Master programme Geo-information Science (MGI) for meeting NCG 17 April 2018.

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Background
This summary presents the vision statement for MGI (2017). Based on this vision a self-study report was made for the next visitation (site visit 26-27 June 2018). We added some relevant tables and figures.

Vision on the content of the MGI programme
The objective of the Geo-Information Science master's programme (MGI) is to educate graduates in becoming skilled geo-information scientists with the competences to analyze the usability of geo-information in complex spatial problems and to develop innovative and interdisciplinary solutions. Geo-information has become an important societal commodity. Our graduates are able to critically evaluate this commodity and add value by deriving additional quantitative and qualitative information, and analyzing, modelling and visualizing the resulting geodata. The MGI programme focuses on geo-spatial problems related to the mission of the university "to explore the potential of nature to improve the quality of life". Examples include supporting the decision making process in environmental and agricultural management, integrated land monitoring, optimizing food production and distribution and analyzing changing human-space interactions.

Developments in society, science and technology
The MGI programme is part of a rapidly developing field of Geo-information Science. These developments are triggered both by technological and scientific developments. Society is not only using geo-located information but is also a producer of (geo)data. Cell phones, for example, have turned into location-aware personal devices enabling geo-social networking, hardcopy maps are being replaced by flexible and living maps and image displays with integrated navigational functionality and online search now easily considers our current location.
As solutions can be found in new technological developments (e.g. big data, open data policies and real-time sensing), students need to be prepared for and should help to advance these ongoing developments in existing courses or new thematic (capita selecta) courses.
Handling, managing, analyzing, modelling and visualizing big datasets is critical to the Geo-information Science field. As a result students need to develop not only geo-IT knowledge and skills but also capabilities for management and communication with scientists from other disciplines and stakeholders from various sectors. Increasingly interdisciplinary cooperation will be required to achieve project goals while in cooperation with specific user communities (e.g., farmers, forest rangers, and citizens) even trans-disciplinary cooperation is needed.
Next to the large challenges on monitoring and analyzing environmental systems regarding land-use, deforestation, food-security and biodiversity, analyzing the integrated complexity of spatial societal problems is urgently needed due to, for example, increasing urbanization world-wide.

Ambitions concerning the didactical setup, coherence of the MGI programme and teaching and learning methods
The programme offers a unique mix of courses introducing geo-information theories, concepts, methods and technologies from introductory to general into advanced state-of-the-art levels. The use of local, regional and global geo-information in different application domains is evaluated including societal aspects like institutional organization, end-user requirements, data security and

ethics. At the start of the program, these specific elements of the domain and their coherence is discussed within the course Geo-information Science and Context. In selected geo-ICT and scripting courses, specific attention is given to the analysis of big data(sets), spatial modelling and advanced visualization. This develops both conceptual insights and hands-on skills. Integrating the use of Earth Observation techniques and Geographical Information Systems towards the design of integrated monitoring systems is a special asset of the Wageningen approach. Students can use free-choice courses to include current data-science related topics like big-data and machine learning in their program.
Students are active participants in the MGI programme and gain specific in-depth competences based on their individual course choices. Students are engaged in group and project based education and the interaction with staff and the professional field (through excursions and guest lectures) will stimulate interactions offer inspiration and critical thinking. Students know where to find additional knowledge and skills to further develop scientifically and academically, and are encouraged to critically reflect on new results and knowledge. Mutual feedback is an essential part of the learning process.

Further development of the MGI programme
Students have to be able to make well-informed individual choices in the study programme with respect to their future career development. We are increasingly looking for opportunities to use online learning instruments to strengthen the programme and are developing online learning material (e.g. flipped class room) to enrich the campus education. We will also use online learning instruments to settle individual differences before the start of the programme, to increase the overall level of the students during the courses and to provide possibilities for further deepening of knowledge . Students are made aware of increasing online learning opportunities (e.g. MOOCs) to enhance limited knowledge and skills. As technological innovations are an important part of the Geo-information field, this approach fits very well with the competences of staff and students. Feedback from the students is an important component for future development of the programme.

Student population and internationalization
Students entering the program have a broad range of backgrounds regarding their previous education, culture and working experiences. At the start of the programme, every student brings its own competences and context within the field of geo-information science. In the course Geo-information Science and Context, students are stimulated to exchange on their background and reflect on the course selection and planning of their personal program. We attract students from different universities within The Netherlands, Europe and the rest of the world. We strive for an international classroom with at least one third international students.
For students from other universities, we provide knowledge clips and suggested reading to cope with the variation in prerequisite knowledge required for the courses.

Perspectives of graduates
On graduation, students within the MGI programme have walked a fundamental scientific learning path and developed a critical mindset towards responsible use, delivery, value-adding and quality of geo-information to meet societal demands. The programme prepares the students to function academically in a professional and interdisciplinary environment.
Within the programme, three main profiles have been identified:
1) Geo-Information researcher: preparing for a PhD based research career;
2) Geo-Information engineer: preparing for a career within the geo-IT domain;
3) Geo-Information consultant: preparing for career in consultancy and policy support.

Each profile expresses specific (sets of) competences that may be realized by dedicated courses within a so-called learning path. These paths present the planning of the recommended courses per profile within the program.
Graduates are finding jobs at universities, research institutes, governmental organizations, non-profit organizations, consulting firms or within (their own) start-up companies.

Selected Tables and Figures

In this section we present:

1) Learning outcomes (table 1)
2) Overview of the programme (figure 1 and table 2)
3) Research themes of the chair groups and programme (figure 3)
4) Background of students (figure 4)
5) Jobs of graduates 2006-2016

Table 1 **Learning outcomes of the MGI programme**

After successful completion of this MSc programme graduates are expected to be able to:

1. explain the basic theories, concepts and methods in the field of geo-information science and remote sensing;
2. apply geo-information science and remote sensing tools for the acquisition, storage, analysis, visualization and dissemination of spatial data;
3. investigate and judge the usability of geo-information in complex spatial problems in domains related to natural resources, living environment, food production and human society
4. create geo-information solutions for spatial problems in an interdisciplinary application domain;
5. analyze concepts, approaches and methods and reflect upon scientific literature, with special reference to the field of geo-information science and remote sensing;
6. design a research plan in the field of geo-information science and remote sensing by integrating adequate methods and techniques to collect, process and interpret data;
7. carry out a research in the field of geo-information science and remote sensing and judge on the quality for the different phases of the scientific research process ;
8. communicate clearly - both orally, in writing and visualizing - to present the outcomes of their research and design projects and discuss these results with specialists and non-specialists;
9. function effectively as specialist in international multidisciplinary teams with an active and critical attitude;
10. respond to social, organizational, scientific, multicultural and ethical issues that are encountered in the field of geo-information science and remote sensing;
11. reflect critically on their results and performance, as well as on those of colleagues;
12. design and plan their own learning processes through continues reflection on and experiences gained in the domain of geo-information science and remote sensing.

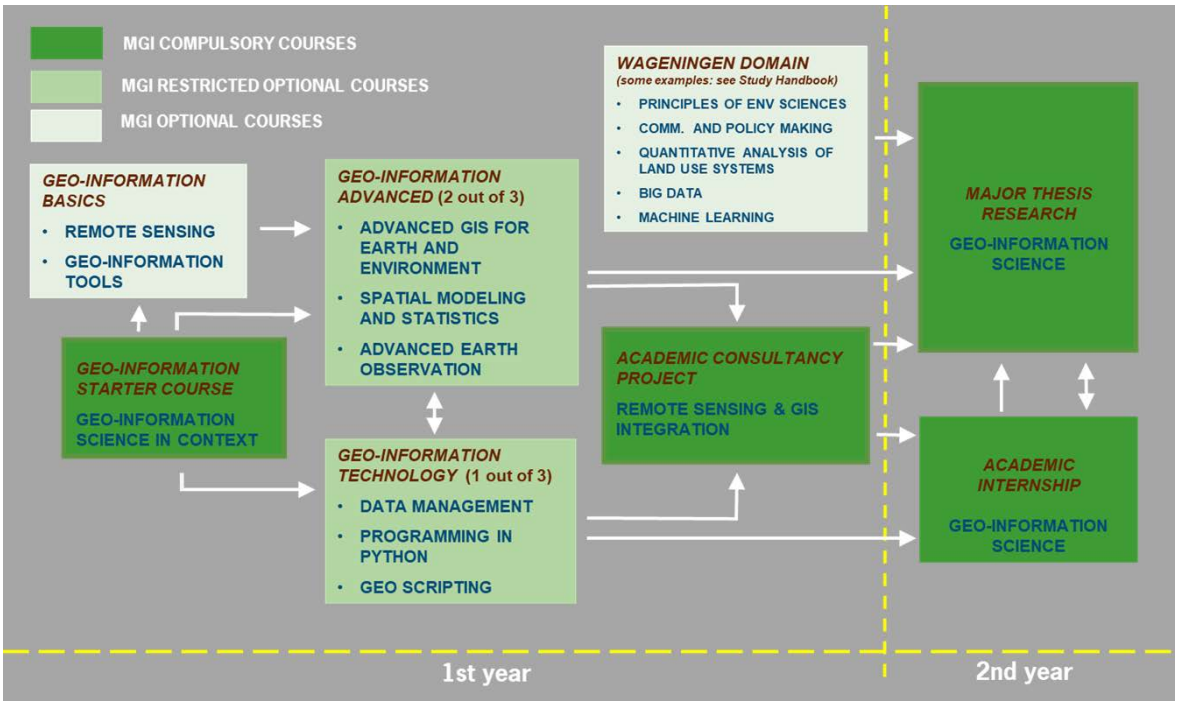

Figure 1: Overview of the compulsory and (restricted) optional courses in the curriculum

Table 2 Overview of MGI curriculum and courses descriptions

In addition to Figure 1 the table below lists all courses of the curriculum, including course code, size in terms of credits, whether they are compulsory (CS) or restricted optional (RO), and scheduling (year, period). More details of each course can be found in **the course description** in the online study handbook of Wageningen University 2017-2018: https://ssc.wur.nl/Handbook/Programme/MGI
To view the description, select the link to a course from the list.

Course	Name	ECTS	Type[1]	Phase[2]
GRS-34306	Geo-information Science in Context	6	CS	M1
GRS-60312	Remote Sensing and GIS Integration	12	CS	M1
GRS-70424	MSc Internship Geo-information Science and Remote Sensing	24	CS	M2
GRS-80436	MSc Thesis Geo-information Science and Remote Sensing	36	CS	M2
GRS-20806	Geo-information Tools	6	RO0	M1
GRS-20306	Remote Sensing	6	RO0	M1
GRS-33306	Advanced Geo-information Science for Earth and Environment	6	RO1	M1
GRS-32306	Advanced Earth Observation	6	RO1	M1
GRS-30306	Spatial Modelling and Statistics	6	RO1	M1
INF-22306	Programming in Python	6	RO2	M1
GRS-33806	Geo Scripting	6	RO2	M1
INF-21306	Data Management	6	RO2	M1
ESA-20806	Principles of Environmental Sciences	6	RO3	M1
PPS-30306	Quantitative Analysis of Land Use Systems (QUALUS)	6	RO3	M1
CPT-21806	Communication and Policy Making	6	RO3	M1

1: CS = Compulsory courses; RO = Restricted optional; RO0 = Choose 0-2 courses, if these competences are not present according to the study adviser; RO1 = Choose 2 courses; RO2 = Choose 1 course; RO3 = Choose preferentially at least 1 course in the field of the Wageningen UR domain
2: M1 = programme year 1; M2 = programme year 2

		Themes	Key topics
Disciplinary		Sensing and measuring	Improve physical underpinnings of land change time series analysis
		Modeling and visualization	Spatial-temporal processes & flows
Inter-disciplinary		Integrated land monitoring	"Big data" approaches for global land change assessments & resilience analysis
		Human-space interactions	Using citizens in the context of urban energy and material flows
Trans-discipline		Empowering agro-environmental Communities	Participatory, spatially enabled and interactive resource monitoring & management

Figure 2: Research themes of the Geo-information Science and Remote Sensing Chair Groups of Wageningen University. These themes are also part of the courses and thesis work.

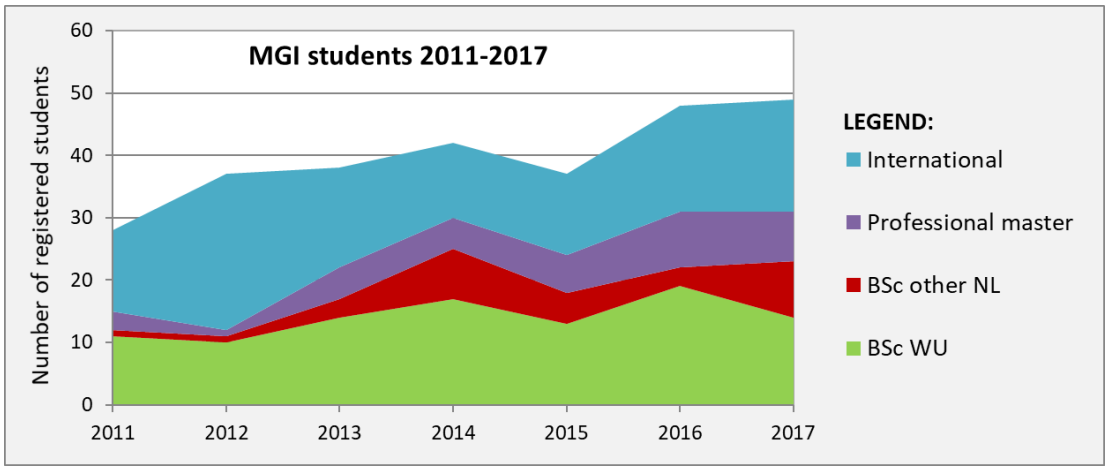

Figure 3: Background of students registered for the programme over period 2011-2017

2017 as example:
Wageningen University:
Forest and Nature Conservation; Soil, Water, Atmosphere; International Land and Water Management (6) ; Landscape Architecture and Spatial Planning (5) ; Environmental Sciences.
Professional Master (HBO): Environmental Sciences, Forest and Nature Management (2); Geomedia and Design; Geo-informatics.
(Avans, HAS, HU, VHL)
NL-Universities: Human Geography and Planning (2), Human Geography (2), Earth sciences (3), Liberal Arts and Sciences.
(UU, RUG, RUN, Univ. College, VU)
International: Environmental Sciences (6), Engineering (3), Human Geography and Planning (3), Marine Biology, Geography, Geo-informatics (2), Remote Sensing.
(countries: (Belgium), China (3), Germany (2), Greece (2), Hungary, Indonesia, Mexico, Saudi Arabia, Spain, Surinam, Switzerland, United Kingdom, USA (2))

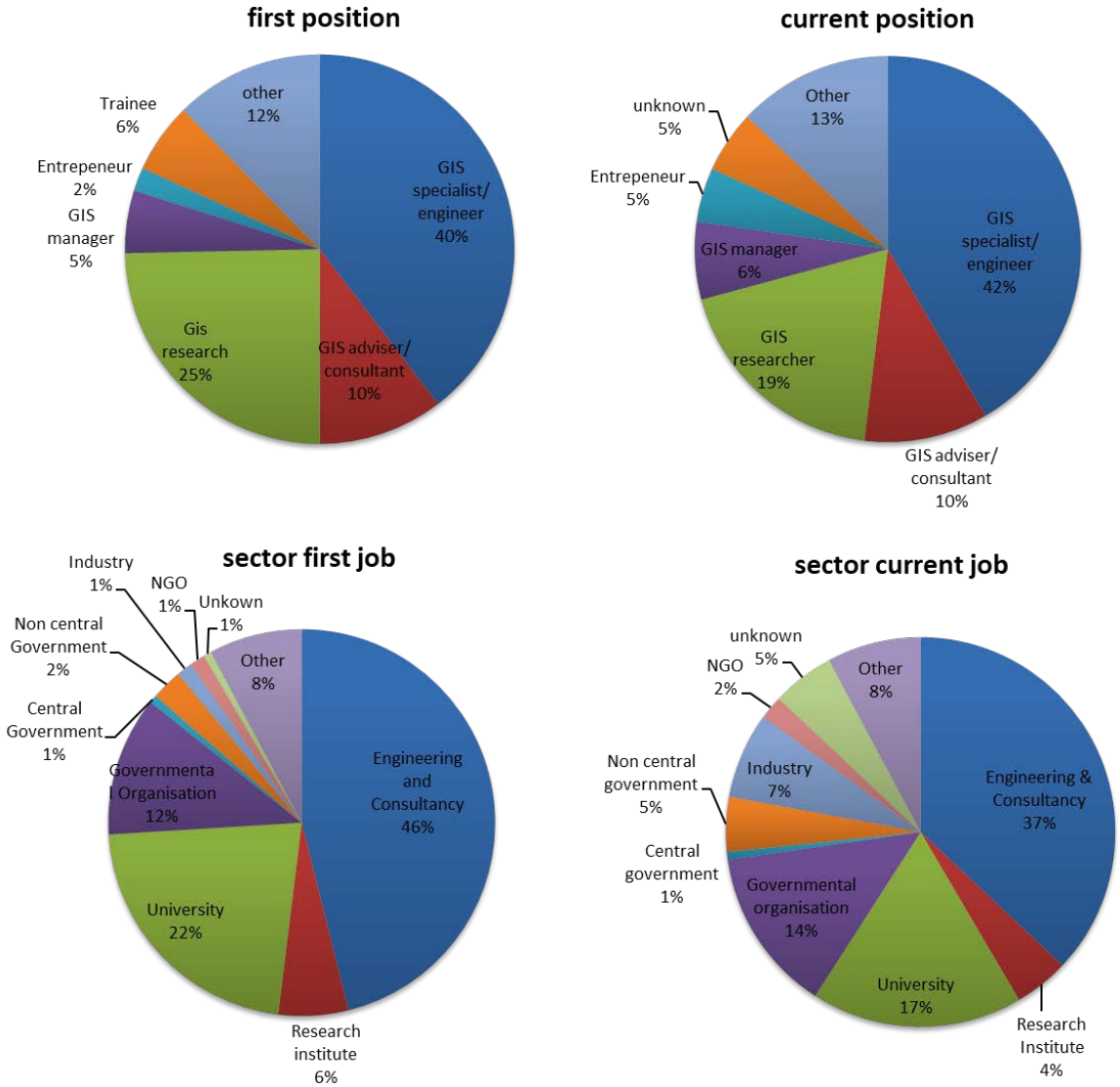

Figure 4: Results of job market analysis of the Linked-in profiles for 154 graduates (2006-2016; 69% of total) of the programme presenting first position and current position and associated sector.

The MGI programme provides graduates with a solid basis for a career in research, engineering and consultancy companies, and governmental organisations. The graduates consider that they are well-prepared for a professional career as indicated by the high score (4.3 compared to 3.5 WU average) in the National Student Evaluation (NSE). At the end of their study, 90% of the students obtained a job within 6 months after graduation. For example, 55% of the students graduating in 2016-2017 received a job-offer from their internship provider.

Graduates obtain jobs within a variety of organisations (Figure 4) both in the Netherlands and abroad. Around 40% of the students start their career as GIS specialist/engineer often with a consultancy or engineering company. Some examples of companies are: CGI, Sweco, NEO BV, Arcadis, Ordina and Royal Haskoning DHV. A second group of around 25% of the students continue as researcher (often PhD) at universities in the Netherlands or abroad (Australia, Brazil, Belgium, Ethiopia, Finland, USA, UK), or with research institutes (WENR, NASA GSFC, CGIAR, Deltares, and CNRS). Governmental organisations are also important employers for the graduates (15%) where they start as trainees or GIS advisors (municipalities, ministry, Cadastre, European Commission,

European Maritime Safety Agency, European Space Agency, Geological Survey of Bangladesh, German Aerospace Centre, and National Land Agency of Indonesia). Working for NGOs or industry is often a next step in their career. Recently, we observed an increase in alumni who started as entrepreneur in a start-up company either directly or having gained some years of working experience in the geo-domain.