FuseGI - "Cooperation for fusing skills on Cloud-based Open GeoInformatics: Innovative Environmental Management"

IO1

Research and field review

FINAL VERSION 25/08/2020

AGREEMENT NUMBER: 2019-1-FR01-KA203-062767

Coordinator: UNIVERSITE D'AVIGNON

Leading Organisation of IO1: HELLENIC FORESTS PARTNERSHIP (OLYMPOS PC)

Participating Organisations in IO1: DEMOCRITUS UNIVERSITY OF THRACE, EE4S, INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES, MAISON REGIONALE DE L' EAU, INTERNATIONAL HELLENIC UNIVERSITY, AVIGNON UNIVERSITY

INTELLECTUAL OUTPUT 1 REPORT CREATION

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SUMMARY

AVIGNON UNIVERSITE, in cooperation with DEMOCRITUS UNIVERSITY OF THRACE, EE4S, INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES, MAISON REGIONALE DE L' EAU, INTERNATIONAL HELLENIC UNIVERSITY and OLYMPOS PC, has undertaken the implementation of the project entitled "***FuseGI – Cooperation for fusing skills on Cloud-based Open GeoInformatics: Innovative Environmental management"*** under the Agreement n° 2019-1-FR01-KA203-062767 with Agency Erasmus + France, within the **"2019 Round 1 KA2 - Cooperation for innovation and the exchange of good practices KA203 - Strategic Partnerships for higher education"** Call.

This report presents the implementation and the tangible results of IO 1 "Research and field review"

This IO aims to deliver a thorough baseline assessment of the discrepancies between the GIS skills that are provided by academia, in France, Greece and Bulgaria, and the ones that are required by the environmental/ health market. To achieve that, primary and secondary research took place, in the forms of survey, observations, analyses and desk research.

The information baseline that was created was necessary to guide the implementation of the following IOs and included the documentation of the recognised gap between the GI (Geoinformatics) skills that are provided by academia and the ones that are required by the environmental/ health market, as well as information for the potential developing, testing and implementing the means and material that is necessary to bridge this gap.

The findings of IO1 were used as input data in IO2 in order to thoroughly review the courses that are currently offered in France, Greece and Bulgaria and appropriately draft the initial FuseGI curricula, in IO3 for the suitable design of the VLE that will hold the necessary material, in IO4 to guide the compilation of material that will bridge the identified gap and finally IO5 which will compile all the finding of the IOs and design the proposed curriculum that will meet the need for the GI skills that are necessary for the young professional that enter the environmental/ health market.

ABBREVIATIONS

BSc	Bachelor of Science
ECTS	European Credit Transfer System
EU	European Union
FOSS	Free Open Source Software
GI	Geoinformatics
GIS	Geographic Information Systems
HEI	Higher Education Institutions
ICT	Information and Communication Technology
IO	Intellectual Output
MSc	Master of Science
NGO	Non Govermental Organisation
QGIS	Quantum GIS
VLE	Virtual Learning Platform

1 Introduction

1.1 Overall objectives, implemented activities and results of the FuseGI Project

The FuseGI consortium had identified a gap between what the academic world provides towards its teachings and what the environmental labor market requires in terms of Geographic Information Systems (GIS) skills. Skills that are nevertheless essential for environmental and health risks management.

The goal of this consortium was to conduct an in-depth study (qualitative and quantitative) on the subject and then to design, develop and make available an adapted online tool to fill this GIS skills shortage to students and young professionals for the needs of the labor market.

The FuseGI consortium is composed of experts in the fields of water management, forestry and health (from both the academic world and the private sector) as well as computer scientists capable of setting up and sustaining online training tools. It was therefore relevant from the perspective of the project. ERASMUS+ through the projects "Cooperation in innovation and exchange of best practices" was the ideal and most relevant framework to achieve a project in this direction.

The overall objectives of the FuseGI project were:

1. Establishment of a transnational, interdisciplinary and open collaboration between academia and industry within the EU to address the training needs in GIS for a better functionality and better environmental and health risks management.
2. Knowledge transfer and bridging of gaps in academic and professional experience of the partners in the use of GIS applications in different key environmental and health sectors.
3. Improved professional skills in the use of open GIS platforms for interdisciplinary collaborative data processing.
4. Development, implementation and validation of a virtual learning environment (VLE).
5. Design of the architecture of an adapted curriculum, corresponding to the needs of the market world, for MSc degree courses.

Five transferable, innovative and tangible outputs:

IO1: Research and field review

IO2: Draft Curricula

IO3: Learning platform

IO4: Training toolkit

IO5: Final Curricula

1.2 Interrelations of project Intellectual Outputs

The concept and the methodological approach of the FuseGI project allowed strong interactions between all IOs. Each IO represents an innovative, transferable and tangible result also as a necessary step for the project finalisation.

The following scheme (Figure 1) represent the interrelations and connectivity of the FuseGI IOs.

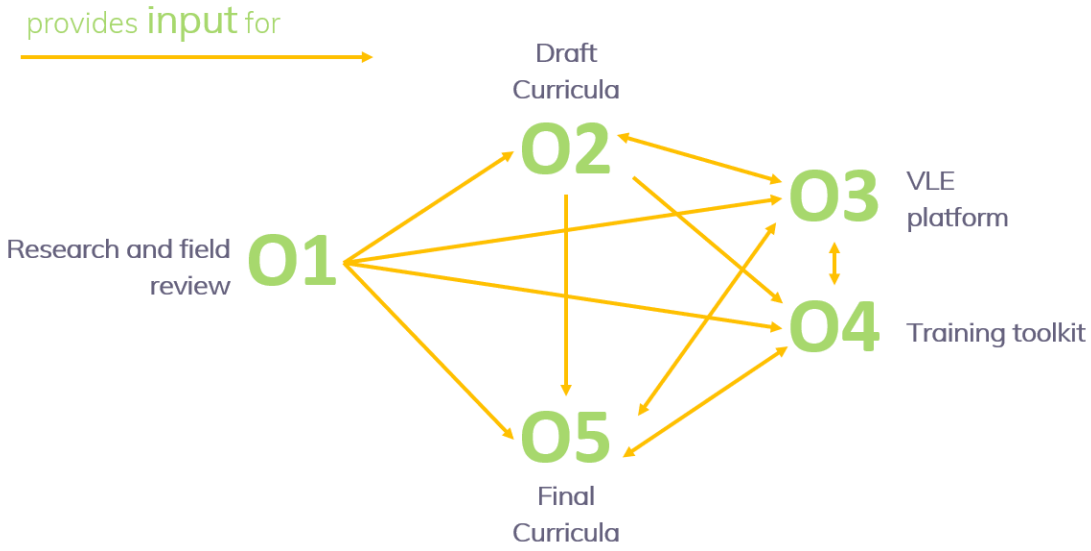

Figure 1 : Scheme of interrelations of FuseGI intellectual outputs

The findings of IO1 will be used as input data in:

- IO2 because the skills required by the market and the available courses that are offered in France, Greece and Bulgaria will be the basis for their further thorough review in IO2, which will demonstrate the skills that are offered and consequently the ones that are missing and need to by incorporated in the draft curricula.

- IO3 because information collected though the primary and secondary research will provide insights on the VLE users' needs that need to be met by the design of the platform, which will hold the necessary material,

- IO4 because the findings of IO1 will guide the compilation of material that will bridge the documented gap,

- IO5, which will compile all the finding of the previous IOs and design the proposed curriculum that will meet the need for the GI skills that are necessary for the young professional that enter the environmental/ health market.

1.3 Scope and Objectives of Intellectual Output 1

The scope of this IO is to provide a thorough baseline assessment of the discrepancies between the GIS skills that are offered by the academia to Higher Education Institutions (HEIs) students and the GIS skills that the environmental/ health labour market requires of them, as well as information for the potential developing, testing and implementing the means and material that is necessary to bridge this gap.

In detail, the specific objectives of IO1 are:

1. Create a baseline regarding the best practices in strategies and technological tools used in GI Environmental education, as input information on the potential of developing, testing and implementing GIS training, adapted to marker requirements,
2. Identify and document the various aspects of the previously recognised gap between academia offered and market required GIS skills
3. Contribute to the development of sustainable improved materials, products and processes to support adapted GIS education

1.4 Structure of Intellectual Output 1

The content of this report is organized as shown below.

1st section presents the FuseGI project and provides details on the scope, objectives and other basic information of Intellectual Output 1 (IO1).

2nd section presents the design and results of the secondary research, which aimed to create a baseline regarding the best practices in strategies and technological tools used in GI Environmental education, as well as the inventory of available courses that provide GIS education in France, Greece and Bulgaria, also providing statistic on several of their characteristics. These resulted from desk research and subsequent statistical analysis.

3rd section presents the methodology of design and the results obtained by the questionnaire survey (primary research) that was conducted in order to identify the details of the academia offered and market required GIS skills, as perceived by the participants. This was the main

source of what the market requires, as there was no possibility in collecting this information via desk research.

4th section demonstrated the Innovative, Transferable and Tangible character of IO1.

1.5 Intellectual Output 1 Sub tasks

IO1 Sub tasks
Review of the strategies and technological tools used in GI Environmental education
Review of academic GIS courses (France, Greece, Bulgaria)
Design of questionnaire survey
Releasing of the survey and collection of results
Analysis of survey results
IO1 report writing

2 Literature review

2.1 Strategies and technological tools in GI Environmental Management education

In order to create a baseline regarding the best practices in strategies and technological tools used in GI Environmental education a methodology based on secondary research, i.e., desk research, has been developed.

To retrieve the necessary information, the databases of **Erasmus+, Capterra, CORDIS** using the key words **"GIS education / GIS training / GIS courses / GIS curriculum"** (Tables 1-3). In addition, the GIS courses of **three top European universities** have been reviewed through the material published on their websites (Table 4). The following table summarises the results of this research.

Table 1: Findings in the Erasmus+ database

ERASMUS+		
Project	Focus	Tools/ Strategies
Toward an Open Resources Upon Services: Cloud Computing of Environmental Data	Meeting between two worlds, geosciences and cloud computing: progress from a multidisciplinarity towards an operational transdisciplinarity - where the disciplines interpenetrate with a common language and knowledge bases	cloud computing for: air pollution, land use change, remote sensing
Innovative educational integration of urban planning based on BIM-GIS technologies and focused on circular economy challenges	Development at an educational level the interoperability among metadata generated by the emerging technologies of BIM and GIS	triple helix Integration BIM tools
Higher Education interdisciplinary Reform in Tourism management and Applied Geoinformation curricula	Reform in higher education programmes at master level and continuing education integrating Geo-information Technologies (GIT) applied to cultural heritage documentation, tourism management and entrepreneurship	re-training academic staff in GIT, introduction of good practices for quality assurance, establishment of organized links between universities, administration and society, creation of labor market days, introduction of GIT in tourism industry, promotion of local entrepreneurship
Open educational resources platform for Geomatics applications to social and environmental issues.	Teaching & training activities on GIS applied to socioeconomic and environmental issues	Power point presentations, Printed and online maps, Online tutorial videos, Software such as ArcGIS and others that are freely available, Smartphone Apps for geomatics education, Case studies in PDF and printed formats, E-books that are freely available
Developing a learning line on GIScience in education	Creation of a series of resources which introduce students (age 12 - 18 years) to geospatial thinking using these GI tools, develop their ability to use them, and be critical of them	learning lines: perception - analysis - structure - application
Geo tools for Modernization and Youth employment	Promoting the acquisition of key skills related to the use of GIS for sprecision farming, photovoltaic systems, and survailance of plant health	documents, text, slides, videos, links to online resources as well as tools for the evaluation of its “learning impact” towards the user

Table 2: Findings in the Captera database

Captera		
Project	Focus	Tools/ Strategies
Agile GIS ($100)	A user-friendly interface which promotes self-service and guides non-expert users through geospatial datasets.	Slides, videos

Table 3: Findings in the CORDIS database

CORDIS		
Project	Focus	Tools/ Strategies
Strengthening the Capabilities and Training Curricula for Conflict Prevention and Peace Building Personnel with ICT-based Collaboration and Knowledge Approaches	Cube Model describes curricula structures including stakeholders, new methods, course structures, techniques as well as further aspects, e-approaches, tools and entities.	knowledge base, stakeholder maps, expert navigators, infographics, best practice libraries, and digital guidebooks, curricula Setup Utilities and search tools, lectures, group work, case studies, role-play, simulation, reflective interviewing, arts-based methods

Table 4: Findings in the websites of Top Universities

Top Universities in GIS education		
University	Degree	Tools/ Strategies
University of Edinburgh	MSc in Geographical Information Science	Lecture Seminar/Tutorial Supervised Practical/Workshop/Studio Summative Assessment Programme Level Learning and Teaching Directed Learning and Independent Learning Formative Assessment Hours
Delft University of Technology	MSc in Geomatics	Lectures Assignments self-study online excursions Labs (supervised individual and group hands-on exercises)
University College London	MSc in Geospatial Sciences	lectures seminars and tutorials self-directed study

Review of the information that is presented above leads to the following conclusions:

- There is a growing interest in **modernising GIS education**
- The reviewed projects focus on different sector, and none was found that aimed to enhance the employable skills of HEIs students
- There is a number of different **learning approaches, each adapted to the specific focus** of each project
- Offering of **asynchronous on-line resources** as means to educate students is very **favourable to the current situation**, when physical presence in classrooms is often difficult to achieve

2.2 ICT tools in education and skills improvement

Online education, made possible by the advances in Information and Communication Technology (ICT) tools, did not really exist some decades ago, however, nowadays it is considered a necessity, because it accommodates for a number of modern needs, aside from the recent lockdown situations.

This shifting in the learning means/mode has been addressed by sophisticated online courseware. Nonetheless, it is important that the right tools are used in the right circumstances in order to achieve high learning outcomes.

A critical perspective in online education is that **learning objectives are prioritized over technology**. If this perspective is overlooked, it is common to end up with complicated teaching that results to poorer learning outcomes. When choosing instructional tools and methods, it is essential not to aim to recreate a more traditional campus-based course environment online but **allow a great deal of scheduling flexibility**.

Synchronous instruction which is aims to replicate physical attendance needs to encourage live participation and interaction, which is made possible with a combination of technologies such as:

- Streaming video platforms
- Live chats, individually or course-wide
- Web conferencing tools
- Telephone availability
- Virtual office hours

Online courses that allow students access materials on their own schedule are called asynchronous courses. Many employ more than one technology, which could include the following:

- Downloadable pre-recorded lectures
- Microsoft PowerPoint presentations with or without voice-over
- Forums and discussion boards
- Email communication
- Google Drive and similar collaborative tools
- Tools for off-hour support (e.g., resource centres)

The instructional strategies which can be used in online courses include:

Lecture

It can be either recorded lectures or delivered live. It should be noted that lectures place students in a passive role, which reduces engagement.

Discussion

In synchronous courses, is achieved by using real-time chats and web-conferencing tools. In asynchronous courses communication is achieved through discussion boards, Web forums, and social media tools.

Demonstrations

They are useful when it comes to conveying certain concepts and processes. They are delivered synchronously or asynchronously. In the latter method, students can review these clips as often as necessary.

Simulations

Simulations delivered in a realistic digital environment allow online students to test practical skills and knowledge remotely.

Games

Games, used in synchronous teaching, let online students gain practical experience in an accessible digital environment, through leaderboards and other motivating tools that introduce friendly competition

Case Studies

Case studies are another instructional method that places students in an active learning role while promoting research, problem-solving, and high-level cognitive skills. They are mostly used in asynchronous courses.

Problem-Based Learning Projects

Such projects are typically collaborative in nature. Student teams use collaborative document programs (e.g., Google Drive, chats, and forums) to share information and create results.

Guided Design

Students are tasked with solving open-ended problems and requires students to complete some work outside of "class".

The above strategies in conjunction with the tools that were identified and presented in the previous section, will be considered when designing the training toolkit, i.e., the FuseGI curricula (IO2 and IO5), the education material (IO4), and the VLE platform that will deliver them (IO3). The development of the above IOs will be focused on the three thematic pillars of the project, water, forest and health, and on enhancing the employability skills of the students that aim to enter the Environmental Management labour market.

2.3 GIS courses in Universities of France, Greece, and Bulgaria

The method of **secondary research** has been employed in order to map the GIS courses that are offered by the three consortium countries' HIE. The following tables summarise the offered courses and their basic characteristics, namely the type of degree, the ECTS (European Credit Transfer System) of each course and whether they are compulsory (C) or elective (E). This information will demonstrate whether they are available to all graduates, meaning if they are offered during BSc degree and if they are compulsory to all students or not, and the depth to which they cover the subject based on the ECTs.

This research demonstrated that HEI in the three countries have differences in the structure of the Faculties and Departments and in the organisation of the curricula offered. Also, the HEI websites present the offered curricula they provide with different type and depth of information, therefore some inconsistencies arise during the homogenisation and tabulation of the collected information.

Table 5: Panorama of the French universities that offer GIS courses

France				
University	**Department/Degree**	**Degree type (BSc/MSc)**	**ECTS**	**Compulsory /Elective**
Avignon University	BSc in Earth and Water Sciences, MSc in Hydrogeology, Soil and Environment	BSc/MSc	2	C
Diplôme délivré par AgroParisTech, localisation Montpellier Agropolis	Specialized MSc in Water Management	MSc	4	C
Diplôme délivré par AgroParisTech, localisation Montpellier SupAgro	MSc in Water Sciences in Water and Agriculture	MSc		C
Faculty of Angers	BSc in Geoscience and Environment	BSc		C
Faculty of Angers	Master Bio-Geosciences	BSc		C
Faculty of Angers	Medicine	BSc		
Faculty of medicine and pharmacy	Medicine	BSc		
Faculty of medicine Lyon Est	Medicine	BSc		
Faculty of Tours	BSc in archaeology	BSc		C
Faculty of Tours	Degree in geography and management	BSc		C
Faculty of Tours	Master in Sustainable Culture, Landscape and Phytovalorization	MSc		C
Faculty of Tours	MSc in Environmental and Urban Law, Environment	MSc		C
Faculty of Tours	Master Hydrosystem and Watersheds	MSc		
Faculty of Tours	Medicine	BSc		
Grenoble Faculty of Medicine	Medicine	BSc		
Paul Sabatier	Medicine	BSc		C
Sorbonne University	Professional License Resources and Water Quality	BSc	1	C
Sorbonne University	BSc in Earth Science	BSc		C
Clermont Auvergne University	Certificate of Orthoptist Capacity	BSc	1	C

Clermont Auvergne University	Agronomy Pro License	BSc	3	C
Clermont Auvergne University	BSc in Life Sciences	BSc	3	C
Clermont Auvergne University	MSc in Plant Biology	MSc	3	C
Clermont Auvergne University	MSc in Environmental Management	MSc	3	C
Clermont Auvergne University	MSc in Environmental Management	MSc	3	
Clermont Auvergne University	MSc in Public Health	MSc	3	
Clermont Auvergne University	MSc in Public Health	MSc	6	C
Clermont Auvergne University	MSc in Public Health	MSc	9	
Clermont Auvergne University	Master of Earth and Planetary Sciences, Environment	MSc	6	
Côte d'Azur University	Medicine	BSc		
d'Aix-Marseille University	Medicine	BSc		
Bordeaux University	Medicine	BSc		
Bourgogne University	BSc in Earth Sciences	BSc	2	C
Bourgogne University	Master of Earth and Planetary Sciences, Environment	MSc	2	C
Bourgogne University - AgroSup Dijon	MSc in Business Management and Innovative Technologies for Agricultural Equipment	MSc		

Franche-Comté University	Master Géoressources, géorisques, géotechnique (CMI)	MSc	3	C
Franche-Comté University	MSc in water and soil quality and treatment	MSc		
Franche-Comté University	Master Health Host Graft	MSc		C
la Réunion University	Medicine	BSc		
Lille Henri Warembourg University	BSc in Earth Science	BSc	3	C
Lille Henri Warembourg University	Medicine	BSc		
Limoges University	Medicine	BSc		
Lorraine University	Medicine	BSc		
Montpellier University -Faculty of Medicine Montpellier-Nîmes	MSc 3S (Statistics and Health Sciences)	MSc		C
Nantes University	Medicine	BSc		
Pascuale Paoli University	Medicine	BSc		
Picardie Jules Verne University	Master Agrosciences, environment, territories, landscape, forest	MSc	2	C

Picardie Jules Verne University	MSc Agrosciences, environment, territories, landscape, forest	MSc	2	C
Picardie Jules Verne University	MSc Agrosciences, environment, territories, landscape, forest	MSc	2	C
Picardie Jules Verne University	MSc Agrosciences, environment, territories, landscape, forest	MSc	3	C
Reims Champagne-Ardenne University	Geography and development degree	BSc	3	C
Reims Champagne-Ardenne University	Medicine	BSc		
Rennes 1 University	BSc in Earth Sciences in Geosciences	BSc	8	C
Rennes 1 University	MSc in Public Health Evaluation and Prevention of Occupational Risks	MSc		C
Rouen Normandie University	MSc in Environmental Management	MSc	5	
Rouen Normandie University	MSc in Environmental Management, Management of Biodiversity in Terrestrial Ecosystems	MSc	6	
Rouen Normandie University	Master Environmental Management, Sustainable Management of Hydrogeosystems	MSc	6	
Strasbourg University	MSc in Geology and Dynamics of the Earth	MSc	1	C
Strasbourg University	MSc in Engineering and Geosciences for the Environment	MSc	1	
Strasbourg University	Master in Earth Physics	MSc	1	
Strasbourg University	Medicine			
University Versailles Service Centraux University	BSc in Geography and Planning	BSc	2	C
Antilles University	Medicine	BSc		

Lyon 2 University	MSc in Water Science	MSc	2	
Paris Descartes 5 University	MSc in Public Health and risks related to the general environment	MSc		
Paris Descartes 6 University	MSc in Public Health and risks related to the hospital environment	MSc		
Paris Descartes 7 University	MSc in Public Health and risks related to the professional environment	MSc		
Paris Descartes 8 University	Master of Computer Science Course Machine Learning for Data Science	MSc	2	
Paris Diderot 7 University	IUD Clinical Epidemiology in Pediatrics	MSc		C
Paris Diderot 7 University	BSc in Earth Science in Environment AND Earth	BSc	3	C
Paris Diderot 7 University	MSc in Risks and Environment Course Spaces and Environments: Ecological Territories	MSc	9	
Paris Diderot 7 University	MSc in Risks and Environment Environmental Science and Engineering - Indoor and Outdoor Atmospheres (PRO)	MSc		E
Paris Diderot 7 University	MSc in Risks and Environment Environmental Science and Engineering - Heritage Materials in the Environment	MSc	3	E
Paris Diderot 7 University	Master of Earth and Planetary Sciences	MSc	3	E
Paris-Est Créteil University	Medicine	BSc		
Paris-Saclay University	Masters with the common core "Political Economy and Institution Mention"	MSc	1	
Sorbonne Paris-Nord University	Medicine	BSc		

Table 6: Panorama of the Greek universities that offer GIS courses

Greece				
University	**Department**	**Degree type (BSc/MSc)**	**ECTS**	**Compulsory /Elective**
Agricultural University of Athens	Department of Agricultural Business Management and Supply Systems	BSc	5	
Agricultural University of Athens	Department of Plant Production Science	BSc	5	
Agricultural University of Athens	Department of Agricultural Economics and Rural Development	BSc	5	
Aristotle University of Thessaloniki	Department of Agriculture	BSc/MSc	9	
Aristotle University of Thessaloniki	Department of Architecture	BSc	6	
Aristotle University of Thessaloniki	Department of Biology	BSc/MSc	4	
Aristotle University of Thessaloniki	Department of Economics	BSc	4	
Aristotle University of Thessaloniki	Department of Geology	BSc	3	
Aristotle University of Thessaloniki	Department of Forestry and Natural Environment	BSc/MSc		
Aristotle University of Thessaloniki	School of Medicine	-		
Democritus University of Thrace	Department of Production and Management Engineering	BSc	3	
Democritus University of Thrace	Department of Forestry and Natural Resources	BSc	5	C
Democritus University of Thrace	School of Medicine	-		
Democritus University of Thrace	Department of Environmental Engineering	BSc	4	C
Hellenic Mediterranean University	Faculty of Health Sciences	-		
International Hellenic University	Department of Agriculture	BSc	3	E
International Hellenic University	Department of Forestry and Natural Environment	BSc/MSc	4	E
International Hellenic University	Department of Environmental Engineering	BSc	4	
Ionian University	Department of Environment	BSc	4	C
National and Kapodistrian University of Athens	Center for Education and Lifelong Learning	BSc	5	
National and Kapodistrian University of Athens	Department of Agricultural Development, Agrofood and Management of Natural Resources	-		
National and Kapodistrian University of Athens	Faculty of Geology and Geoenvironment	BSc/MSc	6	C

National and Kapodistrian University of Athens	School of Medicine	-		
National Technical University of Athens	Department of Architecture	BSc	4	
National Technical University of Athens	Department of Civil Engineering	BSc	5	
National Technical University of Athens	Department of Geological Sciences	BSc	3	E
Technical University of Crete	Department of Environmental Engineering	BSc	6	
Technical University of Crete	Department of Mineral Resources Engineering	BSc/MSc	5	
University of Crete	School of Medicine	-		
University of Ioannina	Department of Biological Applications & Technology	BSc		
University of Ioannina	School of Medicine	0		
University of Macedonia	Department of Applied Informatics	BSc	4	
University of Patras	Department of Chemical Engineering	BSc	3	
University of Patras	Department of History and Archaeology	BSc	5	
University of Patras	Department of Physics	BSc	3	
University of Patras	Faculty of Health Sciences	-		
University of Patras	Department of Geology	3 BSc/MSc	3	C
University of Patras	Department of Environmental Engineering	BSc	3	C
University of Peloponnese	Department of Agriculture	BSc	5	
University of Peloponnese	Department of Economics	BSc	3	
University of Peloponnese	Department of Management Science and Technology	BSc	3	
University of Peloponnese	Department of Public Health	-		
University of Piraeus	Department of Informatics	BSc	5	
University of Piraeus	Department of Maritime Studies	BSc/MSc	6,5	
University of Piraeus	Department of Statistics and Insurance Science	BSc	6	
University of the Aegean	Department of Environment	BSc/MSc	5	C
University of Thessaly	Department of Animal Science	BSc	4	
University of Thessaly	Department of Civil Engineer	BSc	3	
University of Thessaly	Department of Computer Science and Biomedical Informatics	-		

University of Thessaly	Department of Forestry, Wood Science and Design	BSc	3	C
University of Thessaly	Department of Public and One Health	BSc	5	C
University of Thessaly	School of Medicine	-		
University of Thessaly	Department of Environment	BSc	5	C
University of West Attica	Department of Public Health Policy	-		
University of West Attica	Department of Public and Community Health	-		
University of Western Attica	Department of Civil Engineering	BSc	4	
University of Western Macedonia	Department of Agriculture	BSc	5	
University of Western Macedonia	Department of Mineral Resources Engineering	BSc	4	C

Table 7: Panorama of the Bulgarian universities that offer GIS courses

Bulgaria				
University	**Department**	**Degree type (BSc/MSc)**	**ECTS**	**Compulsory /Elective**
Forestry University	Department 'Forest management'	BSc/MSc	N/A	C
Forestry University	Department of Computer Systems and Informatics	BSc/MSc	N/A	C
Architecture, Civil Engineering and Geodesy University	Department of Photogrammetry and Cartography	BSc/MSc	N/A	E/C
Architecture, Civil Engineering and Geodesy University	Department Surveying and Geoinformatics	BSc/MSc	N/A	C
Architecture, Civil Engineering and Geodesy University	Department Hydraulics and Hydrology	BSc/MSc	N/A	E/C
Sofia University	Department Cartography and GIS	BSc/MSc	N/A	E/C
Mining and Geology University		BSc/MSc	N/A	C
South-West University	Department of Geography, Ecology and Environmental Protection,	MSc	N/A	C
University of Shoumen	Department of Geodesy	BSc/MSc	N/A	C
Agricultural University Plovdiv	Department of Agroecology and Environmental Protection	BSc/MSc	N/A	C
Higher School of Agribusiness and Regional Development		MSc		C
cademy of Economics ´Dimitar A. Tsenov´	Business information systems and technologies	BSc		C

2.4 Literature review conclusions

Analysis of the information that is presented in the tables above leads to the following conclusions:

In HEIs of France:

- In health and Biology studies 54% of courses offer GIS in their curricula at the BSc or MSc level
- In health and Biology studies only 15% of the GIS courses are offered in BSc degree, while 85% are offered to MSc level students
- In health and Biology 56% of the courses have 1-3 ECTS and 38% 5 ECTS or more
- In Earth and Water studies 96% of the offered curricula include GIS courses either in BSc or MSc level
- In Earth and Water studies 36% of the offered GIS courses are in BSc and 64%in MSc curricula
- In Earth and Water studies 87% of the courses have 1-3 ECTS and 13% 4 ECTS or more

In HEIs of Greece:

- The percent of the Departments including GIS lessons in their curriculum was 16% (64 out of 408) (Figure 4), 26 of them were Departments in Applied Sciences & Environmental Schools, 24 of them were Departments in Engineering schools, and the rest 14 Departments belonged in various other Schools (table focuses on the FuseGI thematic, i.e., Forest, Health, Water)
- Approximately 65% of the GIS courses offered in Greek HEIs are related with the three FuseGI thematic
- More often than not the GIS course is compulsory
- The total amount of GIS courses in Applied & Environmental Sciences Departments is 56, in Engineering Departments 61 and only one course was discovered in a Department related to Health, namely Department of Biological Applications & Technology
- GIS courses are core and elective courses, depending on the Department
- Significance is recognized as they give an average of 4.5 ECTS, with a minimum of 3 and a maximum of 9 ECTS.
- 21% of the courses correspond to 3 ECTS while 72% correspond to 4 or more ECTS.

- 78% of the courses are compulsory while the rest 21% in elective
- 83% of the offered GIS courses are in BSc and 17%in MSc curricula

In HEIs of Bulgaria:

- GIS courses are offered in 12 HEIs
- The courses are shared between faculties and BSc and MSc level degrees.
- 75% of the courses are offered to both BSc and MSc level of studies, while 8% only to BSc and 17% to MSc
- In almost all cases the courses are compulsory.
- No health-oriented Universities were found to teach GIS courses in Bulgaria

It is apparent that the three countries that were examined show **different patterns on how they incorporate GIS education in their curricula**. Therefore, direct comparison between them is not possible.

However, there are strong indications regarding the question: What GIS skills does academia offer to graduates?

- In Greece and Bulgaria courses are offered starting from the BSc degree, therefore more graduates have some GIS skills. However, this is relevant to the ECTS of each course, i.e., the time that students have devoted to GIS through teaching and studying, and whether there are practical hands-on courses. Unfortunately, very few websites included information on the latter. This is less common in France, where GIS is mostly introduced to students during MSc studies.
- In France and Bulgaria there is a higher percentage of courses been offered in MSc degrees, indicating that more advanced techniques may be included in the curricula, since in MSc studies the specialization is higher.
- Between the three countries, Greece is the one with the less GIS courses offered in MSc level.
- In all three countries GIS courses were offered withing curricula of Water and Forest studies, and typically in the vast majority of the curricula. On the contrary, only in France there are courses in Health and Biology studies, while complete absence is observed in Greece and Bulgaria.
- In France, where GIS is included in all Water, Forest and Health studies, it is more common in the curricula of the first two.

Summarising the above, it is shown that the offer of GIS courses and skills by academia varies according to country, discipline and level of specialization. The non-uniformity of the skills will be further analysed in IO2, where will also be coupled with the questionnaire results leading this way to the draft proposed curricula of the FuseGI project.

3 Questionnaire survey

3.1 Design of the survey

The creation of a questionnaire made it possible to carry out a preliminary study on the use of GIS by professionals and their needs in terms of operationality, in the various countries concerned, in order to take into account, the opinions and impressions of the latter, for setting up the curriculum.

3.1.1 Design of the questionnaire

The questionnaire was created in order to obtain precise answers, in particular on the level of GIS skills of the respondents, as well as on the frequency of use of GIS in the professional and academic world.

3.1.2 Goals

The FuseGI project aims to support higher education institutes and professionals in three main areas (water, agrosciences and health) to **improve the training and use of** GIS, using cloud technologies.

A postulation was proposed at the beginning of the project with the aim of presenting the hypotheses affirming that the students, coming out of the various training courses including a teaching of GIS in a university environment, as well as many professionals, are not sufficiently trained in their use. In order to verify and quantify the hypotheses of the postulation, a questionnaire was set up.

The aim of this questionnaire was to **identify and quantify the gaps between the knowledge** acquired in the field of GIS **at university** during higher education, **and the use and the necessary needs for** the subject **in professional life**.

3.1.3 The EU Survey platform

In order to be able to set up this questionnaire, we used the EU Survey platform. It is an online **survey management** platform that allows the creation and publication of all types of forms accessible to the public.

The EU Survey platform was created in 2013. It is the **official survey management tool of the European Commission**.

EU Survey **aims to create official opinion polls and communication and personnel management forms**. It is an open source platform, released under the EUPL license (European Union Public License). This application is hosted at the Directorate of Digital Services of the European Commission (DG DIGIT), so it is accessible free of charge for all citizens of the European Union.

The EU Survey platform provides a wide variety of elements that can be used for creating forms and surveys. It is possible to use simple elements such as text questions or multiplechoice questions, or advanced elements such as spreadsheets or multimedia elements.

EU Survey is ideal to meet different survey needs since it has many features such as a **customizable form** , **dependent questions** , the possibility of modifying the form after publication, the availability in **several languages** , the customization of **the appearance of the questionnaire** , the possibility of saving a contribution as a **draft** , **offline responses** , **security** and advanced **confidentiality** of the questionnaires, adapted and improved contrasts for visually impaired participants as well as an **analysis of the results** obtained.

3.1.4 The participants

The participants were chosen according to the answers sought in order to best adapt the FuseGI platform.

The participants were therefore mainly academics, users or trainers of GIS, and professionals working in non-university organizations using GIS more or less regularly. The **panel** called upon to answer the questionnaire was more precisely **constituted,** in the disciplines concerned (water, agroscience and health), **academics** , **people working in scientific chambers** , scientific **associations** , **companies** , **public bodies with a GIS service,** whether they are direct **users of GIS or no .**

3.1.5 A suitable questionnaire

The questionnaire was put online from spring 2020, and 285 people answered it. This questionnaire consisted of **23 questions**, and took **approximately 10 minutes** to complete. It was also available in **4 languages**: **French**, **English**, **Greek** and **Bulgarian**.

The first part of the questionnaire focused on the profile of the participants. It made it possible to define the type of organization in which he worked, and gave access to one of the two questionnaires created, one for the university environment and the other for the professional environment. This makes it possible to better target certain questions and to have more precise and specific answers on the uses of GIS.

3.1.5.1 Profile of participants

This first part of the questionnaire is made up of a **series of personal questions for discern the profile of each of the participants**. Questions relating to the participant's age, country of residence or field of work are asked **(Figure 2)**.

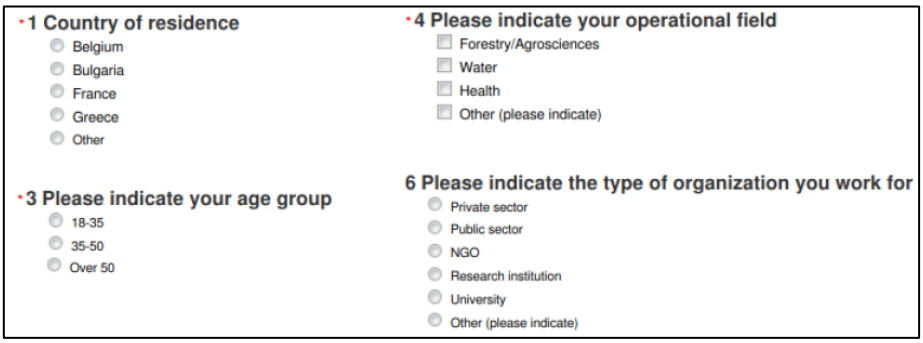

***Figure 2**: Overview of the participant profile questionnaire*

The last question in this part, on the **type of organization for which the participant works, allows them to be divided into one of the following two questionnaires**. The first is intended for participants working in the public sector, the private sector, research institutes or NGOs (Non-Governmental Organization), while the second is intended for academics.

3.1.5.2 Non-academic participants

This part of the questionnaire is only available to participants from non-academic backgrounds, i.e., from the public sector, the private sector, NGOs and research institutes.

The questionnaire is then divided into three sections: **personal skills**, **systems geographic information in the organization** in which the participant works and **collaborations possible**.

In the first section of this questionnaire, participants should specify their professional level and indicate their level of GIS skills, when they learned GIS, and how often they use GIS in their work **(Figure 3)**.

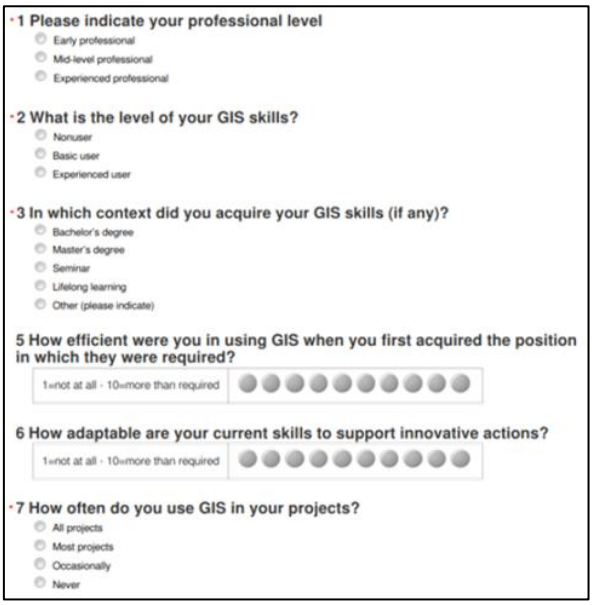

***Figure 3**: overview of the questionnaire on the personal skills of professionals*

The second section of the questionnaire allows participants to provide details on the use of GIS in the context of their work. In particular, they should **indicate who uses GIS** in their organization, **how effective new employees are in using GIS,** and their gaps, if any. They also need to indicate if the organization works with commercial or free open-source software (FOSS), if an improvement is necessary, but also if they use clouds for data access **(Figure 4)**.

***Figure 4**: overview of the questionnaire on the use of GIS in the work organizations of professionals*

The "Collaboration" section of the questionnaire **provides information on whether or not there is collaboration with professionals from other fields of activity in the use of GIS**. The participants therefore specify with which type of organization they collaborate, if they encounter difficulties for the use of GIS in these collaborations **(Figure 5)**.

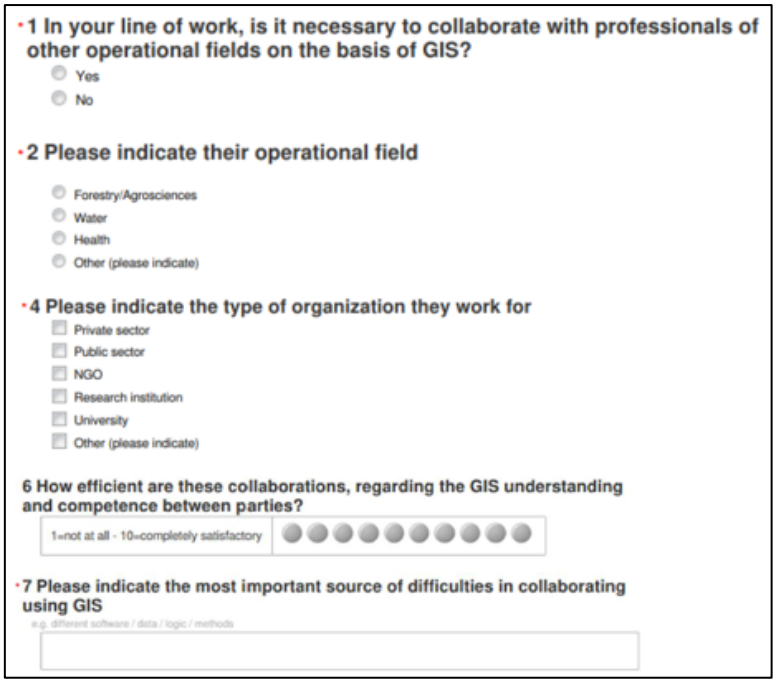

***Figure 5**: Overview of the questionnaire on collaborations with other GIS users from different fields of activity*

3.1.5.3 Academic participants

This part of the questionnaire is only available to participants from an academic background, that is to say mainly teacher-researchers from universities.

The questionnaire is then divided into three sections: **GIS courses, GIS** course **content,** and **software and hardware used**.

The first section is used to collect information on the GIS courses taught at the university of the respondents to the questionnaire. They must then indicate whether they are responsible for one or more GIS courses at the university, whether these are compulsory or not, and at what level the course is taught. They must also specify the type of course that is taught (theoretical, practical or both), and the frequency of updating the teaching, as well as the use or not of Cloud for data access **(Figure 6)**.

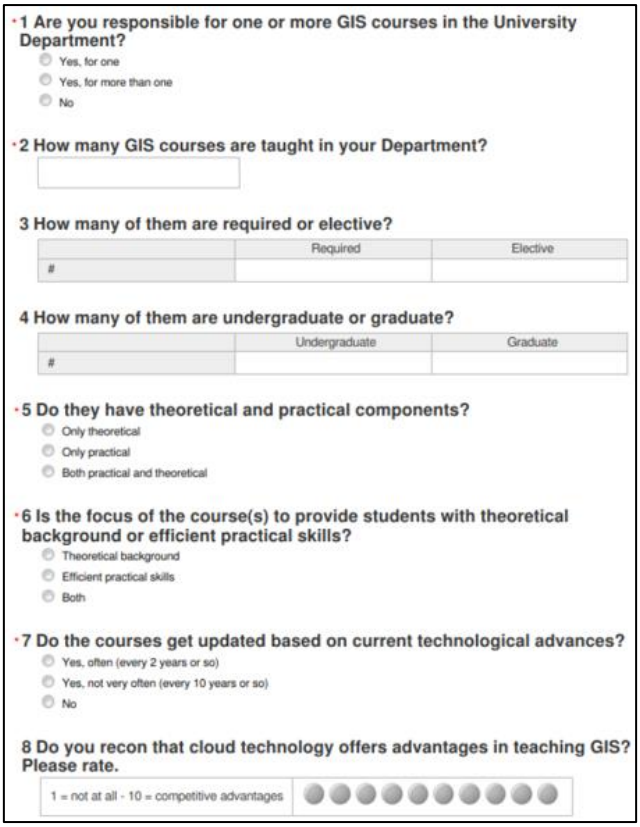

***Figure 5**: Overview of the questionnaire on GIS courses in universities*

The second section provides **details on the content of the courses taught to students**. Participants indicate if they use data from the Cloud, but also which data sources, and if other courses in the course show the importance of using GIS. They also specify whether the data and scenarios used for the practical work are real, whether they are focused on the world of work, or whether they show the interest of collaborations between several disciplines **(Figure 7)**.

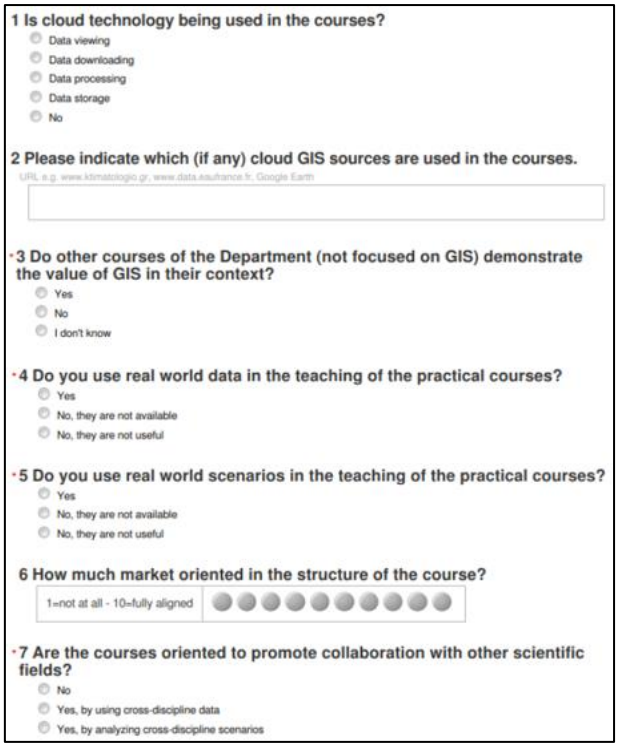

***Figure 6**: Overview of the questionnaire on the content taught at the university*

The last section of the questionnaire **makes it possible to know the types of software and hardware used by the students during GIS courses at the university**. Participants must indicate the type of software used during the course. It is also asked to specify if the software is chosen according to what is used in the world of work. Finally, participants must specify whether the hardware used is suitable for the use of this software **(Figure 8)**.

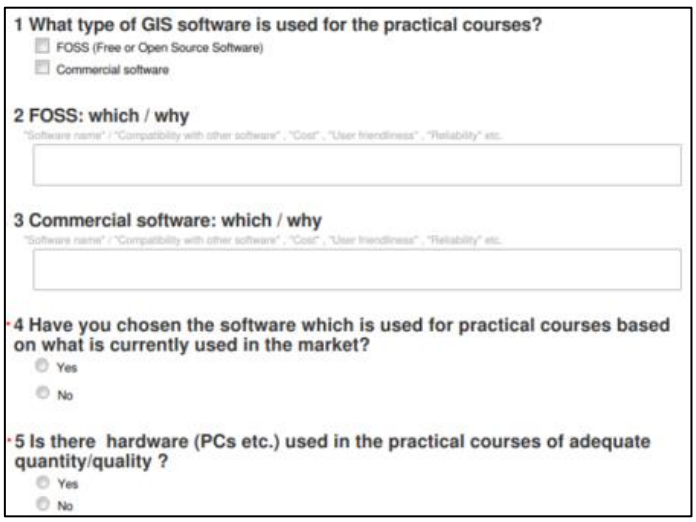

***Figure 7**: Overview of the questionnaire on hardware and software used at the university*

3.2 Collection and analysis of results

The questionnaire received a total of 285 responses. These were statistically analyzed, i.e., collected, sorted and examined **in order to better understand the differences between the teaching of GIS at HEIs and the necessary use in the professional environment**.

3.2.1 Profile of participants

The first part of the questionnaire tells us more about the profile of the participants. Thus, 65% of the participants reside in France, while 27% live in Greece, and 6% are Bulgarian residents **(Figure 9)**.

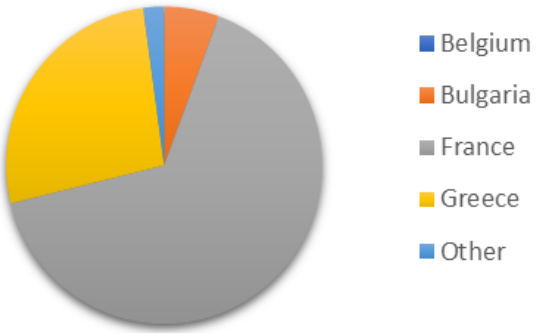

***Figure 8**: pie chart representing the responses to the question "Country of residence "*

They are divided into three different age groups: 48% are between 35 and 50 years old, 34% are between 18 and 35 years old, and finally, 18% are over 50 years old **(Figure 10)**.

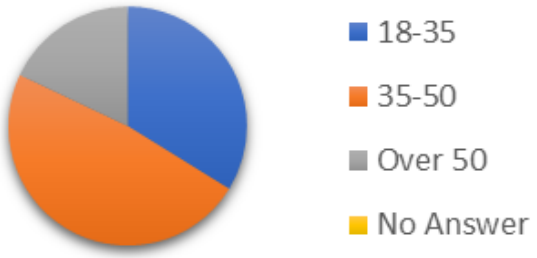

***Figure 9**: pie chart representing responses to the "Age group" question*

Regarding the professional fields of the participants, 55%, or more than half, work in the water sector, 22% in the forestry and agrosciences sector, giving a very good representation of the two main thematics of FuseGI project, 1% in the health sector, and 22% in other industries **(Figure 11)**.

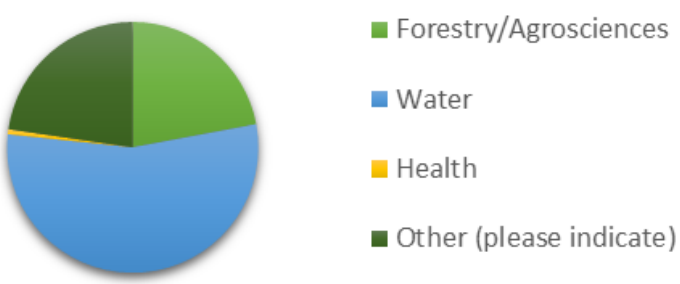

***Figure 10**: Circular diagram representing the answers to the question " Operation field "*

The type of organization in which the different participants work is quite varied: 31% of participants come from the public sector, 28% from the private sector, 15% come from academia, 4% come from NGOs, while 5% come from another type of organization **(Figure 12)**.

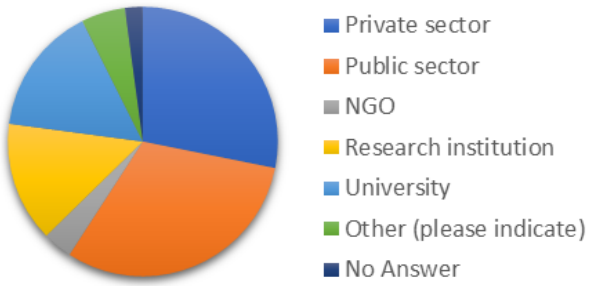

***Figure 11**: Pie chart showing responses to the question "Type of organization they work for"*

It is then possible to create an average profile of the participants who answered the questionnaire. The average participant would be between 35 and 50 years old, residing in France or Greece, and working in the field of water or agrosciences or forests. It would also come more from the professional world than from the academic world.

3.2.2 Results of non-academic participants

In this part of the questionnaire, we learn more about GIS knowledge and skills in the work environment. More than half of the participants consider their level in GIS as basic (56%), against 39% of them who consider themselves expert in the field **(Figure 13)**.

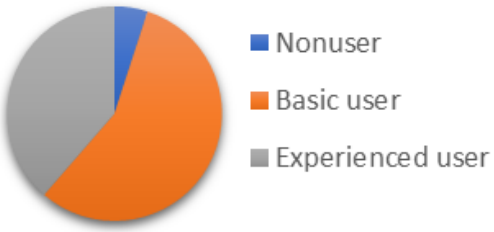

***Figure 12**: Pie chart representing responses to the question " What is the level of your GIS skills "*

Most of the participants claim that they acquired their GIS skills during their MSc degree and Lifelong learning. Only 10% of them learnt GIS during BSc and 17% are self-taught or learned it through working **(Figure 14)**.

Table 8: Where did participants acquired GIS skills

a. BSc degree	10%
b. MSc degree	34%
c. Lifelong learning	35%
d. Seminar	4%
e. Other	17%

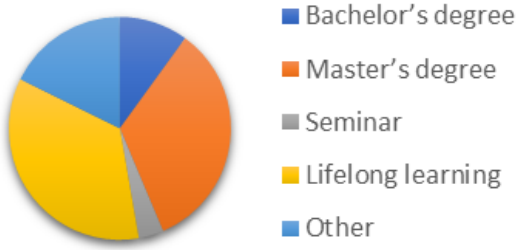

***Figure 13**: Pie chart showing responses to the question "In which background did you acquire your GIS skills "*

It is interesting to note that the pattern changes between age groups. The most common source of GIS skills in the age groups over 50 and 35-50 is lifelong learning (55% and 35%, respectively), while the most common source of GIS skills in the age group 18-35 is MSc degree (52%). This shows that GIS skills are being recognised as necessary in the labour market and academia has been offering more courses to accommodate for this need mainly through postgraduate studies.

When participants were asked to self-evaluate their GIS skills when entering their professional life, 50% of the ones that acquired their skills at BSc level gave scores 6-10/10, while for the ones that acquired their skills at MSc level the percentage was 63%. This finding shows that the ones that were taught GIS during MSc studies find themselves more competent as new professional.

Table 9: Self-evaluation of participants GIS skills when entering their professional life, based on the degree during which they acquire them

	1/10	**2/10**	**3/10**	**4/10**	**5/10**	**6/10**	**7/10**	**8/10**	**9/10**	**10/10**	**Grand Total**
BSc	2	2	1	2	4	4	2	3		2	22
MSc	4	4	4	5	8	10	18	14	3	4	74
Grand Total	6	4	4	5	33	59	18	14	3	4	74

These two groups also self-evaluated the adaptability of their GIS skills with similar pattern to the above, i.e. 63% of the ones acquired their skills in BSc gave scores 6-10/10, while for the ones that acquired their skills at MSc level the percentage was 73%. This again shows the confidence that have the ones of the second group.

Table 10: Self-evaluation of participants adaptability of GIS skills, based on the degree during which they acquire them

	1/10	2/10	3/10	4/10	5/10	6/10	7/10	8/10	9/10	10/10	Grand Total
BSc	3		1	2	2	6	2	6			22
MSc	5	2	1	3	9	12	16	14	7	5	74
Grand Total	8	2	2	5	11	18	18	20	7	5	96

According to the responses, the frequency of use of GIS by participants in their professional field is very high: 62% of participants claim to use GIS in all or almost all of their projects, and 36% use it occasionally **(Figure 15)**.

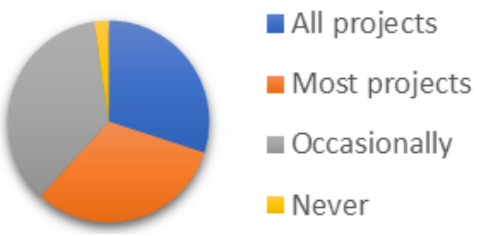

***Figure 14**: diagram representing the answers to the question "How often do you use GIS in your projects "*

An interesting pattern is that 57% of early professionals use GIS in most or all projects, while 71% of Mid-level professional use it at the same frequency. This shows that employers do not rely on early professionals as much as in mid-level when it comes to GIS related tasks.

Table 11: Frequency on using GIS skills in participants' line of work, based on their professional level

	a. Never	b. Occasionally	c. Most projects	d. All projects	Grand Total
a. Early professional		19	12	13	44
b. Mid-level professional	2	19	24	28	73
c. Experienced professional	3	41	33	24	101
Grand Total	5	79	69	65	218

When participants were asked to judge the new professionals that come to their companies/ organisations the respond that 57% of them are less competent (scores 1-5) while 43% of them are more competent (scores 6-10). This is another finding that demonstrates the gap between the GIS skills that new professionals acquire in HEIs and what is required by them in their first jobs **(Figure 16)**.

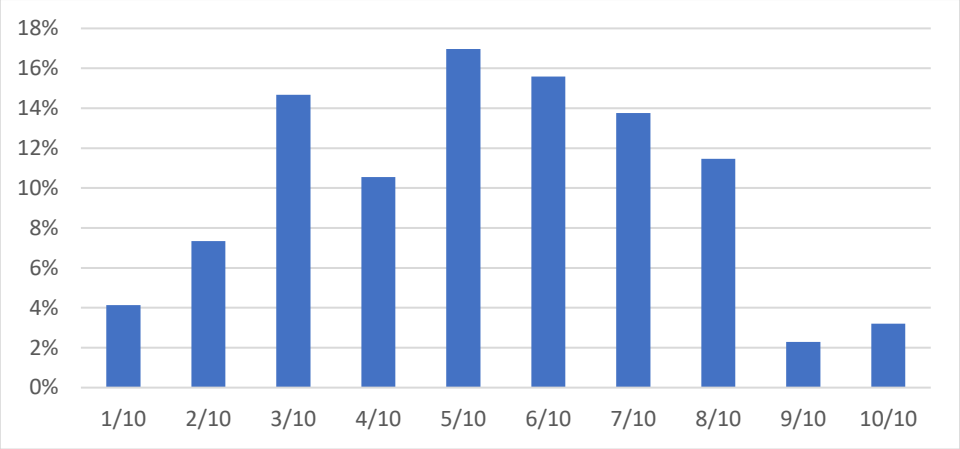

***Figure 15**: diagram representing the answers to the question " How efficient are new professionals that join your organisation in using GIS? "*

52% of participants think that their shortcomings, if any, are related to their initial teaching of GIS, and 27% think that they come from the use of several GIS software **(Figure 17)**.

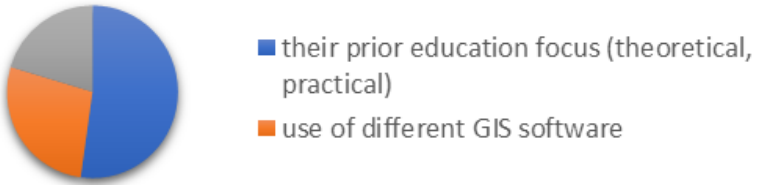

***Figure 16**: diagram representing the answers to the question "Is their lack of skills related to"*

Another very interesting statistic that resulted of the survey is that GIS related tasks in a company/organization are assigned mostly to permanent employees (75%), showing that each company/organisation prefers to have in-house employees with GIS skills, rather than employ temporary staff or outsource tasks **(Figure 18)**.

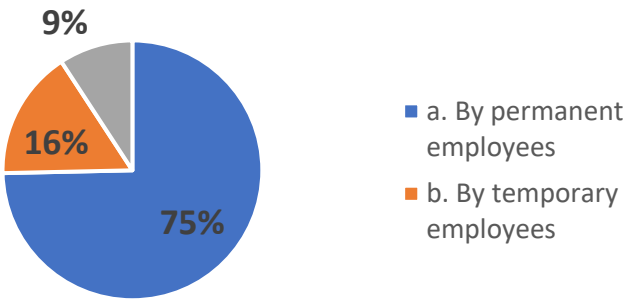

***Figure 17**: diagram representing the answers to the question " How is the GIS component of your business is implemented?"*

Regarding cloud-accessible data sources, 20% of participants who use them use them to visualize data, and only 21% download data useful for their GIS productions **(Figure 19)**. Since cloud technology has been improving and proving extremely effective, this finding shows that there is much room for improvement in the use of cloud services and therefore the FuseGI project correctly identified them as a topic that need to be addressed more thoroughly.

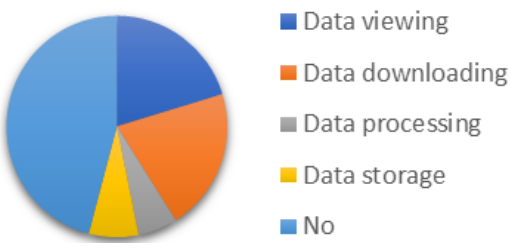

***Figure 18**: diagram representing the answers to the question " Does your organization uses GIS cloud sources"*

Nearly a third of participants believe that continuous improvement in the use of GIS for professionals is necessary. 79% of participants also indicate that collaboration with professionals from other fields is necessary in their GIS practice **(Figure 20)**.

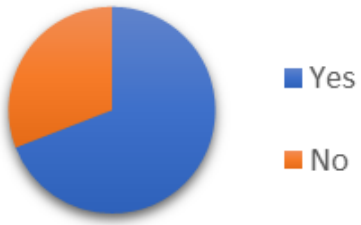

***Figure 19**: diagram representing the answers to the question "In your line of work, is it necessary to collaborate with professionals from other operational fields on the basis of GIS"*

However, they find their collaboration effective (scores 6-10) by 62%, while 38% of the collaborations are not that effective (scores 1-5) mainly due to the different methods and data that are used. This highlights the need for interdisciplinary understanding and common learning goals and techniques, like the ones that FuseGI project aims to build.

Regarding the GIS software that should be used when designing FuseGI curricula, including VLE and toolkit material, the survey showed that the majority of the participants use FOSS, and mainly QGIS **(Figure 21)**.

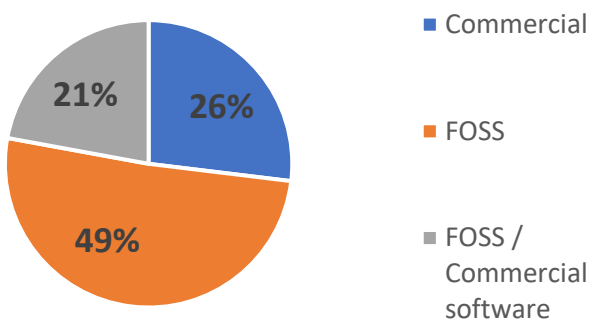

***Figure 20**: diagram representing the answers to the question "What type of GIS software do you use in your line of work?"*

To summarise the most important points of the analysis of the results of the professional world, which describe and document the recognised gap between academia offered and labour market needed GIS skills:

- The majority of participants claim to use GIS in all or almost all of their projects, showing the great importance of GIS skills in the environmental labour market.
- Most of the participants claim that they acquired their GIS skills during their MSc degree and Lifelong learning. This shows that BSc curricula do not provide enough GIS training, which is sought by the student in postgraduate studies.
- During the 90's most GIS competent professional acquired their skills in lifelong learning, the next decade there was a significant increase in participants acquiring them in BSc and MSc degrees and the last decade there is an increase in GIS skills acquired in MSc degrees but not at all in BSc. This shows that, over the last decades, academia has recognised the significance of these skills incorporating them in their curricula, however with some reluctancy, since in many cases they have not found their way into BSc curricula yet.
- Participants that gave higher scores (6-10/10) to their GIS competence when they acquired their first job, were the ones that acquired them in MSc studies. This shows that GIS skills provided in BSc studies are not regarded adequate by early professionals.
- Moreover, half of the participants believe that any shortcomings in their skills is related to their training, more than any other reason.
- Also, mid-level professional use GIS in higher frequency than early professionals, showing that employers do not rely on the skills of early professionals.

- New professionals (as judged by older colleagues) are found less competent that what is required for GIS tasks, demonstrating again that academia acquired skills do not meet labour market needs.
- The majority of GIS tasks in the company/organisation's line of work are assigned to permanent employees, rather than temps or outsourced to specialised companies. This shows that environmentalist need to have GIS skills in order to be adequate for a position, because these skills needed in-house and are rarely outsourced to pure GIS experts.

To summarise the most important points regarding the needs of the Environmental labour market, that need to be addressed during the FuseGI project:

- Nearly a third of participants believe that continuous improvement in the use of GIS for professionals is necessary. This has inspired the FuseGI team to design the VLE and toolkit having in mind that should be useful for professionals that do not feel confident and may use them as supportive training.
- Nearly a third of participants use FOSS in their line of work, therefore it was decided to use the FOSS QGIS when demonstrating/ describing practical knowledge.
- The VLE, toolkit and curricula should accommodate for the needs of MSc students, who at the moment are the main practitioners of GIS training, BSc students that need to increase their GIS training and for professionals as explained above.
- The use of data sources via cloud remains very limited by professionals, while cross-functional collaborations with other fields of activity are essential in terms of GIS. This means that efforts to bring cloud resources into GIS education will be beneficial to keep environmental professionals up to speed with current technological advances.

The conclusion drawn based on the above points is that a high percentage of environmental scientist are required to have GIS skills when they enter the labour market, however, few of them have adequate GIS skills though their BSc curriculum, while MSc curricula make them more competent. Therefore, there is need to increase GIS education both in BSc and MSc curricula. Adding to that, GIS training will also be beneficial for professionals than need to update their skills.

3.2.3 Academic participants results

The answers of the participants (n=47) with academic profile will deliver their take on what academia offers regarding employable GIS skills and provided insights on content details regarding the courses they teach. This information will be used in conjunction with the results of the secondary research of the HEIs' websites.

From the answers it is revealed that and 87% of the courses have both theoretical and practical parts **(Figure 22)**.

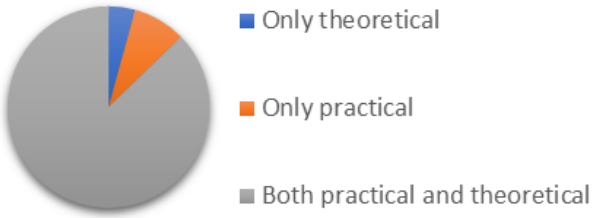

***Figure 21**: diagram representing the answers to the question "Do they have theoretical and practical components"*

Although, more than 60% of the courses are regularly updated based on different technological advances **(Figure 23)**, there is still 36% of courses that get update every 10 years.

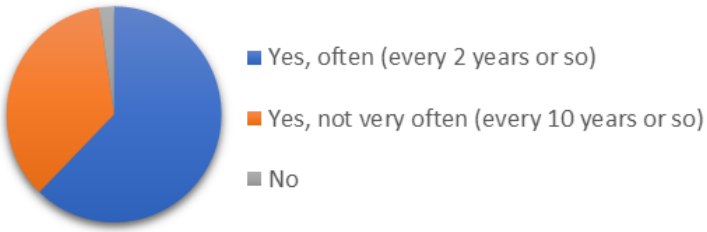

***Figure 22**: diagram representing the answers to the question "Do the courses get updated based on current technology advances "*

Almost half of the courses use FOSS in the practical part, and QGIS in particular, because it is fully compatible with all commercial GIS software, at no cost, and combines a friendly interface and numerous freely available plugins, while 29% of the courses are based on commercial software **(Figure 24).**

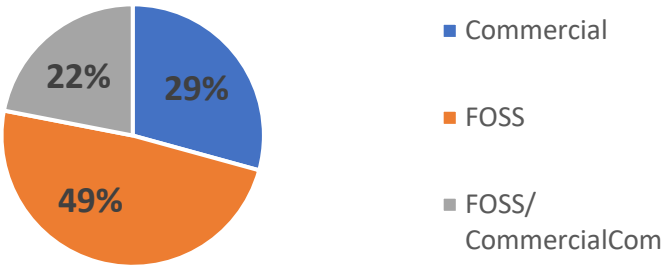

***Figure 23**: diagram representing the answers to the question " What type of GIS software is used for the practical courses"*

In 38% of the courses, cloud-accessible GIS data are not used at all. However, nearly 45% of them employ cloud services for downloading or viewing data **(Figure 25)**.

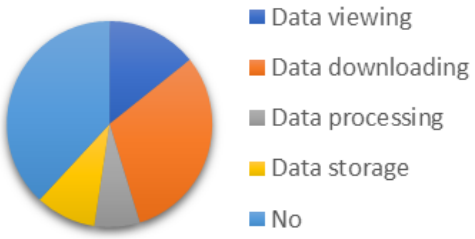

***Figure 24**: diagram representing the answers to the question "Is cloud technology well used in the courses"*

Also, only 57% of the courses are structured to be market oriented and be useful for the labour market and the professional world, while the rest 43% is not **(Figure 26)**.

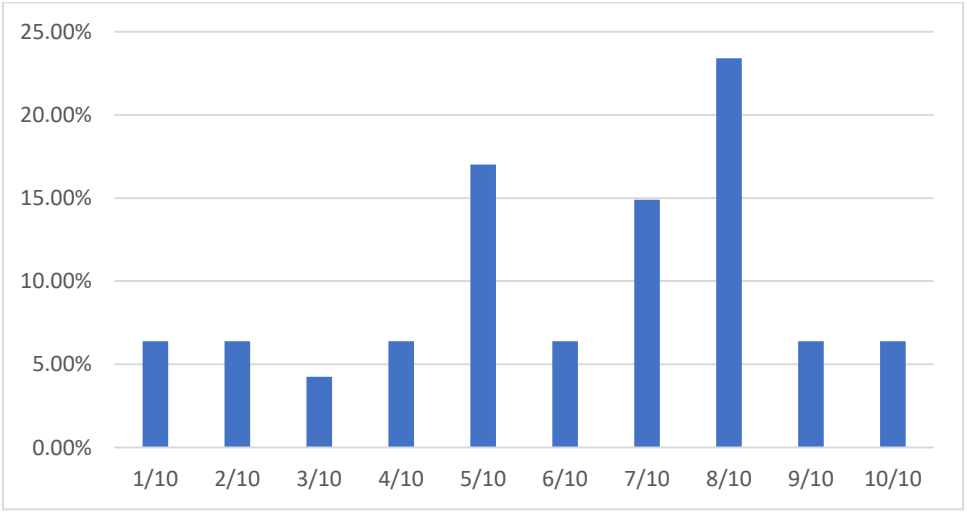

***Figure 25**: diagram representing the answers to the question " How much market oriented in the structure of the course?"*

To summarise the above, based on academics:

- Most of the courses provide both theoretical and practical GIS education
- Most of the courses are regularly updated but a significant part is not
- Most of the courses use FOOS, namely QGIS, but also commercial software
- Cloud services are used in less than half of the courses, mostly for data downloading and viewing
- Most courses are structured to be market oriented, but a significant part is not.

3.2.4 General assessment

The cross-examination of the results of the primary and secondary research that was implemented in IO1, lead to **justified conclusion of the interaction between academia offered and labour market required GIS skills**, which will allow the **bridging of this gap**.

The **professionals believe** that there is a **lack of knowledge and skills in GIS for BSc and MSc students in relation to their real and concrete needs**, while **academics believe that the courses provided are adapted to the job market** and to the world of work. The vision between academics and professionals is therefore **contradictory**, as it is summarised in sections 3.2.2 and 3.2.3. The courses taught to university students seem **appropriate but insufficient.** The desk research that took place during IO1 on the offer of GIS courses in France, Greece and Bulgaria must be further analysed (in IO2) in order to identify the points to be improved and target the means of achieving this.

In addition, GIS clouds are mainly used for data visualization and downloading, but very little for direct data processing. This is perhaps linked to a lack of knowledge or mastery of these tools?

Finally, transdisciplinary collaborations are essential in the labour market, and it therefore seems important to take this into account in the teaching.

4 Innovation, Transferability and Tangibility

In what follows, detailed justification is given for the innovative, transferable, and tangible nature of this IO, in line with the initially accepted description provided in the proposal Form ID KA203-14AC0F01.

Innovation

Considering the definition of innovation as “the practical implementation of ideas that result in the introduction of new goods or services or improvement in offering goods or services”, the main innovation characteristic of this IO “IO1 Research and field review” is that the primary research, i.e., the questionnaire survey of 283 participants from several European countries (mainly France, Greece and Bulgaria), has collected data on several aspects of academia offered GIS courses/ skills and Environmental management labour market needs, which were not previously available and aggregated. These data, transformed into knowledge though the meta-analysis that took place during the implementation of IO1, provides new insights for the improvement of GIS education offering in BSc and MSc levels of environmental and health studies and therefore improvement of the future workforce in the respective labour market.

Therefore, the innovation of the OI1 results relies on the quantitative and qualitative analysis of GIS teaching in universities as well as the assessment of the way the professional world conceives GIS academic training, providing a qualitative and quantitative analysis of their interaction.

Indeed, the specification of the industry needs that were recorded and quantified through the implementation of IO1 constitutes new knowledge that make possible the advancements of GIS education, based on evidence as opposed to previously postulated needs.

These results go beyond the regular organizations’ activities, contributing both to the objectives of the project and having potential impact on the wider environmental and health sector.

Transferability

Taking into account the definition of transferability as “the degree to which the results of study can be applied in other contexts and studies”, it is evident that the outcome of IO1, i.e.,

the Report at hand that includes the methodology design and analysis results of "IO1 Research and field review" study constitutes a perfectly transferable output.

Specifically, it can be used as study by any interested party that needs to gain valuable insights on the market requirements and opinions regarding the necessity and the optimal specifications of GIS-oriented training in EU countries.

Adding to that, the methodology applied to both primary and secondary research as well as the design of the questionnaire can be used either to extend the research to include GIS academia/labour market insights of more European countries or extend to different sectors that need to identify the interaction between academia offered and industry required kills.

Such interested parties include HEIs, other Educational Organizations for adult training, governmental services on educational, labour, and/or environmental matters, professional bodies and unions of environmental professionals et al, which can exploit the derived conclusions to realize their own training programs, recruitment procedures, lifelong seminars, employment plans et al.

Concluding, the transparency of the procedure, the designed methodological approach, and the results obtained have impact and potential for extension, both within the consortium and other sectors and levels (local, regional, national, international).

Tangibility

The implementation of IO1 led to the production of a Report, which presents and describes the methodological steps and the obtained results of primary and secondary research. The tangibility of the IO1 outcome arises from the fact that it is "a result that is clear enough or definite enough to be easily seen, felt, or noticed". Hence, the existence and public availability of the present report which documents all the findings of O1 constitute evidence of its tangibility.