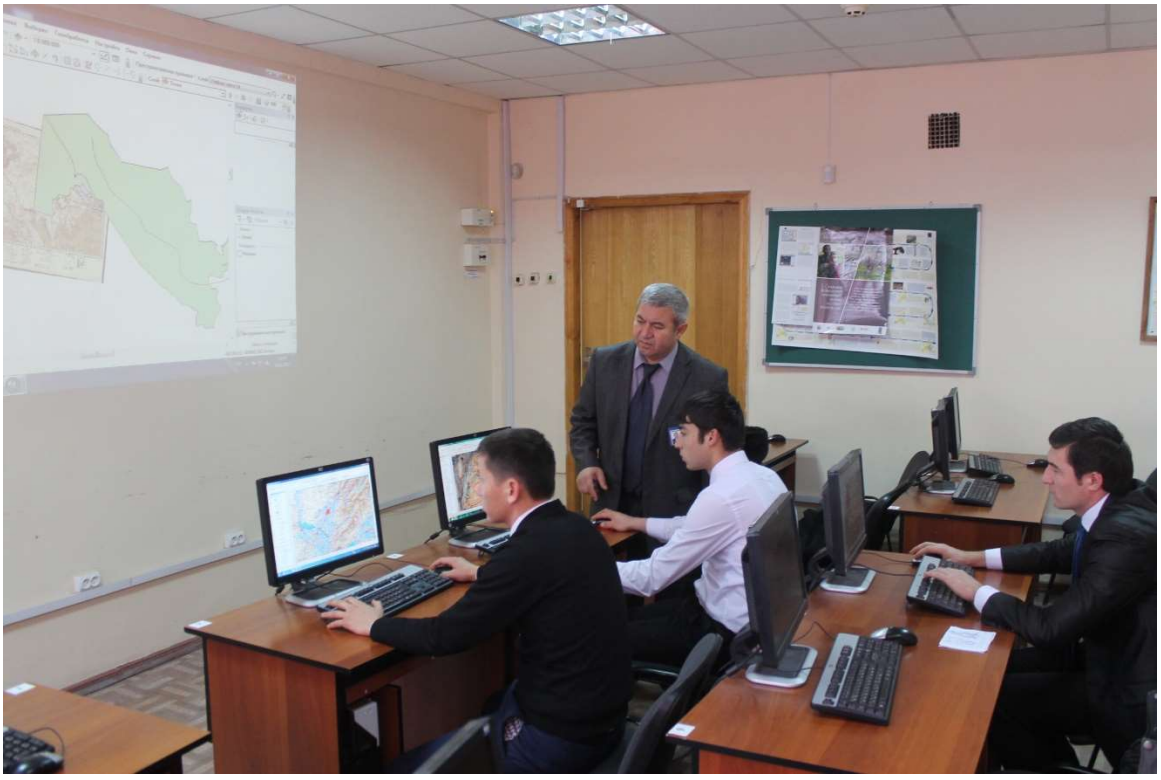
- Use of standardised templates
- Corporate project design
- Objectives achieved
- Clearly presented in appropriate languages

- Compliance with project plan
- Compliance with EU and international standards

The Uzbek partners accepted the above mentioned routines and they keep continuing use the documents created during the project. These guidelines ensure that they will guard the general quality of MSc programme successfully.

5.2 Pilot course delivery

The pilot courses for this above mentioned modules are planned to be implemented by every national partner universities (National University of Uzbekistan, Tashkent Architecture Building Institute, Tashkent Institute of Irrigation and Melioration, Karakalpak State University). According to the plan, minimum 3 students will participate in each course and it will be minimum 24 in total graduate and undergraduate students from every partner universities.



Dr. Ilhomjon Musaev introducing ArcGIS software for MSc students at TIIM

6 Sustainability

6.1 Educational Network Development

National and international agreements had been established between Uzbek partners and EU partner sites. These agreements are considered a major instrument to achieve sustainability beyond the current project collaboration. In order to carry out and fulfil the aims of these agreements, all partners have appointed a Campus Co-ordinator managing the development and conduct of joint activities. The Campus Co-ordinators are responsible for the evaluation of activities under this Agreement according to the practices of their respective institutions. The following activities had been agreed upon:

- Organization of joint academic and scientific activities, such as publications, courses, conferences, seminars, or symposia.
- Development of collaborative research projects.
- Sharing of equipment acquired during the Tempus GE-UZ project.
- Using the Tempus GE-UZ Learning Management System as an open learning environment.
- Exchange of staff.
- Exchange of undergraduate and graduate students.

The Final review meeting proposed that project partners should aim at developing follow-up projects and pursue independent professional research and education activities in order to maintain the quality of their collaboration. Following recommendations are proposed to support this:

- Conducting an annual meeting amongst Uzbek partners to re-frame objectives needed to pursue mutual benefits; e.g. at the end of the academic year.
- Description of expected outcomes to institutions involved.
- Clear description about financial arrangements (e.g. faculty exchange, research activities, technology maintenance costs, etc.).
- Raising awareness and discussing opportunities and challenges of cooperation.
- Long term aim should be on ‘excellent international partnerships’ for a structured utilization of synergies in the geospatial domain.
- Long-term strategic goal: access to online publications, training and e-learning courses.

6.2 Business plan

The business plan is necessary to keep the further sustainability the new Master course. It defines the expenses and benefits of the new course. An acceptable balanced was defined knowing the expenditures like teaching materials, lab facilities, equipment, infrastructures, administration and the income like financial support from the government and tuition fee connected to the new course. The business model defined the strategies and premises to stabilize the development.

Huaan Fan (KTH) leading a discussion on the Business Plan

1. Introduction

2. Programme organization and management
   2.1 Programme Board
   2.2 Programme Leaders and Programme Committees

3. Programme finance
   3.1 State budget and staff expenditure
   3.2 Tuition fees
   3.3 External funding
   3.4 Maintenance cost for educational infrastructure

4. Recruitment of master students
   4.1 Marketing the master programme
   4.2 Directed marketing to target groups
   4.3 Promotion events
   4.4 Student career services

5. Programme update
   5.1 Update of the curriculum and learning materials
   5.2 Staff competence upgrading

6. National cooperation
   6.1 Teaching staff sharing
   6.2 Equipment sharing

The structure of the Business plan

In the following Chapter 3 is introduced, where the financial issues related to the new master programme are discussed in details.

3.1 State budget and staff expenditure

The most important source is the state budget. In general, Uzbekistan spends about 10% of GDP for educational sectors which is very high in any international comparison. In practice, the Ministry of Finance and Ministry of Higher and Secondary Specialized Education (MHSSE) decide on the allocation of funds to different higher education institutions (HEI).

It has turned out that budgeting is made at the university level in Uzbekistan. Incomes from the state budget are received at university level and financial decisions on expenditures are decided by university administration (rector, vice-rectors). This means that a department or a programme does not have its own budget responsibility and financial decision-making power.

If the new MSc programme can be successfully accredited by MHSSE and if GE-UZ project consortium succeed to obtain support from the respective Uzbek university administrations, basic funding to the 4 departments involved in the master programme should be regarded as secured. This basic funding should cover the salary costs for permanent staff as well as for maintenance costs.

For some new courses in the MSc programme, it can happen that new teachers are needed. A long-term solution for new teachers must be based on funding from the state budget. With the present university regulation in Uzbekistan, increase of new positions requires the permission of MHSSE and Ministry of Finance. Therefore, each Uzbek partner university should analyse present human resources and future needs in order to ensure sufficient teaching staff for the new MSc programme.

3.2 Tuition fees

In Uzbekistan about 75% of Uzbek master students pay tuition fees while the other 25% of students will receive scholarship from the government. Scholarship is differentiated based on the grade of the students. For grade 3, 4 and 5, each student will receive a scholarship of 170 000 UZS, 200 000 UZS and 250 000 UZS, respectively. For MSc studies, annual tuition fee amounts to 4 – 5.4 million UZS for Uzbek universities and about 5000 USD for international private universities.

Income from student-paid tuition fees does not decrease the state budget from the government and thus can be kept by the respective university. However, as budget is at university level, income from tuition fees will go to the university, not individual programme or department. Naturally university administration should be supportive to programme which are at high international standard and which can attract students and generate income in the form of tuition fees. Therefore, the GE-UZ consortium should try its best to develop a high quality programme, relevant to labour market and attractive to students.

3.3 External funding

External project funding, both national and international, can be a more and more important funding source in the future. The GE-UZ project should facilitate Uzbek partners to build effective partnership and networks to attract external funding. Uzbek partner universities are encouraged to take advantage of the new master programme, new GIS equipment and new competences acquired through the GE-UZ project to establish cooperation with geodesy/GIS industry and public organizations and generate income to the relevant departments. One type of such commercial cooperation is providing GIS training courses to professionals and/or organizations.

During the life time of GE-UZ project, the consortium (in particular Uzbek partners) should investigate the possibilities for external projects such as:

- new EU projects
- national or international research and development projects
- consulting services to private industry and public organizations
- GIS re-training courses for external working professionals

3.4 Maintenance cost for education infrastructure

Maintenance cost can be expected for different types of facilities:

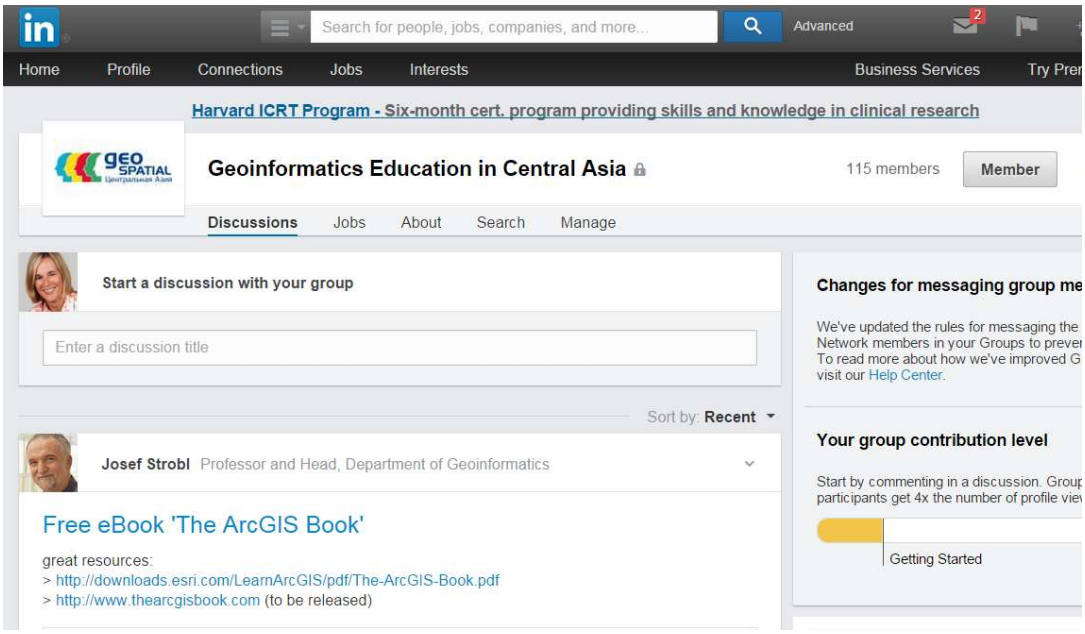
- server and computers in GIS lab
- internet connection
- maintenance or update of software
- maintenance of geodetic instruments (reparations, replacement of non-functioning parts, batteries, etc.)

At present, most equipment has not been purchased and installed. Therefore, it is difficult to estimate the exact costs for each of above facilities. However, for long-term sustainability it is necessary to university administrations make commitment to cover the maintenance costs in the future. Some of the maintenance costs can be paid from external projects if possible.

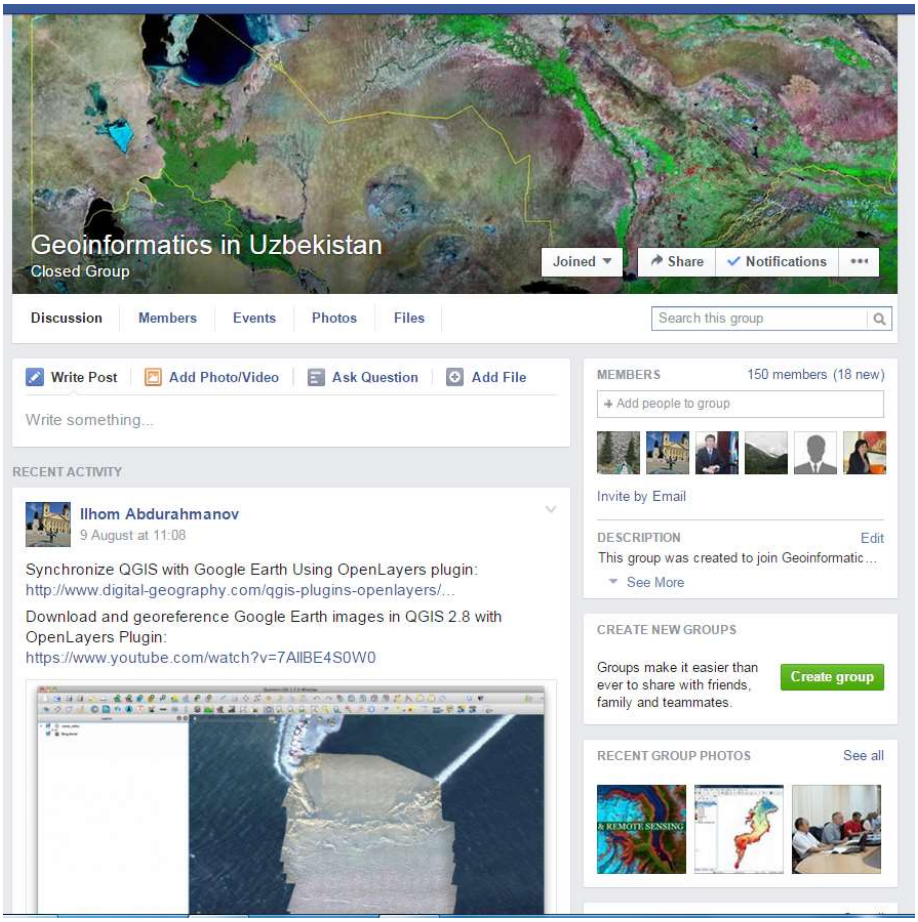
6.3 Social networking

The development of professional and educational networks within the Tempus GE-UZ project had been considered as a critically important element of the project's sustainability strategy, providing informal quality assurance and offering semi-structured motivational impulses. The educational social networks will maintain connectivity between the partner institutions, their staff and students after the project will be finished.

A critical mass of communication, interest, and perceived added value had been reached in the third year of the project, this required a proactive development and support efforts in the earlier phases coordinated by the University of Salzburg (PLUS). The actual implementation of communication networks for teachers has been integrated into the 'Geoinformatics Education in Central Asia Group' on the LinkedIn platform, while students and faculty initiated a very active Facebook site for Uzbek students.



LinkedIn: Geoinformatics Education in Central Asia Group



Facebook Group: Geoinformatics in Uzbekistan

An open and free use of social media is desirable for Uzbekistan. The long-term strategic goal should be on open access to online media and educational resources. The development of a 'media plan' establishing objectives and desired outcomes is recommended for all international education projects.

Activities and benefits can be manifold:

- Sharing information worldwide.
- Publish content via social media channels on a regular basis by providing accurate information.
- Feedback on project activities will provide insight on how to improve project activities.

6.4 Sustainable MSc programme

The Ministry of Higher and Secondary Specialized Education (MHSSE) has formally recognized the new program in Geoinformatics on national level and assured with eligible number of students to be enrolled according to the national quota. According to national quota in 2014 TIIM was able to enrol and start teaching for 3 master students. This year 2015, TIIM has received – 5 places, TABI – 3 places and NUU – 3 places. The interest about the programme is high. The partner universities received fifty applications, and after a successful entry exam the second intake started with 11 students. It is expected that interest about the program will increase following the recent governmental review meeting on development of e-government supported by geospatial tools. The number of quota for undergraduate students were considerably increased and it is obvious that after graduation these students will increase number of applications to our program.

Lecture on Spatial Analysis

Peter Ranacher introduced the problems of “moving objects”

Sustainability of the Learning Management System

To support the study process a learning environment has been developed by introducing Moodle platform. This Moodle platform was extensively used during development of teaching materials jointly with EU partners. As an indirect impact nicely presented Moodle platform was recommended by the MHSSE to apply on national level for all universities. Nowadays there is ongoing installation process in each university.

7 Meetings

The management was directed by University of West Hungary. The UWH staff was taking care of management and handled financial tasks throughout the project. Meanwhile Tashkent Institute of Irrigation and Melioration (TIIM) supported the project leader in Uzbekistan.

At the beginning of the project a Project Management Board was set up, where each project partner from the universities delegated one representative into the Board. The Board was led by the project coordinator, and his duty is to supervise the decisions and evaluation throughout the project. The Project Management Board members are as follows: Bela Markus (UWH) chair, Odil Akbarov (TIIM) co-chair, Andrea Podor (UWH), Josef Strobl (PLUS), Huaan Fan (KTH), Fakhar Khalid (UoG), Attila Petrik (UWH) international secretary (he was replaced by George Molnar from 1 March 2013), Tolmas Boltayev UZ secretary (he was replaced by Mamanbek Reymov from 1 September 2014). The Board communicated regularly mostly online and it have had meetings 3-4 times per year.

Four project meetings are planned. The role of the meetings is to follow the progress of the project, to discuss the work to be done during the next project period and to make important decision concerning sustainability issues. In these meeting all project partners delegated 2 representatives.

At the beginning of the project a Project Advisory Board (PAB) was set up, comprising 1 delegate person from every partner plus representative of UZ organizations (NTO, Ministry of Education, representatives of industry companies). Project Advisory Board (PAB) are: Prof. Uktam Umurzakov (TIIM) chair, Odil Akbarov (TIIM) national co-ordinator, Prof. Bela Markus (UWH) project co-ordinator, Attila Petrik (UWH) international secretary (he was replaced by George Molnar from 1 March 2013), one representative from each UZ partners, Aziza Abdurakhmanova (NTO-UZ). The PAB supported with advices during the 4 regular “face- to-face” meetings and in two other occasions.

Within all the WPs, leaders were delegated, each was responsible for agreeing operational plans and allocating resources to contributors for the timely achievement production of deliverables. Partners submitted concise reports of progress, problems at PMB meetings.

7.1 Kick-off meeting

A well-organized and successful conference was held in Tashkent with GE-UZ project partners on 17-19th January in 2013. The goal of the project is to ensure that Uzbek partner universities (TIIM, TABI, NUU, KSU) will have the capacity to offer a Master program in Geoinformatics that meets Bologna process, international academic quality standards, job market needs and support Uzbekistan in sustainable development. The objective of the conference was to bring project partners and stakeholders together and to discuss project aims, tasks and future plans. The conference was organized by Uzbek partners and was held in NUU, TABI and TIIM premises.

The Vice Rector of TABI welcomed the project partners and wished a very fruitful cooperation on the 1st day of the conference. Under the guidance of Prof Bela Markus (Project Coordinator) PMB (Project Management Board) meeting was held in TABI premises with participation of Project Partner Coordinators to debate the project objectives, undertaken tasks, future plans, expected outcomes and responsibilities. Several motions and decisions were passed regarding work-packages. In the afternoon the project partner coordinators met the stakeholders and project beneficiaries at PAB (Project Advisory Board) meeting organized at NUU premises. First Odil Akbarov (TIIM) and Andrea Podor (UWH) presented the objectives of the project and the results of the needs analysis for beneficiaries. After acceptance of several reports and agreements, we walked around the Department of Geography and Geology at NUU.

PAB meeting at NUU

On the 2nd day the conference continued with opening ceremony inaugurated by the rector of TIIM. This talk was followed by the presentation of EU delegate (Yuri Sterk) who explained the EU's policy on higher education and wished a very successful cooperation in the framework of this project. As a closing of the morning session after Prof Bela Markus's speech, the project partners' introduction was presented. In the afternoon during the technical session the presentation of work-packages were discussed by Project Partner Coordinators and stakeholders. After a long-lasting and useful meeting a conference dinner was addressed to project partners at TIIM where we could get acquainted with each other much better and enjoyed the local dishes and traditional Uzbek dance, in a word a dash of Uzbekistan. The hospitality and the local people's attitude were amazing and respectful.

PMB meeting at TIIM

To sum up the kick-off meeting, one thing is for sure; the conference was obviously positive and effective proven by evaluation forms completed by participants therefore a great thank you to the organizers especially to Odil Akbarov. During the meeting a number of issues were clarified and we were able to meet with stakeholders and beneficiaries personally and experienced that Uzbekistan and more precisely the project partners need to be provided with MSc Geoinformatics qualification. Uzbekistan declared to enable progress and step on the way of development. The next meeting will be carried out in Tashkent again in June 2013.

7.2 First review meeting

The Project Advisory Board participants from Uzbekistan and Project Management Board from partner universities had one week meeting in October 2013 at UWH GEO in Szekesfehervar (Hungary) to review current situation of the project such as results, problems, standard which should meet the national and EU standards, curriculum, accreditation and module development.

Meeting participants: Béla Márkus (UWH) chair, Odil Akbarov (TIIM) co-chair, Andrea Podor (UWH) project manager, György Molnár (UWH) international secretary, Mukhitdin Akbarov (TIIM), Uktam Umurzakov (TIIM), Muratbay Jumanov (KSU), Sherimmat Avazov (MHSSE), Lola Yuldasheva (Geoinformkadastr), Asomberdi Egamberdiev (NUU),Eshkabul Safarov (NUU), Sarvar Tashpulatov (TABI), Shukhrat Avchiyev (TABI) Josef Strobl (PLUS), Barbara Brunner-Maresch (PLUS), Bernhard Bretz (PLUS), Huaan Fan (KTH), Győző Gidófalvi (KTH), Fakhar Khalid (UoG), Mike McGibbon (UoG). In attendance: Márton Beke (Tempus Office), László Varga (UWH), Gábor Mélykúti (UWH GEO).

Andrea Pődör introducing the GE-UZ cake

Szilvia Taupert slicing the cake

Gifts passed

Meeting participants

7.3 Second review meeting

Due to organisational changes at UWH in July 2014 Óbuda University as new co-beneficiary accepted by the PMB. Changes did not affect implementation of project delivery, budget remained unchanged. The meeting venue was Óbuda University, Budapest. It was organized in October 2014.

Meeting participants: Bela Markus (UWH) chair, Odil Akbarov (TIIM) co-chair, Andrea Podor (OU) project manager, Gyorgy Molnar (UWH) secretary, Szilvia Taupert (OU) secretary, Josef Strobl (PLUS), Huaan Fan (KTH), Fakhar Khalid (UoG). In attendance: Barbara Brunner (PLUS), Berhard Bretz (PLUS), Mike McGibbon (UoG), Akylbek Chymyrov (External Reviewer), Tamás Jancsó (OU), Uktam Umurzakov (TIIM), Ulugbek Khodiev (MHSSE), Khasan Magdiev (NCGC), Ravshan Makhamadaliev (NUU), Muhammadismoil Mahmudov (NUU), Allabergan Babajanov (TABI), Mukhitdin Akbarov (TIIM), Ilkhomjon Musaev (TIIM), Ilhom Abdurakhmanov (TIIM).

Greetings by Prof Uktam Umurzakov, chairman of Advisory Board

Advisory Board meeting

External quality review presented by Akylbek Chymyrov

Barbara Brunner-Maresh (PLUS) donates books to Odil Akbarov

Meeting participants

7.4 Final review meeting

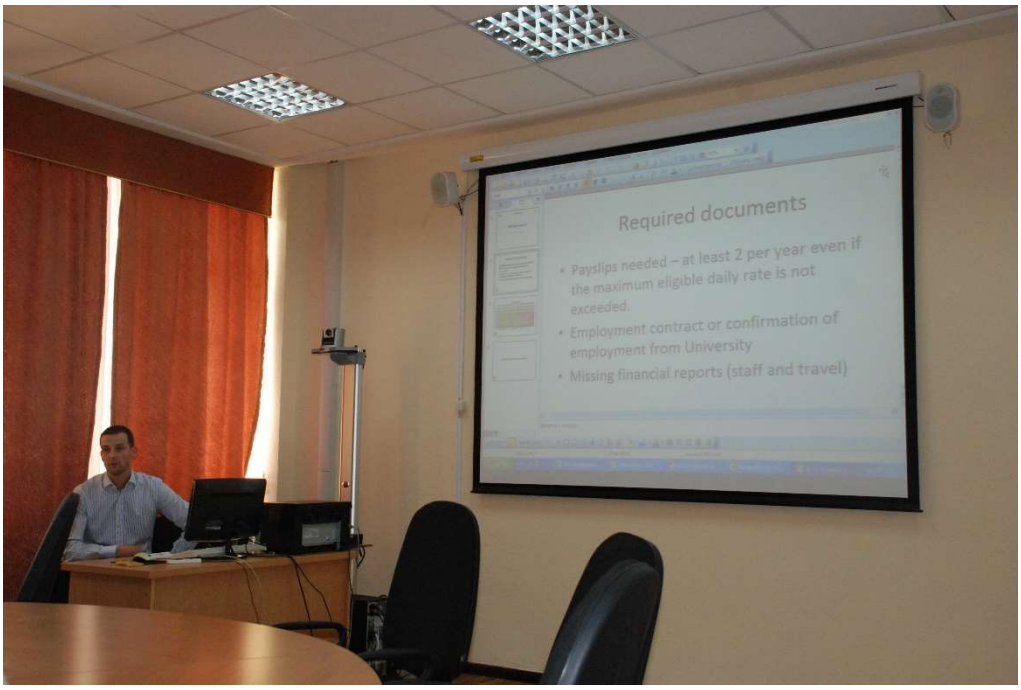
The Final review meeting of the Tempus GE-UZ project was organized in Tashkent at the premises of Tashkent Institute of Irrigation and Melioration (TIIM, the national leader of GE-UZ project) on 14 May, 2015. The meeting was opened with greetings by chair of Project Advisory Board, Prof. Uktam Umurzakov. The GE-UZ Advisory Board have had three evaluation meetings in Tashkent (March), in London (April) and again in Tashkent (May). Summary report of PAB meeting in May 2015 has been presented by Odil Akbarov (national project coordinator).

During the meeting GE-UZ project partners introduced the current state of the project's workpackages, discussed the forthcoming organizational and administrative issues. The following issues were discussed in details: Curriculum development: ECTS transformation; Development of learning materials: Learning Materials and Learning guides; Train-the-

teachers actions: Quality Assurance; Development of learning environment: Experiences in use of Learning Management System and Equipment Purchase; Educational Network Development: Future co-operations; Quality Plan: Quality assurance of learning material development, Quality assurance of course delivery, External evaluation by international expert, Quality Manual; Course implementation: Recruitment, Entry exam, Pilot course delivery status; Dissemination and awareness: PR materials, Newsletters, Website, Publication in social and professional media.

All the expected outcomes were performed in time (Needs (as-is) analysis, Definition of new curriculum, Accreditation, Bachelor program in Geodesy, Cartography and Cadastre was refined, on Five Train-the-Teachers course 32 teachers were trained and qualified, Learning Management System was introduced, Four computer labs were installed with high standard hardware and GIS software, Modern data acquisition equipment were purchased, Sustainable educational network was built, Quality Manual was produced to ensure the quality of MSc programme, Business Plan developed for sustainability, Project websites (EN and UZ), Project results were disseminated in social and professional media, in project newsletters, and International dissemination conference).

Bernhard Bretz summarizes Moodle status



George Molnar presenting financial requirements

During the project some additional actions were done: after the Field course on use of new technologies (in March 2014) a seminar was organized for GI companies and stakeholders with the aim of quick dissemination of knowledge on GNSS and laserscanning; a summer school arranged (in May 2015) for 20 students and staff members of GI companies supporting UZ in sustainable development.


Discussions

One of the most important results in the project life cycle was that a Bologna-conformed MSc course was launched at TIIM and successfully enrolled the first intake in 2014, based on eight

modules developed by UZ teachers with the support of EU counterparts. In 2015 the Ministry of Higher Education will grant almost 20 students at three partner universities in Tashkent (TIIM, National University of Uzbekistan named after Mirzo Ulug'bek (NUU), and Tashkent Architecture Building Institute (TABI). Karakalpak State University (KSU) in Nukus will open the new programme in 2016.

Future cooperation was discussed among partners, especially focusing on Erasmus+ programme where European partners are waiting for candidates from Uzbekistan. Extending the cooperation among new universities was also recommended.

At the end of the meeting Prof Markus thanked for all project contributors for their excellent support. Finally the key project partners were granted with certificates of appreciation for their active participation and inputs during the project period.

Odil Akbarov awarded by a certificate of appreciation

Polat Reymov receives a gift book from Prof Strobl

8 Dissemination and awareness building

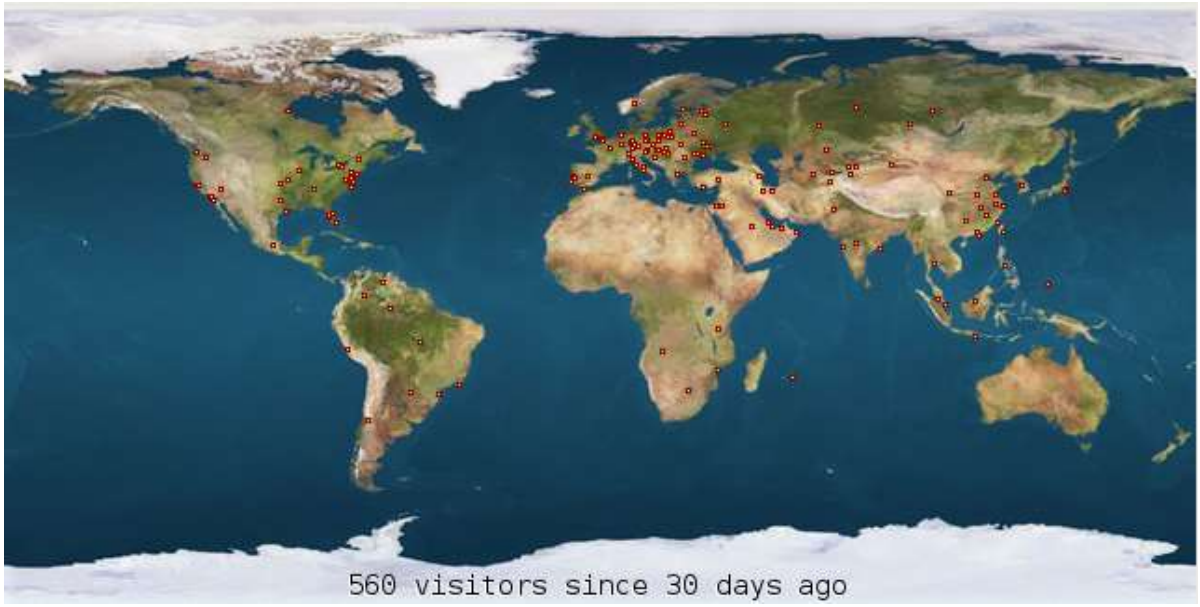
Dissemination was started from the 1st day of the project with the information about the existence and idea of the project. The first step of the dissemination strategy will be the analysis of the possible interested people/organizations in the project idea and project results in EU member countries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

- within the organization itself;
- within the partner group in the framework of the project;
- within every partner country for target sector – students;
- within every partner country for potential social partners - employer organizations, NGO's;
- within the national level – policy making organizations;
- within the international level – for target groups, sector and political project users and policy making organizations at the international level (EU member and candidate countries).

The dissemination strategy emphasized 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 final dissemination conferences at TIIM in September 2015.

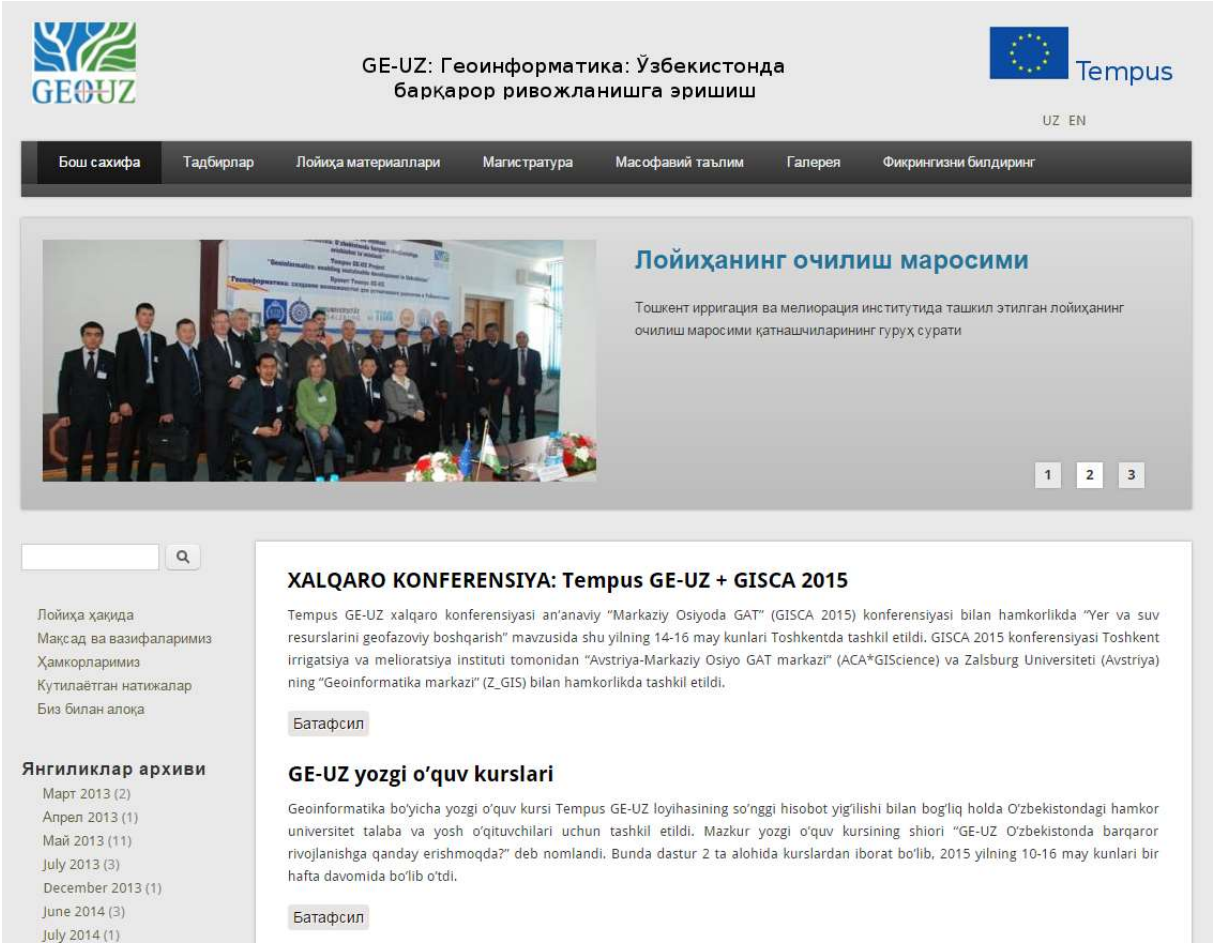
8.1 Websites

Two websites were created presenting the project as a whole, its progress, and important news in connection with the main phases of the GE-UZ project. The English language website is available at http://www.ge-uz.eu, and the Uzbek language website released at http://www.geoinformatics.uz.



The number of visitors is over 200.000 from all over the world

The English website supports public users with general information and project partners through a password protected service



The Uzbek website serving local academia and industry with useful information

8.2 Summer school

At the end of GE-UZ project we wanted to introduce the use of these equipment in real life applications; for that, a Summer School in Geoinformatics was organized for the period 10-16 May, 2015 at Tashkent Institute of Irrigation and Melioration. The Summer School focused on two main courses:

- 3D Laser Scanner Application
- GIS in Environmental Management

The courses are presented below.

3D Laser Scanner Application

During the last decade the airborne and terrestrial laser scanning has become a common tool for collection of spatial data. 3D laser scanning is today routinely used for both large and small scale applications like creation of DTM, inspection and documentation of forests, linear infrastructure, industrial installations and historical buildings. The latter is the application we are going to focus on in this course. The main reason for documenting historical buildings is to create their digital 3D model before they are lost to natural disasters, destroyed by human aggression or ravaged by the passage of time.

The main aim of the 3D Laser Scanner Application is to develop theoretical knowledge and practical skills in use of terrestrial Laser Scanning techniques for 3D building modelling.

Our goal with this course was to introduce the basic concepts of the terrestrial laser scanning instruments and processing software as well as acquiring practical skills in collecting and processing laser scanning data. We scanned and created a 3D model of historical building Barakkhon madrasa.

The study area

After successful completion, course participants gained knowledge about concepts, working principles and different applications of Laser Scanner and be able to apply laser scanner to various engineering problems and perform data processing techniques.

GIS in Environment

The environmental problems we face require profound decisions, be it in the determination of appropriate countermeasures or the minimization of additional stress on our ecosystems due to new infrastructure projects. Since our environment is inherently spatial, the use of Geographic Information Systems (GIS) has a long tradition in delivering the quantitative basis for such decisions. In this Summer School we wanted to explore state of the art methods for monitoring, analysing and simulating environmental processes and their resulting patterns in their spatial and sometimes also temporal dimension. While the first part of the Summer School is devoted to the relevant core concepts and building blocks of spatial analysis, remote sensing and spatial statistics placed within an environmental context, the second part focuses on the development of integrative case studies using local data. A tight coupling of conceptual input and its direct hands-on-application in lab sessions ensures a good transferability of theory into practice.
The main aim of the course was to provide participants with practical and methodological skills which make them capable to use main spatial analysis techniques of GIS in solving Environmental Management issues. Some places where some environmental issues exist will

be analyzed and mapped in Tashkent Institute of Irrigation and Melioration's teaching experimental farm in "Urta Chirchik" region, Uzbekistan, (approximate 50 km from Tashkent city).

After successful completion, course participants gained knowledge about GIS, RS and GPS/GNSS concepts, data acquisition techniques, methods of spatial analysis for decision making in environmental challenges.

The study area "Urta Chirchik" region

School director: Ilhom Musaev, TIIM
3D Laser Scanner Application:

- National teacher: Utkir Shermanov, TIIM
- International teacher: Milan Horemuz, KTH

GIS in Environment:

- National teacher: Sherzod Rakhmonov, TIIM
- International teacher: Christopher Traun, PLUS.

8.3 Final conference

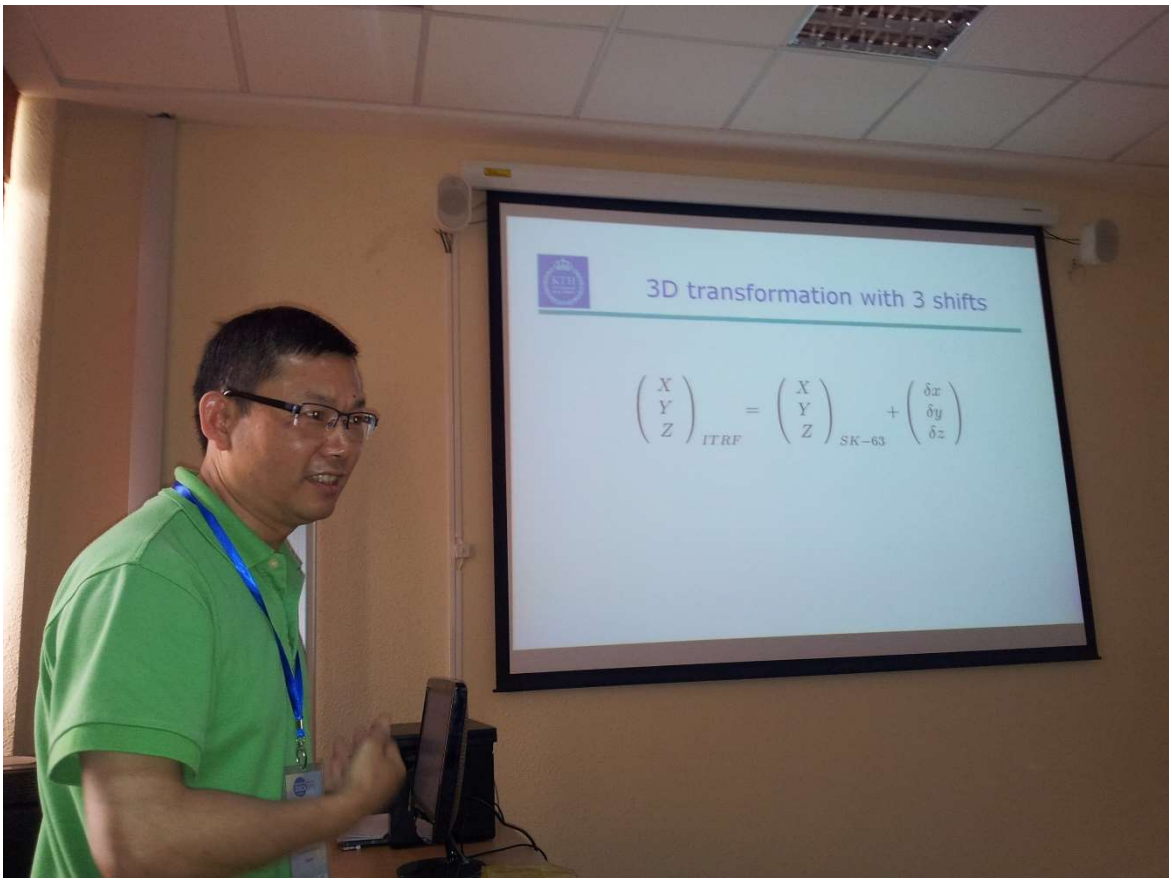
The TEMPUS GE-UZ International Final Conference was jointly organized with the annual GIS in Central Asia Conference (GISCA 2015). The Conference was held in May 14-16 in Tashkent, Uzbekistan on "Geospatial Management of Land, Water and Resources". The GISCA 2015 was locally organized by the Tashkent Institute of Irrigation and Melioration (TIIM) in cooperation with Austria-Central Asia Centre for GIScience (ACA*GIScience) and the Interfaculty Department of Geoinformatics (Z_GIS), University of Salzburg, Austria. The conference was supported by Trimble http://www.trimble.com), ESRI (http://www.esri.com) and media partners from the Geoinformatics industry.

The main objectives of this conference were to bring together GIS academics, researchers and practitioners focusing on the Central Asian countries and to encourage international cooperation and knowledge exchange in GIS education and science.

Conference opening

More than 150 participants from Central Asian countries and Austria, China, Germany, Hungary, Netherlands, Romania, Spain, Sweden, UAE, UK, USA have enjoyed scientific research presentations and discussions, exchanged experiences and findings of international initiatives on GIS education and research.

The 10th anniversary of the GISCA conference series was celebrated and the valuable contribution of “GIS in Central Asia” conferences in educational and research cooperation in the region has been mentioned by the conference participants. Michael Gould (esri Global Education Manager) has highlighted the importance of Geoinformatics in the social-economic development of countries in his keynote “GIS education to create the next generation of decision-makers”. Participants have expressed thanks to the local conference organizing team of the Tashkent Institute of Irrigation and Melioration for their hospitality and excellent facilities for this really interesting international event.



Huaan Fan (KTH) give a presentation on geodetic reference systems

Conference participants

The conference proceedings are available on the official website soon and selected papers of the conference will be published in the special issue of the International Journal of Geoinformatics.

8.4 Publications

- Odil Akbarov: Outcomes of the GE-UZ project, Tempus book, Tashkent, 2015.
- Bela Markus: Harmonized module development, Tempus book, Tashkent, 2015.
- Josef Strobl and Barbara Brunner-Maresch: Tempus GE-UZ project: Networking in an Educational Environment, Tempus book, Tashkent, 2015.
- Andrea Podor et al.:Tempus GE-UZ project: Quality Assurance to ensure the sustainability of MSc program, Tempus book, Tashkent, 2015.
- O'ktam Umurzoqov, Qosimjon Raxmanov va Muxitdin Akbarov: Geoinformatika mutaxassisi xalqaro standartlarga mos tayyorlanadi, Ma'rifat, 02/2015;
- Геоинформатика – Баркарор экологик Ривожланишга хизмат кулади, Qishloq HAYOTI 09/01/2015.
- Erkin Usmanov: Geografiya TEMPUS dasturida, "O'zbekiston Milliy Universiteti", 01/2015;
- Interview with Allabergan Babadjanov by Uzbekistan radio ("Qishloq hayoti" program), 25/11/2014;
- Allabernan Babajanov, Obid Davronov: Yangi mutaxassislik tashkil etilmoqda, O'zbekiston Respublikasi er resurslari, geodeziya, kartografiya va davlat kadastri davlat qo'mitasi axborotnomasi, 4/2014, Toshkent, O'zbekiston;
- Baxit Paluanov:Tempus joybarlarы-xarekette, Erkin Qaraqalpaqstan, 06/2014;
- Interview with Yakhshimurad Khudayberganov by "Xabar" television, 04/2015;
- Tamara Masharipova: Geoinformatika boyinsha jana joybar, Erkin Qaraqalpaqstan, 04/2015;
- Béla Márkus: Managing Curriculum Development and Enhancing Quality, FIG Congress, Kuala Lumpur, 2014.
- Odil Akbarov, Béla Márkus, Andrea Pődör: Development of Advanced Education in Geoinformatics for Enabling Sustainable Development in Uzbekistan, FIG Congress, Kuala Lumpur, 2014.
- Tolmas Boltayev: Geoinformatics Education towards Sustainable Development of Uzbekistan, GISCA Conference, Urumqi, China, 2014.
- Shukhrat Shokirov: Assessment of Pasture Land Derogation by Remote Sensing Methods, GISCA Conference, Urumqi, China, 2014.
- Andrea Pődör, Béla Márkus, Odil Akbarov: Development of Advanced Education in Geoinformatics for Enabling Sustainable Development in Uzbekistan, Tashkent, 2014.
- Interviews with Márton Beke and Béla Márkus by Fehérvár Television, 14/10/2013.
- Interview with Andrea Pődör by Vörösmarty Radio, 10/2013.
- Béla Márkus et al.: About GE-UZ, Tempus book, Tashkent, 2013.
- Shukhrat Shokirov et al.: Development of Learning Infrastructure (UZ), Tempus book, Tashkent, 2013.
- Andrea Pődör et al.: Needs and responses, Tempus book, Tashkent, 2013.
- Piros az alma Üzbegisztánban is…, GEO webpage, 27/03/2013.
- Béla Márkus: Tempus GE-UZ project, GISopen 2013, Székesfehérvár, Hungary, 13/03/2013.
- Янгилик ва Хабарлар, Irrigator, Tashkent, Uzbekistan, 01/2013.
- Attila Petrik: Üzbegisztánban "húz" a GE-UZ, Vivat Academia, Sopron, Hungary, 09/2012.

Acknowledgements

The work summarized in this paper has been carried out within the framework of the Tempus programme (Ref. No. 530808-TEMPUS-1-2012-1-HU-TEMPUS-JPCR Tempus IV), partially funded by the European Commission. The project partners are grateful to the EU for the support.

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The GE - UZ

Geoinformatics: enabling sustainable development in Uzbekistan

Aims

The aim of the project is the development and implementation of a new university program in Geoinformatics to be offered on the second level (Masters) at Uzbek partner universities. The goal of the project is to ensure that Uzbek partner universities will have the capacity to offer a Master program in Geoinformatics that meets Bologna process, international academic quality standards, job market needs and support Uzbekistan in sustainable development.

Objectives

- 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 educational network.

Outcomes

1. Needs analysis report
2. MSc curriculum
3. Core learning materials (8 modules)
4. Retrained staff at four UZ universities
5. Four GIS centers with geomatic equipment
6. Business plan
7. Cooperation agreements
8. Two summer schools (3D modelling and Environmental management)
9. International dissemination conference (GISCA ’15)

Consortium

P1 University of West Hungary (UWH), Sopron, HU
P2 National University of Uzbekistan named after Mirzo Ulug’bek (NUU), Tashkent, UZ
P3 Karakalpak State University (KSU) Nukus, UZ
P4 Tashkent Architecture Building Institute (TABI) Tashkent, UZ
P5 Tashkent Institute of Irrigation and Melioration (TIIM) Tashkent, UZ
P6 Ministry of Higher and Secondary Specialized Education (MHSSE) Tashkent, UZ
P7 National Center of Geodesy and Cartography (NCGC) Tashkent, UZ
P8 State Unitary Enterprise “Geoinformkadastr” (Geoinformkadastr) Tashkent, UZ
P9 Paris-Lodron Universität Salzburg (PLUS) Salzburg, AT
P10 Royal Institute of Technology (KTH) Stockholm, SE
P11 University of Greenwich (UoG) London, UK
P12 Óbuda University (OU), Budapest, HU