# Geomatics

**Faculty of Architecture**
**Delft University of Technology**

**QANU, December 2012**

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This report was finalised on 12 December 2012.

# Report on the master's programme Geomatics of Delft University of Technology

This report is written according to the standards of the NVAO Assessment Framework for Limited Programme Assessments.

## Administrative data regarding the programme

| | |
|---|---|
| Name of the programme: | Master of Science Geomatics |
| CROHO number: | 66954 |
| Level: | master |
| Orientation: | academic |
| Number of credits: | 120 EC |
| Degree: | Master of Science |
| Mode(s) of study: | full-time |
| Location(s): | Delft |
| Expiration of accreditation: | 31 December 2013 |

The site visit of the Geomatics programme assessment committee to the Faculty of Architecture of Delft University of Technology took place on 29 and 30 October 2012.

## Administrative data regarding the institution

| | |
|---|---|
| Name of the institution: | Delft University of Technology |
| Status of the institution: | Government supported |
| Outcome of the institutional quality assurance assessment: | Positive |

## Quantitative data regarding the programme

The required quantitative data regarding the programmes are included in Appendix 6.

## Task and composition of the committee

The task of the assessment committee was to evaluate the master's programme in Geomatics (CROHO number 66954) at the Delft University of Technology (TU Delft) according to the accreditation criteria set by NVAO. The committee is expected to assess different aspects of the quality of the programme, based on the information provided by the programme in the critical reflection and from discussions held during the site visit. The assessment report does contain recommendations made by the committee, but the emphasis lies on the assessment and justification of fundamental quality. The committee consisted of a chairman and four members. Appendix 1 gives the abbreviated curricula vitae of the committee members.

Chair

- Prof. H.F.L. (Henk) Ottens, emeritus professor of Social Geography, University Utrecht;

Members

- Prof. P. (Paul) van der Molen, professor at the Faculty ofr Geo-Information Science and Earth Observation ITC, University of Twente;
- Prof. N.J. (Nico) Sneeuw, professor and head of the Institute of Geodesy, University of Stuttgart;
- Drs. W.C.A. (Wim) de Haas, senior advisor information management, Staff Directorate General Rijkswaterstaat;
- Ms. A.R. (Anne-Ruth) Sneep, BSc, student of the master's programme Geo-information Science, Wageningen University.

The project leader of the assessment was Ms. N.M. Verseput, MSc, QANU staff member. Ms. P.G.A. Helming, MSc, was the secretary of the committee and present during the site visit. The site visit took place on 29 and 30 October 2012. The programme of the site visit is included as Appendix 2.

All members and the secretary of the committee signed a declaration of independence as required by the NVAO protocol to ensure that the committee members judge without bias, personal preference or personal interest, and the judgement is made without undue influence from the institute, the programme or other stakeholders (see Appendix 8).

## Working method of the assessment committee

*Preparatory phase*
After receiving the critical reflection, the project leader checked the quality and completeness of the information provided. After approval, it was forwarded to the committee. In addition, each committee member received and read two or three theses for the programme being assessed. The theses were selected by the project leader in consultation with the chair of the committee (see Appendix 7).

Before the site visit the project leader created a draft programme for the interviews (see Appendix 2). The draft programme was discussed with the chair of the committee and the programme coordinator. As requested by QANU, the programme coordinator carefully composed and selected representative panels.

*Site visit*
During the initial meeting at the start of the site visit, the committee discussed its findings based on the critical reflection. It also discussed its task and working methods and the proposal for the domain-specific requirements (see Appendix 3).

During the site visit, interviews were held with representatives of the Board, students, staff members, alumni, the Educational Committee, the Examination Committee, a member of the University Board and the student advisor. The committee also received and studied additional information, for example study books of several courses and reports from the meetings of the Educational Committee. When considered necessary, committee members could read additional theses during the site visit. A consultation hour was scheduled to give students and staff of the programme the opportunity to talk to the committee informally, but no requests were received.

The committee used a significant part of the final day of the site visit to discuss the assessment of the programme and to prepare a preliminary outline of the findings. The site

visit concluded with an oral presentation of these findings by the chairman, consisting of a general assessment and several specific observations and impressions of the programme.

*Scores of the standards*
The assessments were performed in line with NVAO's accreditation framework. Each standard is scored on a four-point scale (unsatisfactory, satisfactory, good and excellent). The committee adopted the standard decision rules provided by NVAO. These are:

- Generic quality: The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.
- Unsatisfactory: The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.
- Satisfactory: The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.
- Good: The programme systematically surpasses the current generic quality standards across its entire spectrum.
- Excellent: The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

*Reporting*
After the site visit the secretary wrote a draft report based on the committee's findings. This draft was first read and commented upon by the committee members before being sent to the faculty to check for factual irregularities. Any comments of the faculty were discussed with the chair of the committee and, if necessary, with the other committee members. After that, the report was finalised.

# Summary judgement

This report reflects the findings and considerations of the Geomatics assessment committee on the master's programme Geomatics of Delft University of Technology. The committee's evaluation is based on information provided in the critical reflection and from examination of selected theses, additional documentation and interviews held during the site visit.

At the time of assessment, the master's programme in Geomatics was undergoing a substantial transformation. The faculty hosting the programme has been changed (from Aerospace Engineering to Architecture), the profile of the programme was redefined by a focus on the built environment, and the curriculum was thoroughly redesigned. The new master's programme was implemented in September 2012. As a consequence, the committee had to assess the previous master's programme in Geomatics over the last four years, as well as the revised master's programme in Geomatics that had just started with first-year students. The committee tried to do that in a balanced way.

The committee highlighted both positive aspects and the ones that could be improved. Taking those aspects into consideration, the committee decided that the master's programme fulfils the requirements of the criteria set by NVAO which are the conditions for accreditation.

*Standard 1: Intended learning outcomes*
The committee assesses this standard as **satisfactory**.

The committee compared the final qualifications of the programme against the domain-specific reference frameworks for Geomatics (original and revised) and examined its profile and orientation. It concludes that the framework provides an adequate reflection of the domain and the general knowledge and skills that graduates should have acquired. The committee is satisfied with the profile of the programme, in which the entire geo-information chain is covered. Given the organisational and profile shift towards the Faculty of Architecture, it agrees with the greater attention paid to the built environment and the combination of technology and applications in the revised programme. The committee concludes that the attention paid to scientific and professional development in the programme's orientation is well balanced.

According to the committee, the final qualifications clearly meet the standards for graduated students at master's level. In general, the intended learning outcomes properly reflect the general 3TU domain-specific reference framework and the programme's specified profile. However, the qualifications should be adjusted and refined for the revised master's programme, to better reflect the new focus on geo-information technology and provision for management of and decision-making for the built environment.

*Standard 2: Teaching-learning environment*
The committee assesses this standard as **satisfactory**.

The committee concludes that the original and revised master's programmes in Geomatics, the personnel available for teaching and the programme-specific facilities enable master students to acquire the final qualifications.

The committee confirms that both curricula are sufficiently explicit and adequately meet the intended learning outcomes. The old programme had a complex structure and organisation

that made it not very transparent and difficult to manage. This situation was aggravated by the low level of student influx. The committee noted that the structure and coherence of the curriculum are significantly improved in the renewed programme. Nevertheless, it suggests that the revised programme incorporates the orientation on the built environment more explicitly and in a more structured way. It is satisfied with the balance between the development of scientific research skills and the preparation for professional practice.

The committee noted that the didactic vision underlying the teaching in the master's programme is not well elaborated and rather traditional. It recommends applying more contemporary and innovative teaching methods as soon as possible. The study facilities are first-rate. Based on the interviews conducted with students, alumni and lecturers, the committee feels that the study support for students in the master's programme is satisfactory. It also appreciates the adequate level of internationalisation.

The greatest point of concern is the low annual intake of master students, despite the many determined actions taken over time. Just like the programme management, the University Board and the staff members, the committee is aware that a larger intake is vital to the continuation of the programme. It emphatically advises the management and teaching staff to take every opportunity to improve student intake provided by the new stimulating environment of the Faculty of Architecture. It expects that encouraging sufficient numbers of bachelor students in Architecture to continue on to the master's programme in Geomatics will contribute to giving Geomatics a sustainable future. The committee was pleased to learn that the University Board will give the new programme a fair chance to develop. It will require strong leadership of the programme management to make this happen. The committee ascertained that the programme's study load is acceptable. Because of the rather low completion rates, the committee also suggests further exploration of the possibilities to prevent drop-outs and study delays. In this respect, it is positive about the recent implementation of a strict monitoring system while writing the master thesis.

The committee concludes that the teaching staff is dedicated and has the correct expertise and level. During the site visit the students expressed their very positive opinion of the didactic skills and approachability of the lecturers. The committee is confident about the ability of the Geomatics staff (and their Architecture colleagues) to make the revised master's programme in Geomatics a success.

The committee confirms that the institute is well aware of the quality of the teaching environment, in which lecturers and students are properly involved and well supervised.

*Standard 3: Assessment and achieved learning outcomes*
The committee assesses this standard as **satisfactory**.

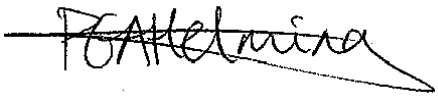
The committee concluded that the programme has a satisfactory system of assessment and can demonstrate that the final qualifications are realised. The assessment policy is comprehensive and adequately addresses all relevant aspects. The committee was impressed by the engaged and proficient Examination Committee and ascertained that it exercises sufficient control over the quality of assessments. It is pleased with the hard work that has been done to harmonize the assessment procedures of the master's programme in Geomatics with those of the Faculty of Architecture. The assessments as a whole are sufficiently varied and well reflect the contents of the programme and the students' level. The committee compliments the programme on the sophisticated and well-organized master thesis procedure.

The committee concluded that the master students acquire an adequate final level by the end of the programme. This was confirmed by the theses the committee evaluated. It found that the final qualifications of the master's programme were realised. Moreover, it ascertained that graduates of the master's programme in Geomatics are adequately prepared for their careers.

*General conclusion*
The committee assesses the master's programme Geomatics as **satisfactory.**

The chair and the secretary of the committee hereby declare that all members of the committee have studied this report and that they agree with the judgements laid down in it. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 12 December 2012



Prof.dr. H.F.L. Ottens

Ms. P.G.A. Helming, MSc

## Description of the standards from the Assessment framework for limited programme assessments

At the time of the programme assessment, the master's programme in Geomatics was undergoing a substantial transformation. Since its start in 2005, the desired intake of at least 20 students has never been reached. As noted by the previous assessment committee in 2006, an increase of student numbers is absolutely vital to the continuation of the programme. This situation lead to the decision by the institute in February 2011 to make substantial organisational and structural changes to the programme. To start with, the faculty hosting the programme has been changed. While previously the Faculty of Aerospace Engineering was responsible for the master's programme in Geomatics, from September 2011 the programme became part of the Faculty of Architecture. A consequence of this organisational shift has been a profiling towards the built environment: the title of the master's programme received the affix 'for the built environment', the student catchment area was redefined, and the curriculum was thoroughly redesigned. The new master's programme was implemented in September 2012.

The recent and extensive change of the master's programme made the task of the programme assessment committee more complicated. As a consequence, the committee had to assess the previous master's programme in Geomatics over the last four years, as well as the revised master's programme in Geomatics that had just started with first-year students. The committee tried to do that in a balanced way.

As a consequence, the underlying report refers to both the original and the revised master's programmes. The emphasis is put on the latter, since it is the most relevant one for students entering the programme in the near future (during the following accreditation period).

**Standard 1: Intended learning outcomes**
The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

**Explanation:**
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

### 1.1. Findings

In this first standard the committee's findings are examined against the domain-specific reference framework (1.1.1.). Then attention is paid to the profile and orientation (1.1.2.) and the final qualifications (and their level) (1.1.3.) of the master's programme in Geomatics at Delft University of Technology.

#### *1.1.1. Domain-specific requirements*
The Faculty of Architecture prepared the domain-specific reference framework (hereafter the framework), which is included as Appendix 3. The framework covers both the original and revised master's programmes. According to the critical reflection, the framework is partly based on the 3TU system of learning outcomes jointly defined by the three universities of technology in the Netherlands (Delft, Eindhoven and Twente). It is also inspired by the international accreditation standards and curriculum pathways given by the Geographic

Information Science & Technology Body of Knowledge (GI-BoK) drafted by the Association of American Geographers.

The committee studied the framework and ascertained that it properly reflects the domain of Geomatics. Given the strong international orientation of the field, the committee appreciates that the framework is based on internationally acknowledged standards. It is also positive about the straightforward connection with the core elements of the Geo-information Technology & Governance research programme of the OTB Research Institute for the Built Environment. This research centre will in the near future become part of the Faculty of Architecture. The committee noted that the domain-specific requirements are well defined and provide sufficient insight into the requirements set by professional colleagues. The framework specifies clearly the knowledge and skills that students must have at the master level.

### *1.1.2. Profile and orientation*

In addition to the domain-specific reference framework, the critical reflection elaborates on the profile and orientation of the master's programme in Geomatics at Delft University of Technology. It states that the objective of the programme is to offer high-quality education covering the entire geo-information chain. This includes:

- A systematic and sound approach to data acquisition and information extraction, covering state-of-the-art techniques in surveying, satellite positioning, photogrammetry and remote sensing from terrestrial, marine, airborne and space-borne platforms, based on optical, laser, radar, acoustic and seismic sensors.
- An information system's approach to store, process, manage, disseminate and visualise data and information, acting at the forefront of data analysis methodology and spatio-temporal database management systems technology, and also paying attention to legal and organisational aspects of geo-information.
- The role of geo-information in decision-making within a broad spectrum of the fields of Civil Engineering and Geosciences, covering design and construction, hydraulic engineering, water management, transport and planning, and geo-technology.

While the main pillar of the whole geo-information chain (from acquisition to visualisation and dissemination) is preserved, the profile of the revised Geomatics programme concentrates on the built environment. Furthermore, the critical reflection showed that less attention is paid to data acquisition in the new master's programme while the focus on applications is extended.

The committee examined the attention paid to academic and professional orientation in the programme. In line with the domain-specific reference framework, the scientific and academic development plays an important role in the orientation of the programme. For instance, the programme aims to strongly connect to the Faculty's research programme. Meanwhile, preparation for the professional field is not ignored. According to the critical reflection, graduates of the master's programme will be able to deliver valuable technological and methodological contributions to industry, the public sector and society in general, in all domains involving the production, management, dissemination and application of geo-information. The final qualifications of the master's programme explicitly refer to scientific, academic and professional competencies and skills (see 1.1.3.).

The committee is satisfied with the profiling and the orientation of the programme. It is pleased with the complete Geomatics chain being the structuring principle of the programme

and approves the renewed combination of technology and applications within the programme. It is also satisfied with the adequate balance in attention paid to the academic and professional orientation; the programme aims to prepare students in a scientific manner for the professional practice. The committee feels that the master's programme is rather specific, training students for interdependent occupational groups.

#### *1.1.3. Learning outcomes and level*

The final qualifications of the Geomatics programme are listed in Appendix 4. The critical reflection states that the intended learning outcomes are based on the 3TU system of final qualifications and the Dublin descriptors (which are considered to be general, internationally accepted descriptions of a master's programme). The programme's learning objectives are set in the Course and Examination Regulations, which are accessible to students and staff members via Blackboard.

The committee examined whether the final qualifications match the profile and the orientation presented in the programme and the domain-specific reference framework. It ascertained that the intended learning outcomes meet the requirements demanded of a Geomatics graduate at the scientific master level. It also verified the relationship between the final qualifications and the Dublin descriptors. The committee observed that all Dublin descriptors are reflected upon in the intended learning outcomes (see Appendix 4). During the site visit the committee was pleased to find that the interviewed students and teachers were well aware of the final qualifications of the programme. It noticed that, in contrast to the programme's profile and general learning objectives, the final qualifications have not yet been fully changed for the revised programme. During the interviews with the management, the committee understood that plans are being made to institute these necessary adjustments.

### 1.2. Considerations

The committee compared the final qualifications prepared by the programme against the domain-specific reference framework for Geomatics and examined its profile and orientation. It concluded that the framework provides an adequate reflection of the domain and the general knowledge and skills that graduates should have acquired. It is satisfied with the profile of the programme, according to which the entire geo-information chain is covered. Given the organisational shift towards the Faculty of Architecture, it agrees with the increase in attention paid to the built environment and the combination of technology and applications. It concludes that the attention paid to scientific and professional development is well balanced in the programme's orientation.

According to the committee, the final qualifications clearly describe the expectations of students at the master's level. In general, the intended learning outcomes properly reflect the domain-specific reference framework and the programme's specified profile. It expects the programme to adjust and refine the final qualifications so they better reflect the new focus on geo-information technology and provision for management of and decision-making for the built environment.

### 1.3. Conclusion

*Master´s programme in Geomatics:* the committee assesses Standard 1 as **satisfactory**.

**Standard 2: Teaching-learning environment**
The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

**Explanation:**
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

## 2.1 Findings

In this standard the design and the coherence of the curriculum of the master's programme in Geomatics were examined (2.1.1.). In addition, the committee looked at the extent to which the final qualifications are translated within the curriculum (2.1.2.) and the amount of attention paid to scientific training and the professional practice (2.1.3.). Finally, the following topics were considered: the didactic concept and the facilities (2.1.4.), intake, study load and outcomes (2.1.5.), teaching personnel (2.1.6.) and programme-oriented internal quality assurance, which includes descriptions of the measures for improvement implemented as a result of the previous programme assessment (2.1.7.).

### *2.1.1. Content and structure of the curriculum*

The committee studied the curricula of the original and the revised master's programme in Geomatics, looking for coherence and a logical structure. Both curricula are included in Appendix 5.

*Curriculum of the original master's programme in Geomatics*

The original master's programme consisted of 120 EC spread over two years. The programme did not offer any specialisations. According to the critical reflection, the original curriculum started with convergence courses (like *Matlab/Programming* and *Introduction to GIS*, in total 17 EC) to make sure that graduates and undergraduates who apply from a variety of backgrounds attain an adequate entrance level with sufficient Geomatics knowledge. The entrance level is determined by a specially appointed intake commission, directly after applying. For students with insufficient knowledge of mathematical subjects, deficiency courses are offered, though they are not part of the two-year master's programme, implying an extension of the two-year study period. Subsequently, the mandatory core courses worth 29 EC are offered, covering the data acquisition domain (for instance, *Multivariate Data Analysis*), the information technology domain (such as geo-database management systems and geo-information infrastructure technology), as well as a course that connects both domains to each other (*Location Based Services*). In addition, students can broaden their knowledge in geo-data acquisition or information technology via several electives (including *Microwave Remote Sensing*, *3D Geo-Information Systems* and *Photogrammetry*; 24 EC) or deepen their knowledge in several application domains through at least 3 application courses (like *Coastal Dynamics*, *Spatial Information in Utilities* and *Transportation and Spatial Modelling*, minimum of 11 EC). The second year of the master's programme is mainly devoted to the *Synthesis Project* (11 EC) and the *Graduation Project* (45 EC). In addition, one elective (4 EC) has to be chosen.

*Curriculum of the revised master's programme in Geomatics for the built environment*

The critical reflection describes that, given the limited student numbers (<20), many courses in the original master's programme were attended by only 2-4 students. In response, the programme decided to make major structural changes, including:

- One generic and mandatory core programme of 45 EC, covering the entire geo-information chain with an emphasis on Geo-ICT and applications (including courses like

*Sensing Technologies for the Built Environment* and *Geo Web, Sensor Networks and 3D-Geovisualisation Technology*). Some of the electives of the original master's programme have been incorporated in the core programme.
- 20 EC of electives covering various application domains to enhance, broaden or deepen knowledge. The electives are arranged in the domains *Urban Design*, *Urban Analysis*, *Landscape Architecture*, *Built Environment*, *Informatics* and *Geo-data Acquisition*.
- Convergence courses are provided as electives.
- The study load of all courses has been harmonised to 5 EC.

The *Synthesis Project* (10 EC in the revised master's programme) and *Graduation Project* (45 EC) remain unaltered.

*Contents and coherence*
Based on the information provided in the critical reflection, on the reading table during the site visit and in the interviews, the committee found that the design of the curricula of both the original and revised programmes is sufficiently explicit. While it found the structure of the original curriculum rather complex, especially given the limited student numbers per course, it noted that the extended core programme and the reduced room for electives give the new curriculum more transparency and efficiency. It agreed that the new curriculum still provides enough freedom of choice to compose an individualised study programme based on a student's personal interests. During the site visit the students and alumni expressed their gratitude for the substantial space for electives in the previous and revised programmes. They also valued the connection of electives to the various application domains. However, the committee advises to keeping a watch on the range and variety of electives provided, to prevent Geomatics students from disappearing in the crowd in electives provided by other master programmes (thereby losing a focus on the Geomatics perspective when discussing subject material and solving cases). The 'new generation' of Geomatics students can be expected to have more affinity with the built environment profile of the new programme and will have less specific preference for data acquisition technology. The new MSc-track Geoscience and Remote Sensing within the master of Civil Engineering and Geosciences, will cater for the highly data-acquisition technology interested students. The committee also stresses the importance of early and proactive study support by the study advisors when students choose their electives (see 2.1.5.).

The committee ascertained that the curriculum's transparency and coherence are significantly improved in the revised master's programme. It approves the inclusion of convergence courses in the core programme. Moreover, it found that the content of individual courses and the curricula as a whole are sufficiently accurate. Nevertheless, it expects the programme to incorporate the orientation the built environment, including computer aided planning and design more explicitly and in a more structured way into the compulsory (for instance via the *Synthesis Project*) and elective courses. It suggests introducing a peer review system, in which the teaching staff of Geomatics and Architecture cooperate to insert the focus on architecture into Geomatics courses and vice versa. Also, an introductory course covering the whole scope and structure of the new programme deserves consideration.

### *2.1.2. Learning outcomes*
The committee examined whether and how the final qualifications formulated by the master's programme have been translated in the curriculum. It paid specific attention to the extent of internationalisation.

The committee verified the translation of the final qualifications of the master's programme by studying the cohesion between the intended learning outcomes and the curriculum. The critical reflection included very elaborate overviews of the relation between the final qualifications and the learning objectives at the course level for the original and the revised programmes. Furthermore, the committee examined the study guides of several courses made available during the site visit, including a description of the learning objectives, specification of contents, assignments and the literature. The committee feels that the intended learning outcomes are thoughtfully translated into the curriculum. According to the committee, the original and revised curricula demonstrate proper internal consistency. It ascertained that all learning outcomes are cross-matched to courses of the programme. In line with the missing focus on the built environment in the programme's final qualifications (see 1.1.3), the committee again stresses the importance of translating the orientation on the built environment explicitly into the curriculum. Furthermore, during the site visit the committee received mixed signals about the connection between education and research in the curriculum. While the interviewed students did not have a clear image of staff members' research projects and the translation of their research into courses, the interviewed alumni and staff members did recognise the reflection of contemporary research projects in the cases and assignments of the master courses. The committee asks the programme to inform students clearly about the translation of current research activities into the curriculum. Despite these points of attention, it states that the original and new master curricula adequately match the intended learning outcomes.

*Internationalisation*
The committee also studied the degree to which internationalisation is part of the programme. Based on the critical reflection and the interviews with students, alumni and the management, it found that the level of internationalisation adequately meets the international standard in the Geomatics domain. The committee is pleased with the relatively high intake of foreign students (see intake rates in Appendix 6), collaboration with universities abroad with regard to a substantial number of graduation projects, and the internationally oriented research projects of staff members. A minor point involves paying better attention to international students who would like to contribute to the internal quality assurance or student participation, since the default language of most institutions and official documents is Dutch.

### *2.1.3. Academic and professional orientation*
The committee feels that the development of scientific research skills is effectively addressed within the programme. It noted that both the original and the revised programmes have a proper scientific orientation, which is reflected in a sufficient number of methodological courses and the training of research skills in nearly all courses of the core programme. The site visit revealed that students and alumni are positive about the academic orientation of the programme.

The committee found that the interviewed students and alumni also value the preparation for professional practice and the vocational guidance given within the curriculum. The students explained that job perspectives are clearly outlined in the study guides and study material and on the faculty's website. Additionally, students are invited to several career events and Geomatics symposiums by the institute and its staff members. The critical reflection mentions the organisation of the Open Guest Lecture Series by the faculty's research department. It provides a platform on which prominent representatives of the professional field are invited to give a lecture. Based on the interviews during the site visit, the committee noted that guest lectures by professionals from the working field and company visits are also

included in some of the courses. It feels that the programme could formalise its contacts with alumni better and take advantage of their working experience to contribute to the professional orientation within the programme and to fine-tune the curriculum. It particularly liked the institute's Trainee Programme mentioned by the alumni, which facilitates Geomatics graduates working at various organisations as a trainee for two years. The committee feels that the Trainee Programme increases graduates' job opportunities and enables them to further develop their professional skills. Currently, seven profit, non-profit and governmental organisations participate in the Trainee Programme.

### *2.1.4. Didactic concept and facilities*

The committee examined the didactic vision underlying the teaching in the programme. It also explored whether the available facilities are adequate.

Unfortunately, the committee found that the didactic vision has not been clearly elaborated or written down. The critical reflection does not mention a particular didactic concept being applied. Based on the critical reflection, the course information on the reading table and the interview with lecturers, the committee noted that quite traditional teaching methods are being applied (for example, frequent use of one-way communication in lectures). The committee expects the master's programme to start using more up-to-date and innovative teaching methods applied in courses of other master's programmes of the faculty (think of ateliers, workshops, teaching by means of projects and group assignments). The committee stresses the importance of involving the teaching staff in constructing a contemporary didactic vision in order to make sure that they will be able to translate their views on education into practice.

Based on the documentation received, the interviews conducted with various groups and an improvised guided tour of the faculty's facilities, the committee ascertained that the facilities for the students in the Faculty of Architecture are excellent. The study information on Blackboard and the faculty's website is well-arranged. The committee compliments the programme on the Geolab facility. It provides students with equipment for practicals, the *Synthesis Project* and their graduation work; specific equipment and software are available. Moreover, it offers a home base for the Geomatics students within the large-scale faculty.

### *2.1.5. Intake, study load and completion rates*

The quantitative data for intake, feasibility and outcomes are listed in Appendix 6, and obviously most of these data concern the original master's programme in Geomatics.

*Intake*

As noted in the introduction of standard 1, the previous assessment committee expressed its concerns about the low student intake. These worries were shared by the programme's management, which took a range of measures to try to improve the number of students entering the programme. The critical reflection described these measures:

- On the advice of the previous assessment committee, a range of focused marketing activities was undertaken, including the appointment of a Marketing and Communication specialist.
- A minor in *3D Virtual Earth* was offered from 2009 to 2011 to promote the Geomatics domain among bachelor students.
- An Open Guest Lecture Series was introduced to interest students in the domain (see 2.1.3.).

- Together with the professional field the programme initiated activities to promote the Geo-sector among students and (potential) employers in order to build a strong 'Geomatics trademark'.
- Each year one of the applicants is offered a scholarship.
- The curriculum has been rigorously redesigned (see 2.1.1.).

Despite the measures taken, the number of students did not reach the required annual intake of 20 (see Appendix 6). The total number of students entering the master's programme even declined from 14 students in 2008 and 2009 to 8 students in 2010 and 2011. During the site visit, the management explained that the intake had risen to 10 students in 2012. The students come from a variety of backgrounds: the application domain, an information and communication technology background, and the geo-data acquisition domain. According to the critical reflection, students should have obtained a bachelor's degree from Delft University of Technology or from other universities of technology or geo-sciences or a bachelor's degree from related polytechnic programmes (particularly from Hogeschool Utrecht).

During the site visit, the committee spoke with the programme's management, a member of the University Board, the Faculty's dean and the Examination Committee about the intake. During these interviews the decision of the University Board was discussed, in which the Board proposes an increase to a yearly intake of 20 students within several years as a condition for continuation of the master's programme in Geomatics. The management expressed its understanding of this firm decision. While it stressed the importance of a long tradition of education and research in the domain, it shared the concerns about the student numbers still lagging behind the target.

The committee is greatly concerned about the number of students entering the master's programme in Geomatics each year. It considers it very unfortunate that the many determined actions taken to improve the intake rates have not resulted in higher student numbers. It recognises the disadvantageous influence of low student numbers on several aspects of the programme (e.g. students' interaction and financial consequences). It understands the decision of the University Board to reach an intake of 20 students by the end of 2014. However, in the eyes of the committee, such a strict deadline might work out discouraging for the teaching staff. Therefore, the committee was pleased to learn that the University Board will give the new programme a fair chance to develop. It will require strong leadership of the programme management to make this happen. Therefore, the committee emphatically recommends that the programme management and teaching staff seize the opportunities to improve student intake provided by the new stimulating environment of the Faculty of Architecture. Based on the interview with the member of the University Board and the dean of the Faculty of Architecture, it is convinced that the Faculty welcomes the Geomatics master's programme and its staff with open arms.

The committee favours the programme's new plans to improve student intake. It was pleased to note that while previously Delft University of Technology did not offer a bachelor's course in Geomatics, as of the 2012-2013 academic year one of the minors in the bachelor's programme in Architecture (*Sensing the City – Delft van Boven*) puts students in touch with the Geomatics domain and concentrates attention on the possibility of continuing on to the master's programme in Geomatics. The committee stresses the task of the study advisor to advertise the master's programme in Geomatics among bachelor students in Architecture. It feels that, combined with ongoing intensive marketing activities, the new bachelor's minor and the separated master's programme Geomatics and the MSc-track Geoscience and

Remote Sensing will stimulate further the intake of bachelor students from other master's programmes and other universities. Moreover, it is positive about the engagement of the University Board expressed during the site visit to allow the Geomatics programme to also actively recruit from the bachelor's programmes in Civil Engineering. It also likes the idea of a 'Geomatics wall' in the faculty's building to promote the domain among students from other disciplines.

In contrast to the quantity of students entering the programme, the committee is positive about their quality. Based on the information in the critical reflection and from the interviews held during the site visit, it found that students enter the programme with sufficient knowledge and skills to complete it successfully. The committee compliments the intake commission on the thorough and sophisticated assessment of applicants, based on the individual bachelor's programme, the level of engineering and Geomatics knowledge, and the student's motivation (also see 2.1.1.). It feels that the intake procedure is well organised, as confirmed by the students interviewed during the site visit.

*Study load and study support*
The committee examined the feasibility of the master's programme in Geomatics by exploring the study load and study support available to students. It confirmed that the master's programme is feasible, based on the information provided and the interviews it conducted with students, lecturers and alumni.

The committee feels that the average number of contact hours is sufficient, though rather low in the second year of the master's programme (see Appendix 6). According to the critical reflection, the average number of scheduled hours adds up to 10 - 12 hours a week in the first year. Due to the large share of independent work in the *Synthesis Project* and the *Graduation Project*, the number of scheduled hours a week are approximately 4. During the site visit, the students were satisfied with the number of contact hours. They explained that the elective application courses usually require more study time, which implies an uneven spread of the study load in the first year. However, the students had no objections to it.

The committee also found that the study support for the students is adequate. The interviewed students and alumni valued the easy access to lecturers and supervisors. They felt that there are sufficient possibilities to receive study support when needed. Nevertheless, the committee found that the students' acquaintance with the study advisors was rather limited. Keeping in mind the extensive choice of electives in the first master year, the committee feels that the study advisors should fulfill an important role in counselling students on composing their individualised study programme. Although the committee is positive about the lunch with all master students the study advisors initiated at the beginning of the programme in order to introduce themselves to the students, it feels that the study advisors could act more proactively and visibly in the course of the programme.

*Completion rates*
The committee realises that the completion rates (included in Appendix 6) give a somewhat distorted image because of the limited student numbers and the previous absence of a strict separation between bachelor's programmes and the master's programme. Nevertheless, it considers the completion rates rather low. The critical reflection notes that the programme is experiencing a relatively high drop-out rate. This was confirmed by lecturers, the Educational Committee and the Examination Committee during the site visit. They explained that drop-outs are mainly due to personal circumstances (for instance, pregnancy or illness of a family member) and primarily occur in the first year. Furthermore, the committee notes that study

delay appears on a regular basis. Based on the overview of study duration provided by the management during the site visit, it feels that the divergence in study duration is substantial. In the 2010-2012 period, 26 master students graduated, of which 14 needed 30 months or more to finalise their study (7 of them took over 40 months before graduating). Based on the interviews with various groups during the site visit, the committee found that these study delays usually originate during the process of writing the master thesis. It advises the programme to monitor students' study duration conscientiously and to take measures to prevent potential study delays. In this respect, it appreciates the recent implementation of a strict monitoring system for the *Graduation Project* (see 3.1.1.). It expects that the introduction of a more structured thesis trajectory with a clear time schedule and series of successive strict deadlines will improve the efficiency of the writing process.

### *2.1.6. Teaching personnel*

*Quantity of teaching personnel*
The committee ascertained that the current staff-student ratio is high, mainly because of the low student numbers. As described in the critical reflection, the core programme, the *Synthesis Project* and the *Graduation Project* are offered by a teaching staff of one full professor (0.4 fte), two associate professors (0.7 fte) and four assistant professors (1.8 fte). For some elements of the programme 0.4 fte of external lecturers are appointed, which brings the total number of academic staff involved in the core programme to 3.3 fte. When taking into consideration the 20 students currently following the master's programme in Geomatics, the staff-student ratio is about 1:6. In addition, during the site visit the committee understood from students that lecturers are easily accessible and approachable. Students were also very positive about the small working groups, which guarantee a lot of personal attention for any problems experienced during their study.

*Quality of teaching personnel*
According to the overview of teaching personnel involved in the master's programme (see Appendix 6), the staff sufficiently reflects the breadth and depth of the Geomatics domain. The critical report states that, in general, master courses are taught by staff members who have gained a PhD degree and do prominent research. The committee confirmed that the teaching staff is on the leading edge of research in the domain. It asks the teaching personnel to communicate more explicitly about the connection between topics and cases discussed during classes and their own current research activities (see 2.1.2).

Moreover, all new lecturers with less than five years of teaching experience are obliged to obtain the Delft University Teaching Qualification within three years after appointment. The Delft University Teaching Qualification programme provides new university teaching staff with the opportunity to develop competencies necessary to carry out their teaching tasks effectively. The various sections of that programme are also open to any lecturers wishing to refresh or develop their didactic skills. In addition, one focus of the annual performance reviews involves professionalisation and coaching. The committee appreciates the attention paid to the didactic development of staff members.

During the site visit the committee spoke to a delegation of Geomatics staff members involved in the original programme, as well as to those involved in the revised programme. It experienced a somewhat dispirited mood among the staff members. The committee can imagine this had to do with the many elaborate changes made in the programme over the past few years and the substantial pressure on increasing student numbers. Nevertheless, it found that the teaching staff is definitely engaged with the courses and research projects.

Additionally, the students expressed their highly positive opinion of the lecturers in the interviews with the committee. They feel that the staff members provide good teaching. In addition, they are satisfied with the informal atmosphere in the programme and the ease of approaching the staff. The committee appeals to the staff members to have an open eye for the great chances the Faculty of Architecture has to offer. It would encourage a strong partnership with their Architecture colleagues in order to strengthen the focus on the built environment in individual courses and in the curriculum as a whole, while at the same time introducing the Geomatics domain into the bachelor's and master's programmes of Architecture.

Based on the self-evaluation report and the interviews conducted during the site visit, the committee ascertained that the staff members have the correct expertise and level. Given the positive student evaluations and the staff members' commitment to their educational and research activities, it is confident about the ability of the staff to make the revised master's programme in Geomatics a success.

### *2.1.7. Quality assurance*

The committee explored the extent to which students and lecturers are involved and heard in the evaluation and improvement of the quality of the teaching. While course and curriculum evaluations were arranged quite informally in the original master's programme, with the implementation of the renewed programme at the Faculty of Architecture, the quality assurance procedures have become more institutionalised. Yet, in both cases, all courses are evaluated at the end. The outcomes of the evaluations are made available to the management, staff members, the Faculty's Educational Committee and students. Evaluation results of new courses as well as disappointing evaluation results are discussed.

The committee is satisfied with the functioning of the quality assurance system. It notes that its design has become more professional with the shift to the Faculty of Architecture. Still, there is some room for improvement with respect to the structural guarding of coherence between the domains of Geomatics and Architecture and the translation of this into the curriculum (see 2.1.1.). During the site visit students stated that they are involved and feel that their opinions are heard in reference to the quality of the teaching. The committee appreciates the students' initiative to meet with the educational director periodically to discuss the content of the revised programme and related issues. It learned that three or four staff meetings were organised by the management last year to design and discuss the revised curriculum together. The committee noticed that the contact with alumni could be intensified and structured better (see 3.1.2.). It also had the opportunity during the site visit to talk to members of the Educational Committee (including one staff member and one student member representing the Geomatics master's programme). It remarked that this group of students and lecturers is adequately involved in the optimalisation of the quality of education.

*Improvements in response to the previous study visit*

The critical reflection describes which changes have been made based on the recommendations of the previous assessment committee. The current committee confirmed that a large number of the recommendations have been implemented, although the results were not always gratifying. It ascertained that actions were taken to increase the intake of master students, to improve the image of the Geomatics domain (for instance, increased marketing activities) and to develop a bachelor-level minor programme in Geomatics (*Sensing the city – Delft van Boven*). The committee compliments the programme on the internal critical reflection performed by the management in 2011. It found that the programme is paying sufficient attention to the measures for improvement suggested during the previous

programme assessment. It is confident that the programme will continue to resolve the remaining issues. This belief is reinforced by the convincing, supportive mentality and precise direction of the faculty and the university. The committee ascertained that the institute properly monitors and checks the quality of the education provided.

### 2.2. Considerations

The committee concludes that the original and revised master's programmes in Geomatics, the personnel and the programme-specific facilities enable master students to acquire the final qualifications.

The committee confirmed that both curricula are sufficiently explicit and adequately meet the intended learning outcomes. It remarks that the transparency and coherence of the curriculum are significantly improved in the revised programme. Nevertheless, the committee expects the programme to incorporate the orientation on the built environment more explicitly and in a more structured way. It is satisfied with the balance between the development of scientific research skills and the preparation for professional practice in the master's programme.

The committee noted that the didactic vision underlying the teaching in the programme is not well elaborated and rather traditional. It expects more contemporary and innovative teaching methods to be applied. The study facilities are first-rate and based on the interviews conducted with students, alumni and lecturers, the committee feels that the study support in the master's programme is satisfactory. It also values the adequate level of internationalisation.

The greatest point of concern is the low annual intake of students, despite the many determined actions taken over time. Like the management, the University Board and the staff members, the committee feels that a greater, sustained intake is vital to the viability of the programme. It emphatically advises the management and teaching staff to take the opportunities to improve student intake provided by the stimulating environment and the support of the Faculty of Architecture. It expects that the increased focus on bachelor students in Architecture continuing on to the master's programme in Geomatics will contribute to a sustained student influx in the Geomatics programme. The committee ascertained that the programme's study load is acceptable. Because of the rather low completion rates, the committee also suggests further exploration of the possibilities to prevent drop-outs and study delays. In this respect, it is positive about the recent implementation of a strict monitoring system while writing the master thesis.

The committee concludes that the teaching staff is dedicated and has the correct expertise and level. During the site visit the students expressed their very positive opinion of the didactic skills and approachableness of the lecturers. The committee is confident about the ability of the Geomatics staff (and their Architecture colleagues) to make the revised master's programme in Geomatics a success.

The committee confirmed that the institute is well aware of the quality of its teaching environment, in which lecturers and students are properly involved and well supervised.

### 2.3. Conclusion

*Master´s programme in Geomatics:* the committee assesses Standard 2 as **satisfactory**.

**Standard 3: Assessment and achieved learning outcomes**
The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

**Explanation:**
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

## 3.1. Findings

In this standard the findings regarding the assessment method in the master's programme are given (3.1.1.), and then the question is addressed of whether students actually realise the targeted final qualifications (3.1.2.).

### *3.1.1. The system of assessment and evaluation*

The committee explored whether the programme has an adequate system of assessment. It examined the assessment policy, the procedures involved with assessment, the forms of assessment and the functioning of the Examination Committee. It confirmed that there is an adequate system in place. The Examination Committee plays an active role by evaluating final papers and learning goals, and making methods and forms of assessment explicit and aligned. In general, the programmes employ a variety of forms of assessment.

*Assessment policy*

The critical reflection states that formal assessment regulations are outlined in the *Course and Examination Regulations*. These regulations cover examinations (frequency, assessment methods and the right to inspect results), exemptions, the degree audit and study progress checks. The document is available online for students and staff members. The examination regulations are further elaborated in several ways. For instance, the *Graduation Manual* explains the official regulations concerning the graduation process to students, mentors and examiners (internal and external). It contains information about the evaluations, the responsibilities of everyone involved, the subjects to be assessed, and an example of a graduation contract. In addition, matrices about the distribution of assessments (methods and frequency) in the programme are constructed jointly by the management and teaching staff. The Faculty has also defined a set of 'golden rules' and strong recommendations to guarantee the quality of written exams. Every examiner is expected to follow the training on assessment and examination provided by the Faculty. During the site visit the committee found that the policy documents are used by the Examination Committee for quality assurance purposes.

The committee studied the existing assessment policy and confirmed that it is comprehensive and adequately addresses all relevant aspects. The policy covers all steps in the assessment process, from the preparation to the organisation of assessments. The committee is particularly impressed by the extensive *Graduation Manual*.

*Examination Committee*

The critical reflection states that from 2006 to 2011 the Examination Committee consisted of three professors involved in the master's programme and some administrative support. During the site visit, the committee learned that in September 2011, the Geomatics Examination Committee was merged with the Examination Committee of the Faculty of Architecture, on which one staff member now represents the master's programme in Geomatics. The 2011-2012 academic year was used to adjust the rules and procedures of examinations to the Faculty's quality requirements.

The Examination Committee monitors the quality of the programme to ensure that the master students achieve the final attainment levels. This includes determining whether students meet the degree requirements of the Academic and Examination Regulations with respect to knowledge, understanding and learning skills. The Examination Committee is also responsible for ensuring the quality, organisation and coordination of examinations. In case of a dispute regarding the results of an examination between a student and lecturer, the Examination Committee can be called in for adjudication.

During the site visit the committee spoke with representatives of the Faculty's Examination Committee about its role in the implementation of the assessment policy and monitoring the quality of assessment. It found that the Examination Committee has taken certain measures to guarantee the quality of assessments. First of all, lecturers utilise evaluation forms and model answers as much as possible. Second, the Examination Committee is continuously involved in the evaluation of the final grades. From 2006 to 2011 it checked whether the list of marks conforms with the predefined requisites; all members read and reassessed the master theses; and one member of the Examination Committee chaired the graduation defence. In 2011-2012 the graduation procedure was harmonised to the standards of the new faculty. One of the changes was that during the graduation session, the Examination Committee is represented by an external examiner (more information on the renewed thesis procedure can be found below, see *Thesis process*). In addition, the Examination Committee initiated training courses about assessment and examinations for the teaching staff, and about peer-reviewing exams.

The committee is truly impressed by the commitment and professional approach of the Examination Committee in ensuring the quality of assessment. It remarked that, while previously certain procedures of quality assurance regarding assessment were quite informal, more formal procedures and more structured inspection of the quality of assessments were introduced during the last year, helping the Examination Committee to perform its tasks more efficiently. The committee is pleased with the hard work that has been done to harmonise the assessment procedures of the master's programme with those of the new faculty. It is positive about the engaged role of the Examination Committee in the well-structured graduation procedure.

*Process concerning assessment*
The critical reflection states that the formal elements of the procedure concerning assessment are described in the *Course and Examination Regulations*. From the documentation available on the reading table and the interviews with lecturers and students conducted during the site visit, the committee noted that the examination dates are published in the study guides and on the timetable (both available on Blackboard). The forms of assessment, assessment procedure, dates and evaluation criteria are also described in the study guides. Lecturers determine how many tests to impose per course; the number depends partly on the learning goals and the design of the course. During the interviews with students, it was evident that they are well aware of the criteria and the procedures concerning assessment. The committee established that students are satisfied with the examination procedures. They specifically liked the clear grading procedure and the examiners' willingness to provide individual feedback on the exams. While a proper system of peer review of examinations and grading is in place within individual courses, the committee suggests paying more attention to monitoring the consistency in grading between courses.

*Forms of assessment*
Based on the description of the curriculum components in the critical reflection, the committee confirmed that the programme utilises several forms of assessment. A wide range is available: written exams (closed-book and essay examinations), take-home assignments, practical work assignments, computer exercises, lab assignments and oral presentations. Written exams are most commonly used. The weighting attached to the different forms of assessment is specified in the course guidebook. The different assessments are spread as evenly as possible throughout each course.

During the site visit and in preparation for it, the committee looked at the different forms of assessment. It confirmed that the assessment seems adequate in terms of level and content. In addition, it feels that the assessments are sufficiently varied, considered and attuned. It encourages the teaching staff to keep using and developing more contemporary assessment methods, alongside the more traditional written examinations. During the site visit students indicated that they were content with the variety of assessment forms and how the programme dealt with assessment. The alumni valued the assessment by oral presentations, since presentation skills are valued in their professional careers.

*Thesis process*
The critical reflection states that all master students are required to complete their study with the *Graduation Project* (45 EC). This is an individual research assignment which integrates all previously acquired knowledge and skills. With the transition of the master's programme to the Faculty of Architecture, the graduation procedure has been revised. The thesis process now consists of six elements (P0 to P5): the graduation form (P0), two obligatory progress reviews (P1 and P3) and the formal assessments (P2, P4 and P5). Four weeks after filling in the graduation form (P0), the first progress review project plan is to be submitted (P1) and two weeks later, the P2 colloquium progress project plan public presentation is to be held. After twelve weeks, the student presents the first research results during the midterm colloquium (P3), and another twelve weeks later, the colloquium progress assessment will be held (P4). It is noted that P2 and P4 have a formal 'go/no go' assessment. The goal of P4 is to assess whether the content of the academic fields and presentations meets the requirements to admit the student to the final stage of the graduation procedure. When receiving a 'go' approval at P4, the public presentation, defence and final assessment take place four weeks later.

As noted before (see *Assessment policy*), the requirements for the master thesis as well as the procedure and criteria for assessment are specified in the *Graduation Manual*, which is available to all master students. Although students are free to choose a research topic, a strong relation to a field of application and to a current research project of one of the staff members is encouraged. The research may be carried out in organisations outside Delft University of Technology. The thesis is assessed by the thesis supervisor and a second supervisor, both using a standard assessment form. The assessment criteria include originality and scientific level, independence and own initiative, lay-out, clarity of expression, logic of the presentation and insight, and the response concerning the content of the thesis during the defence. The student is given a mark for research conducted ($^1/_2$), report ($^1/_6$), presentation ($^1/_6$) and defence ($^1/_6$). The final mark should at least be a 6. The supervisor provides oral feedback to the student about the grading.

The committee is enthusiastic about the master thesis procedure; it is sophisticated and well organised. The interviewed students expressed their appreciation of the clear *Graduation Manual*, as does the committee. The committee agrees with the intention of the Examination

Committee to supplement the thesis assessment form with more elaborate elucidations on the rating of the different assessment criteria.

### *3.1.2. Achievement of the learning outcomes*

The committee assessed the achieved learning outcomes by inspecting a selection of the master theses from the programme (see Appendix 7). It studied 14 theses, together with the associated assessment forms. Consideration in selecting the theses was given to the grading (low, average and high grades).

The committee members read the theses and assessed their presentation of the problem and review of the literature, methods and justification, conclusion and discussion, structure, legibility and verification. The theses with low grades were read by several of the committee members. In general, the committee agreed with the grades awarded by the supervisors for both programme variants. The grading was fair and reflected the differences in the dissertations. The committee was pleased to observe that the final papers were well written (with proper English language usage) and of an acceptable level. In general, the theses and research reports were based on relevant questions which were clearly formulated, contained an adequate conceptual framework and a solid collection and analysis of data, and demonstrated correct application of the research methods.

The committee concludes that the overall quality of the theses is satisfactory, and graduates of the master's programme achieve the required level.

*Alumni*

The committee reviewed the job positions of graduates of the master's programme in Geomatics and whether they were adequately prepared for them. The critical reflection referred to a list of graduates and their present job positions. It revealed that nearly half of the 54 master students who had graduated since 2005 is working in private companies in the Netherlands. A considerable group of alumni is a PhD student at universities in the Netherlands or abroad. Five graduates are still looking for a job, although three of them just recently graduated.

In addition, the committee spoke with alumni during the site visit. They highly valued the training of academic and professional skills in the programme, and more specifically in the application courses and the *Synthesis Project*. The interviewed alumni concurred that the programme stimulated their analytical and critical capacities, enhanced problem-solving and logical reasoning. Although they indicated that the contact with the programme after graduation could be intensified and structured better (the committee agrees with them), the alumni were definitely satisfied with their ultimate career. It is clear that students with a Geomatics master diploma have no problem finding a job. Moreover, the job prospects for Geomatics students remain most likely relatively favourable as recent labour demand surveys indicate. In this respect, the Geomatics programme is important for the Geo Business sector in The Netherlands.

## 3.2. Considerations

The committee concluded that the programme has a satisfactory system of assessment and can demonstrate that the final qualifications are realised. The assessment policy is comprehensive and adequately addresses all relevant aspects. The committee was impressed by the engaged and proficient Examination Committee and ascertained that it exercises sufficient control over the quality of assessments. It is pleased with the hard work that has been done to harmonise the assessment procedures of the master's programme in Geomatics

with those of the Faculty of Architecture. The assessments as a whole are sufficiently varied and sufficiently reflect the contents of the programme and the students' level. The committee compliments the programme on the sophisticated and well-organized master thesis procedure.

The committee concluded that the master students acquire an adequate final level by the end of the programme. This was confirmed by the theses the committee evaluated. It found that the final qualifications of the master's programme were realised. Moreover, it ascertained that graduates of the master's programme in Geomatics are adequately prepared for their careers.

### 3.3. Conclusion

*Master´s programme in Geomatics:* the committee assesses Standard 3 as **satisfactory**.

# APPENDICES

## Appendix 1: Curricula vitae of the members of the assessment committee

**Prof.dr H.F.L. (Henk) Ottens, emeritus professor of Social Geography, University Utrecht.**

Henk Ottens (1945) has a Bachelors degree in Human Geography of Utrecht University, a Masters degree in Planning of the University of Amsterdam and a Doctoral (PhD) degree in Geography of Utrecht University. In 1985 he was appointed as a full professor in Human Geography, in particular Geo-information Processing. On December 1st 2005 he retired from his professorship at Utrecht University.

Executive functions include(d): Dean of the Faculty of Geographical Sciences, Director of the Netherlands Graduate School of Urban and Regional Research, Vice-Chair of the Commission of Geographical Information Science of the International Geographical Union and President of the Royal Dutch Geographical Society and the Association of European Geographical Societies. Henk Ottens has participated in many academic education and research audits in the Netherlands and Belgium.

**Prof.ir. P. (Paul) van der Molen, professor at Faculty of Geo-Information Science and Earth Observation ITC, University of Twente.**

Paul van der Molen (62) obtained a MSc degree in Geodesy at the Delft University of Technology in 1973. He worked for the Netherlands' Cadastre and Mapping Agency in various director-positions until 2010. Since 2000 he holds a chair in Cadastre and Land Administration at the University of Twente (Faculty of Geo-Information Science and Earth Observation, ITC). He served as chair of Commission 7 (Cadastre and Land Management) of the International Federation of Surveyors (2002-2006), Vice President (2007-2008) and is an FIG-honorary member. His work focusses on land law, property rights, registration and cadastre, mainly in developing countries.

**Prof.Dr.Ing. N.J. (Nico) Sneeuw, professor and head of the Institute of Geodesy, University of Stuttgart.**

Nico Sneeuw obtained his first degree in Geodetic Engineering from the Delft University of Technology. He continued with PhD studies in the area of satellite geodesy, particularly spaceborne gravimetry, at the Technological University of Munich, where he obtained his PhD degree in 2000. In 2001 he accepted a post as assistant professor at the Department of Geomatics Engineering of the University of Calgary, Canada. Since 2005 he is full professor at the University of Stuttgart, where he is Head of the Institute of Geodesy. Over the past 5 years he has been involved in study programme design and accreditation as Associate Dean (Academic).

**Drs. W.C.A. (Wim) de Haas, senior advisor information management, Staff Directorate General Rijkswaterstaat.**

Wim de Haas was trained as a geologist at Utrecht University, where he obtained his MSc in 1992. After working for a year as a research assistant at the Netherlands Institute for Ecology in Yerseke Wim started working in the IT industry as a consultant in the field of business intelligence at both CMG and SAS Institute. In 2001 he continued his career at Rijkswaterstaat in Delft, where he worked in the field of geo-ICT and became responsable for the development of the Geoservices framework. Mr. De Haas is presently senior advisor information management at the staff of the Directorate General Rijkswaterstaat in The Hague.

**A.R. (Anne-Ruth) Sneep BSc, student of the master's programme Geo-information Science, Wageningen University.**

Anne-Ruth Sneep is student in the second year of the Master's programme Geo-Information Science at Wageningen University. As a student member of the Programme Committee she was involved with the improvement of the quality of the programme. She also participated in meetings with the External Advisory Committee. During the visitation of the master's Geo-Information Science she took part in the Management team. Currently she is performing an internship concerning digital hyperspectral imagery for environmental modelling at the 'Institut de Recherche pour le Développement' in Montpellier, France.

## Appendix 2: Programme of the site visit

### Site visit Delft University of Technology

**29 October 2012**

| | | |
|---|---|---|
| 13.30 | 14.30 | First meeting with management |
| 14.30 | 15.30 | Students |
| *15.30* | *16.00* | *Break* |
| 16.00 | 17.00 | Member Board of the University and dean |
| 17.00 | 17.45 | Lecturers |
| 17.45 | 18.15 | Alumni |

**30 October 2012**

| | | |
|---|---|---|
| 9.00 | 9.30 | Educational Committee |
| 9.30 | 10.15 | Examination Committee and study advisor |
| 10.15 | 11.00 | Preparation second meeting with management |
| 11.00 | 12.00 | Second meeting with management |
| *12.00* | *12.30* | *Lunch* |
| 12.30 | 14.30 | Internal meeting committee |
| 14.30 | 14.45 | Presentation of initial findings |
| 14.45 | 15.30 | Reception |

### Delegations

*First meeting with management*

| | |
|---|---|
| Ir. Theo P.J. van Drunen | Head of Education & Student affairs Architecture |
| Ir. Christian H.E. van Ees | Educational director Architecture |
| Prof. dr. ir. Peter J.M. van Oosterom | Professor & head of department GIS-technology |
| Ir. Edward Verbree | Educational director Geomatics |

*Students*

| | |
|---|---|
| Marija Krūminaitė | 1st year |
| Eva B. van der Laan | 1st year |
| Weilin Xu | 1st year |
| Danbi Lee | 2nd year |
| Vera Liem | 2nd year |
| Ravi Y. Peters | 2nd year |

*Member Board of the University and dean*

| | |
|---|---|
| **Prof. ir. Karin Laglas** | **Dean Architecture** |
| Drs. Paul M.M. Rullmann | Vice-President for Education & Operations |

*Lecturers*

| | |
|---|---|
| Prof.dr.ir. Nick C. van de Giesen (professor) | CiTG - Watermanagement |
| Dr. ir. Bastiaan van Loenen (UD) | OTB – Geo-informatie & Grondbeleid |
| Dr. ir. Ben G.H.Gorte (UD) | CiTG – Geosciences & Remote Sensing – Optical & Laser Remote Sensing |
| Prof. dr. Massimo Menenti (professor) | CiTG – GeoSciences & Remote Sensing – Optical & Laser Remote Sensing |
| Drs. C.W. (Wilko) Quak (researcher) | OTB – GIS-technology |
| Dr. Jantien E. Stoter (UHD) | OTB – GIS-technology |
| Dr. ir. A.A. (Sandra) Verhagen (UD) | CiTG – Geosciences & Remote Sensing – Mathematische Geodesie & Plaatsbepaling |

*Alumni*

| | |
|---|---|
| (G.A.K.) Ken Arroyo Ohori, MSc (GIS-technology) | PhD OTB – GIS-technology |
| E. (Sonia) Boufidou , MSc (Water Management) | Shell |
| Tom J.F. Commandeur, MSc (GIS-technology) | Hydrolic Research |
| Bas van Goor, MSc (Mathematical Geodesy & Positioning) | Grontmij |
| Melina S. de Koning, MSc (GIS-technology) | Gemeente Waddinxveen |
| Hang Yu, MSc (Optical & Laser Remote Sensing) | Neo |

*Educational Committee*

| | |
|---|---|
| Jelte G. van Oostveen (student) | Member on behalf of Geomatics |
| Prof.dr. Peter J. Boelhouwer | Chair |
| Ir. Frank W.A. Koopman | Member |
| Ir. Hilde T. Remoy | Member |
| Benjo C. Zwarteveen | Student-chair |

*Examination Committee and study advisor*

| | |
|---|---|
| Ir. Leo P.J. van den Burg | Member |
| Ir. Ype J. Cuperus | Member |
| Mr. Fred A.M. Hobma | Vice-president |
| Dr. ir. Mathias J.P.M. Lemmens (UD) GIS-technology | Member on behalf of Geomatics |
| Ing. H.A.J. (Erik) Ootes | Secretary |
| Ir. Susanne Pietsch | Member |
| P.E. (Ellen) Sakkers | Study advisor |

*Second meeting with management*

| **Ir. Theo P.J. van Drunen** | **Head of Education & Student affairs Architecture** |
|---|---|
| Ir. Christian H.E. van Ees | Educational director Architecture |
| Prof. dr. ir. Peter J.M. van Oosterom | Professor & head of department GIS-technology |
| Ir. Edward Verbree | Educational director Geomatics |
| Prof. ir. Karin Laglas | Dean Architecture |

## Appendix 3: Domain-specific framework of reference

*Introduction*
The learning objectives, or even the mission, of the MSc Geomatics programme are defined as:

- emphasising the role of geo-information in decision-making applied to the built environment.
- an information system's approach to store, process, manage, disseminate and visualise geodata and geo-information, acting at the forefront of data analysis methodology and spatio-temporal database management systems technology, and also paying attention to legal and organisational aspects of geo-information.
- a technology and application driven approach to geo-data acquisition and geo-information extraction.

The revised curriculum of the MSc Geomatics is strongly connected to the Geo-information Technology & Governance programme of the OTB Research Institute for the Built Environment which will become part of the Faculty of Architecture. Therefore, this domain-specific reference framework will link the core courses of the revised MSc Geomatics to core elements of the research programme.

The core courses of the revised MSc Geomatics are:

- GEO1001 Sensing Technologies for the Built Environment
- GEO1002 Geographical Information Systems (GIS) and Cartography
- GEO1003 Positioning and Location Awareness
- GEO1004 3D Modelling of the Built Environment
- GEO1005 Spatial Decision Support for Planning and Crisis Management
- GEO1006 Geo Database Management Systems
- GEO1007 Geo Web, Sensor Networks and 3D-GeoVisualisation Technology
- GEO1008 Geo Datasets and Quality
- GEO1009 Geo-information Organisation and Legislation

*MSc Geomatics for the built environment: research driven*
Research has always played a prominent role in the MSc Geomatics. The same holds also for the revised MSc Geomatics for the built environment. Based on the research programmes of the GIS Technology Section and the GiLD Section (part Geo-information) an overview is given to clarify this relationship.

*Spatial Information Infrastructure (GEO1007)*
The Spatial Information Infrastructure (SII) serves the same purpose as the nerve system for human beings. The nerve system is crucial for the functioning of humans and covers the information flows from sensory receptors (seeing, hearing) via processing, analysis and planning (storing information, thinking) and communication (in speech and writing) to control of actions (walking or moving in other ways, building). SII forms the nerve system of the human environment, both man-made and natural. Our society has realised this and after many isolated initiatives is now heading towards a sustainable SII, in which spatial information or geo-information can be shared and re-used.
SII is an evolving concept and much work remains to be done, both in science and practice, before it can be operational in an effective and efficient manner. Important organisational

steps are currently being taken; e.g. the EU Directive INSPIRE and the EU GMES (Global Monitoring for Environment and Security) Initiative. Several areas of EU FP7 (the European Commission's Seventh Framework Programme) and other programmes support research and development through various projects covering such topics as agreed (formal, machine-processable) definitions of key data sets, definitions of a range of key services (catalogues; viewing systems; data; processing services such as coordinate transformations and buffers), and future geo-information handling systems (vario-scale spatio-temporal 3D/4D models and processes). SIIs are developed within global initiatives (the Global Spatial Data Infrastructure GSDI), national initiatives such as the stelsel authentieke basisregistraties ('authentic basic registration system') in the Netherlands, or by single organisations such as Rijkswaterstaat (the Directorate-General for Public Works and Water Management) in the Netherlands and the multinational company Shell.

*Geo-information Technology (most courses)*
GIS technology, or Geo-information Technology (geo-ICT), is a part of the more general discipline of geo-information science. Geo-information has been applied throughout the world for many centuries or even millennia, so why bother doing scientific research and education within the MSc Geomatics in this area? The answer is that the unprecedented increase in the volume of geo-information means that we need to find improved ways of handling it. The overall goal is to provide and/or develop the technology, including the knowledge behind it, needed for the realisation of a SII. The impact and potential of geo-information are growing, because the information and the services needed to deal with it can be readily transported by electronic means via (wireless) networks and geo-information is more and more combined with emerging sensor, visualisation and interaction technologies. SII nodes throughout the world are increasingly using underlying geo-DBMSs (geo-DataBase Management Systems) to store the geo-information involved. Many applications make use of geo-information and related technologies. The MSc Geomatics devotes particular attention to developing and/or providing geo-information technology and knowledge for use in crisis management and spatial information infrastructures.

*Crisis Management and Spatial Planning (GEO1005)*
Crisis (or disaster) management is a very demanding application, where data is coming from various heterogeneous sources, where users come from diverse backgrounds (and are often unfamiliar with geo-information), the tasks have to be completed in unusual situations (under pressure and stress), and the amounts of information to be processed are enormous. Both existing geo-information and new geo-information (obtained from a wide variety of sensors during and after the disaster) are indispensable in crisis management. All aspects of geo-information handling are challenging. These include real-time data integration from heterogeneous sources (via a reliable SII), integration of 3D indoor and outdoor models, interaction with advanced wireless communication and positioning technologies, performance of real-time 2D/3D spatial analyses and simulations (e.g. for the purposes of evacuation or navigation), 2D/3D geo-visualisation, and use of formal semantics to maximise machine 'understanding' of the context of a task or user (by searching for, combining, aggregating and transforming geo-information).
The pressure on the available space in our physical environment will continue to increase. Managing the scarce resources – land, real estate, roads, railways, waterways and utilities – in an efficient manner requires a huge amount of spatial information (historic, up-to-date and future), together with appropriate processing and dissemination methods. The traditional two-dimensional thinking that has been used for a long time in maintenance, planning and development work is or soon will be no longer fit for purpose. Three-dimensional solutions, taking the space below and above the surface of the earth into consideration, and even four-

dimensional approaches (which also take account of the time dimension) are therefore becoming increasingly applied.

*3D spatio-temporal information management (GEO1004)*
Tunnels, underground constructions, stacked constructions (e.g. buildings above a road or railway) are becoming more common. These systems will require proper support from 3D spatio-temporal information management. There are multiple sources of geo-information in use and multiple users of geo-information, ranging from non-experts to professional users.
The best way of ensuring that geo-services make efficient and effective use of geo-information is to create geo-information 'communities' that share the appropriate information in an efficient manner. This requires a good SII, which in its turn demands effective use of key register geo-information data, geo-information services (functions, analysis), networks and geo-information protocols and standards.

*Sensor network technology (part of GEO1007)*
As far as geo-information data collection is concerned, advances in sensor and sensor network technology have led to significant increases in data resolution and acquisition frequency. While this yields excellent opportunities for improving the quality of geo-information and increasing update rates, it also presents tremendous challenges in terms of processing the huge amounts of data involved. Moreover, these data have to be integrated and analyzed together with existing information. Due to the data volume (and the time pressure e.g. in crisis management), data interpretation by human means is no longer fully feasible and data need to be interpreted automatically. To realise this, hitherto unsolved research problems in the fields of knowledge engineering and formal semantics must be addressed.
In order to take full advantage of the rich sources of geo-information, it is necessary to archive data products and make them widely available. This demands the development of appropriate services, protocols and standards for national and international SIIs. Many challenges can be identified here; for example, how is data to be collected in real time from the expanding global networks of sensors, many in remote locations? How often we need to update and/or archive sensor data? How do sensor and communication networks need to be configured for robust and failsafe operation (e.g. by building in alternative routes, ensuring adequate performance etc.)? Which models are most appropriate for specific geo-information? How can we ensure prompt delivery of data to users with time-critical needs, while maintaining quality control and accessibility for lower-priority users? How should we prepare geo-information for different display devices? How can heterogeneous data flows be processed quickly enough to prevent data volumes from overwhelming managers and users? How can data be recorded in such a way as to enhance search capabilities?

*Access to geo-information (GEO1009)*
Access to geo-information is important for the well-being of society. Technological advances allow improved access to a wide variety of geo-information and the use of sophisticated new access methods. New technology also enables new methods of collecting, processing and using geo-information, resulting in more efficient and less expensive data collection and improved data sharing. It has further stimulated the collection and processing of geo-information by non-professionals without specific geo-information technology expertise. These technological advances represent a challenge to existing institutional principles concerning access to geo-information, and will continue to do so in the future.
Investigates the accessibility of geo-information from an institutional perspective with special reference is performed to three user segments:

- the geo-market, and in particular the position of (private sector) value-added resellers here;
- geo-information within the context of e-government (e.g. European INSPIRE, Dutch base registers and sector arrangements);
- the general public (citizen), both as (end-)user and increasingly as data provider.

Vast amounts of geo-data have been and are constantly collected and processed in response to specific user needs. Nevertheless, much geo-data can be used for other objectives as well, with little or no need to re-collect or re-process it. Since the sharing of geo-data is considered to be in the general interests of society as a whole, from an environmental, social and economic perspective, there is an overall drive to increase the sharing by improving access, removing technical, legal and financial barriers and devising appropriate organisational structures without forgetting the possible consequences for the freedom and privacy of the individual.

*Focus*
The focus of the MSc Geomatics is to underpin the establishment of SII by laying secure technological foundations for it, based on developments in the field of geo-ICT. Since the technology platforms can be numerous, the MSc Geomatics concentrates on the geo-DBMS (database management system) as a core enabling technology for which models, services, protocols and standards need to be developed. The main areas related to this core technology are 3D spatio-temporal modelling, computational geometry (spatial data structures and algorithms), distributed GI processing (network protocols / interoperability / web services / cloud computing), mobile GIS (location- based services, LBS), and knowledge engineering (with special reference to ontology and semantics).

*MSc Geomatics - core research theme: geo-DBMS (GEO1006)*
Fundamental arise on the use of spatial data types, operators, functions, clustering and indexing in Database Management Systems. The geo-DBMS is becoming increasingly important in the transition to the SII, because not only one organisation but the entire geo-information community depends on it. The research topics within this theme are topology structure management within the DBMS, the handling of 3D, temporal and dynamic objects within the DBMS, large point cloud data sets, comparative functional and performance benchmarks and XML (eXtensible Markup Language) support at the DBMS level.

*MSc Geomatics – Refined research themes, all linked to geo_DBMS*

*3D spatio-temporal modelling (GEO1004)*
This research topic focuses on the challenges related to (static and dynamic) data modelling in various systems (such as geo-DBMS, GIS and CAD) and the investigation of new representation and modelling concepts. Research on 3D spatial modelling and 2D spatio-temporal modelling is ongoing, and some preliminary research on 3D spatio-temporal modelling has been started. Furthermore, various aspects of data integration and data harmonisation are undergoing extensive investigation.

Computational geometry (spatial data structures/algorithms) (part of GEO1002)
Linking GIS to computational geometry, spatio-temporal modelling and simulation models permits simpler, faster, more powerful and flexible use. An important related theme is generalisation. The temporal component plays an important role in these models, leading to the development of dynamic geographic information systems.

*Distributed GI processing (network protocols, interoperability and web services) (part of GEO1007)*
This theme emphasises research in the field of distributed GISs, data transfer between various systems, interoperability, geo-information standards, spatial models and query languages. Geo-information processing will need to be subjected to geodetic quality control in the phases following data capture, such as data modelling, analysis and visualisation. Such aspects as components and storage of quality, meta data and error propagation also have to be taken into account.

*Mobile GIS (LBS) (GEO1003)*
Mobile GIS or Location Based Services involve the integration of at least three types of technologies: positioning (GPS, Galileo), wireless communication (GSM, GPRS, UMTS) and GIS (geo-DBMS, geocoding, routing, user interface, small-display cartography). Due to the dynamic and mobile aspects, this type of environment brings obvious potential benefits to a number of applications (navigation/travel support, localised news services, traffic and fleet management, field observations and data collection, etc.), but also has its own research challenges (in particular the architecture and design of these systems).

Knowledge engineering (ontology and semantics) (GEO1006, GEO1007 & GEO1008)
Agreeing on the syntax and formats of spatial data and the development of systems to be used for handling such data is the first step towards interoperability. But getting the syntax and format right does not yet mean that we understand one another's information; the essential next step is to reach agreement on the domain (or thematic) models to be used. Study of the semantic aspect of information is not only important to help human beings to understand each other, but is also essential if we want machines to process this information in useful ways. To this end, the semantics will have to be formalised with the aid of semantic webs, ontologies, etc. OWL (Ontology Web Language) is a useful new tool in this field.

*Supporting research themes and technologies:*

- Spatial data capture (GEO1001);
- Positioning and geo-information (GEO1003);
- Geo-visualisation (GEO1006).

*Conclusions*
The curriculum of the revised MSc Geomatics is based on a profound research agenda. Students will be stimulated by the research frontiers.

# Appendix 4: Intended learning outcomes

## Learning objectives (based on Dublin descriptors)

The MSc Geomatics programme generic learning objectives are set by the system of learning outcomes jointly defined by the three Universities of Technology in the Netherlands (Delft, Eindhoven and Twente). This 3TU system of end qualifications[1] is based on the Dublin Descriptors.

During the assessment period 2006-2011 the specific goals of the Geomatics MSc programme and its application domain were not changed (for the revised MSc Geomatics for the built environment the necessary adjustments will be made), thus a graduate of the MSc in Geomatics, following the 3TU system:

*is competent in one or more scientific disciplines*
A Geomatics graduate is familiar with existing scientific knowledge and has the competence to increase and develop this through study:

- in-depth knowledge and understanding of systems and methodologies for the measurement of positions, shapes and sizes of physical phenomena, structures and objects, natural and man-made, on, below or above the earth's surface, as well as for the signalling and recording of changes over time, including the ability to design, implement and use systems and methodologies to analyse such measurements for the purpose of geo-information extraction;
- in-depth knowledge and understanding of systems and methodologies for handling spatial information, including the ability to design, implement and use systems for management, storage, processing, integration, exchange and dissemination of geo-information;
- the ability to select, combine and extend the above-mentioned systems and methodologies to meet geo-information requirements, notably in civil engineering and geoscience applications, in the present and in the future;
- context knowledge needed for the three main points above:
  - basic understanding of methodologies to measure the shape and the gravity field of the earth, and their meaning for reference coordinate systems used for geo-information;
  - basic understanding of the non-technological aspects of handling geo-information, such as the legal aspects of real estate property, utilities and registration systems, including legal implications and consequences of large civil engineering projects.

*is competent in doing research*
A Geomatics graduate has the competence to acquire new scientific knowledge through independent research. For this purpose, research shall mean: the development of new knowledge and new insights in a purposeful and methodical way. Geomatics research requires, in addition to in-depth knowledge and understanding of the state of the above-mentioned disciplines, the competence to create feasible models of complex situations; to formulate hypotheses and research questions; to make judgments about similarities and differences concerning geo-information demand and supply between different applications and scenarios.

[1] A.W.M. Meijers et al, "Criteria for Academische Bachelor en Master Curricula", 2005.

*is competent in designing*
As well as carrying out research, many Geomatics graduates will also design. Designing is a synthetic activity aimed at the realisation of new or modified artefacts or systems with the intention of creating value in accordance with predefined requirements and desires. Geomatics graduates are able to independently perform the following design tasks in complex, large-scale applications:

- design, implement and use systems and methodologies to analyse above-mentioned measurements for the purpose of geo-information extraction;
- design, implement and use systems for management, storage, processing, integration, exchange and dissemination of geo-information;
- select, combine and extend above-mentioned systems and methodologies to meet geo-information requirements, notably in civil engineering applications, in the present and in the future.

*has a scientific approach*
A Geomatics graduate has a systematic approach characterised by the development and use of theories, models and coherent interpretations, has a critical attitude, and has insight into the nature of science and technology.

*possesses basic intellectual skills*
A Geomatics graduate is competent in reasoning, reflecting, and forming a judgment. These are skills that are learned or sharpened in the context of a discipline, and are generically applicable from then on.

*is competent in cooperating and communicating (with others)*
A Geomatics graduate is able to work with and for others in multidisciplinary projects. This requires not only adequate interaction, a sense of responsibility, and leadership, but also good communication with colleagues and non-colleagues. He or she is also able to participate in a scientific or public debate.

*takes account of the temporal and the social context*
Science and technology are not isolated, and always have a temporal and social context. Beliefs and methods have their origins; decisions have social consequences in time. A Geomatics graduate is aware of this, and has the competence to integrate these insights into his or her scientific work.

The generic learning objectives of the MSc Geomatics has to be reached by a student by its graduation; it is the sum of the different learning objectives for the common core courses, the application domain courses, the electives, the synthesis project, and the graduation thesis.

# Appendix 5: Overview of the curricula

## Curriculum (original) master's programme Geomatics 2011-2012

*Programme overview MSc Geomatics Common Core*

**10-Jul-2012 15:33**

| | |
|---|---|
| **Year** | **2011/2012** |
| **Organization** | **Bouwkunde** |
| **Education** | **Master Geomatics** |

| Code | Omschrijving | ECTS | p1 \| p2 \| p3 \| p4 \| p5 |
|---|---|---|---|
| **GM Common Core** | | | |
| CIE4521 | Multivariate Data Analysis | 4 | |
| CIE4522 | Satellite Navigation | 4 | |
| GE4662 | Organisational and Legal Aspects of Geo-Information | 4 | |
| GM1050-11 | GIS Principles and Applications | 4 | |
| GM1080 | Geo Database Management Systems | 3 | |
| GM1090-11 | Introduction Geomatics | 2 | |
| GM1210 | Location Based Services | 4 | |
| GM1240 | Imaging Remote Sensing | 4 | |

*Programme overview MSc Geomatics 2nd year*

**10-Jul-2012 15:40**

| | |
|---|---|
| **Year** | **2011/2012** |
| **Organization** | **Bouwkunde** |
| **Education** | **Master Geomatics** |

| Code | Omschrijving | ECTS | p1 \| p2 \| p3 \| p4 \| p5 |
|---|---|---|---|
| **MSc Geomatics 2nd year** | | | |
| GM2000-45 | Thesis | 45 | |
| GM2100-11 | Synthesis Project | 11 | |
| **MSc GM 2nd year - Electives 4 EC, from Application Courses list and/or Elective list** | | | |

*Programme overview MSc Geomatics Convergence Courses*

**10-Jul-2012 15:36**

| | |
|---|---|
| **Year** | **2011/2012** |
| **Organization** | **Bouwkunde** |
| **Education** | **Master Geomatics** |

| Code | Omschrijving | ECTS | p1 \| p2 \| p3 \| p4 \| p5 |
|---|---|---|---|
| **GM Convergence Courses** | | | |
| AES1011 | Matlab / Programming | 2 | |
| GM1010 | Reference and Coordinate Systems | 4 | |
| GM1030 | Adjustment Theory | 3 | |
| GM1041 | Introduction to GIS | 2 | |
| IN4186TU | Datastructures, Algorithms and Databases | 6 | |

*Programme overview MSc Geomatics Application Courses*

**10-Jul-2012 15:36**

| | |
|---|---|
| **Year** | **2011/2012** |
| **Organization** | **Bouwkunde** |
| **Education** | **Master Geomatics** |

| Code | Omschrijving | ECTS | p1 \| p2 \| p3 \| p4 \| p5 |
|---|---|---|---|
| **GM Application Courses** | | | |
| CIE4305 | Coastal Dynamics I | 6 | |
| CIE4364 | Introduction to Geotechnical Engineering | 4 | |
| CIE4450 | Integrated Water Management | 4 | |
| CIE4523 | Scientific Applications of GPS | 4 | |
| CIE4801 | Transportation and Spatial Modelling | 6 | |
| CIE5401 | Spatial Tools in Water Resources Management | 3 | |
| CIE5750 | Spatial Planning for the Metropolis | 4 | |
| GE4732 | Spatial Information in Utilities | 4 | |
| GM1110 | Geo-Information Technology for Crisis Management | 4 | |

*Programme overview MSc Geomatics Electives*

**10-Jul-2012 15:37**

| | |
|---|---|
| **Year** | **2011/2012** |
| **Organization** | **Bouwkunde** |
| **Education** | **Master Geomatics** |

| Code | Omschrijving | ECTS | p1 \| p2 \| p3 \| p4 \| p5 |
|---|---|---|---|
| **GM Electives** | | | |
| *AES1650-07 D1* | *Part 1 Shallow depth geophysics- theory* | *4* | |
| CIE4330 | Ports and Waterways 1 | 4 | |
| CIE4431 | Hydrological Modelling | 4 | |
| CIE4520 | Microwave Remote Sensing | 4 | |
| CIE4821-09 | Traffic Flow Theory and Simulation | 6 | |
| GE4612 | Geoinformation Infrastructure Technology | 4 | |
| GE4622 | Quality of Geoinformation | 4 | |
| GM1020 | 3-D Geo-Information Systems | 5 | |
| GM1100 | Research Orientation | 4 | |
| GM1200 | Digital Terrain Modelling | 4 | |
| GM1220 | Acoustic Remote Sensing and Seafloor Mapping | 4 | |
| GM1230 | Photogrammetry | 4 | |
| IN4010 | Artificial Intelligence Techniques | 6 | |
| IN4086 | Data Visualization | 6 | |
| IN4324 | Web & Semantic Web Engineering | 5 | |
| SPM9235 | Game Design Project | 4 | |

## Curriculum (revised) master's programme Geomatics for the built environment 2012-2013

*Programme overview MSc Geomatics for the built envirobnment Common Core Courses*

**10-Jul-2012 15:42**

| | |
|---|---|
| **Year** | **2012/2013** |
| **Organization** | **Bouwkunde** |
| **Education** | **Master Geomatics** |

| Code | Omschrijving | ECTS | p1 \| p2 \| p3 \| p4 \| p5 |
|---|---|---|---|
| **GM Common Core Courses** | | | |
| GEO1001 | Sensing Technologies for the Built Environment | 5 | |
| GEO1002 | Geographical Information Systems (GIS) and Cartography | 5 | |
| GEO1003 | Positioning and Location Awareness | 5 | |
| GEO1004 | 3D Modelling of the Built Environment | 5 | |
| GEO1005 | Spatial Decision Support for Planning and Crisis Management | 5 | |
| GEO1006 | Geo Database Management Systems | 5 | |
| GEO1007 | Geo Web, Sensor Networks and 3D-GeoVisualisation Technology | 5 | |
| GEO1008 | Geo Datasets and Quality | 5 | |
| GEO1009 | Geo-information Organisation and Legislation | 5 | |

*Programme overview MSc Geomatics for the built environment 2nd year*

**10-Jul-2012 15:43**

| | |
|---|---|
| **Year** | **2012/2013** |
| **Organization** | **Bouwkunde** |
| **Education** | **Master Geomatics** |

| Code | Omschrijving | ECTS | p1 \| p2 \| p3 \| p4 \| p5 |
|---|---|---|---|
| **GM Common Core Courses** | | | |
| GEO2000 | Thesis | 45 | |
| GEO2001 | Synthesis Project | 10 | |

# Appendix 6: Quantitative data regarding the programme

## Intake, study duration and achievement rates master's programme Geomatics

The various tables in this appendix contain the official figures from the VSNU for the MSc Geodetic Engineering (66954). As the TU Delft is the only university in the Netherlands offering this programme the figures for the Netherlands are equal to the figures for the TU Delft. Note that there are other geo-information related MSc programmes in the Netherlands, but these are not included in the tables. The column 'Buiten HO' effectively means the intake of non-Dutch students. One last remark related to the high number of students that 'started' in 02/03 (the first year of the MSc Geodetic Engineering programme): these are all the students from the predecessor, Geodetic Engineering. In reality the actual fresh intake was also about 10 new students per year in these proceeding years.

*Intake rates*

**Tabel M4.1 Instroom master**
**M Geodetic engineering (66954)**

| | | Totaal | | | Voltijd | | | Deeltijd/duaal | |
|---|---|---|---|---|---|---|---|---|---|
| | Cohort | Totaal | Mannen | Vrouwen | Totaal | Mannen | Vrouwen | Totaal | Mannen | Vrouwen |
| | **Totaal Universiteiten** | | | | | | | | | |
| | 02/ 03 | 31 | 21 | 10 | 31 | 21 | 10 | 0 | 0 | 0 |
| | 03/ 04 | 18 | 12 | 6 | 18 | 12 | 6 | 0 | 0 | 0 |
| | 04/ 05 | 6 | 6 | 0 | 6 | 6 | 0 | 0 | 0 | 0 |
| | 05/ 06 | 10 | 7 | 3 | 10 | 7 | 3 | 0 | 0 | 0 |
| | 06/ 07 | 15 | 12 | 3 | 15 | 12 | 3 | 0 | 0 | 0 |
| | 07/ 08 | 13 | 9 | 4 | 13 | 9 | 4 | 0 | 0 | 0 |
| | 08/ 09 | 15 | 12 | 3 | 15 | 12 | 3 | 0 | 0 | 0 |
| | 09/ 10 | 14 | 9 | 5 | 14 | 9 | 5 | 0 | 0 | 0 |
| | **Per Universiteit** | | | | | | | | | |
| TUD | 02/ 03 | 31 | 21 | 10 | 31 | 21 | 10 | 0 | 0 | 0 |
| | 03/ 04 | 18 | 12 | 6 | 18 | 12 | 6 | 0 | 0 | 0 |
| | 04/ 05 | 6 | 6 | 0 | 6 | 6 | 0 | 0 | 0 | 0 |
| | 05/ 06 | 10 | 7 | 3 | 10 | 7 | 3 | 0 | 0 | 0 |
| | 06/ 07 | 15 | 12 | 3 | 15 | 12 | 3 | 0 | 0 | 0 |
| | 07/ 08 | 13 | 9 | 4 | 13 | 9 | 4 | 0 | 0 | 0 |
| | 08/ 09 | 15 | 12 | 3 | 15 | 12 | 3 | 0 | 0 | 0 |
| | 09/ 10 | 14 | 9 | 5 | 14 | 9 | 5 | 0 | 0 | 0 |

**Tabel M1.1 Cohortomvang en onderwijs-herkomst masterinstroom**
**M Geodetic engineering (66954)**
(voltijdse instroom)

| | Cohortomvang en onderwijs-herkomst masterinstroom | | | | |
|---|---|---|---|---|---|
| | Jaar | Eigen universiteit | Andere universiteiten NL | HBO | Buiten HO | Totaal |
| | **Totaal Universiteiten** | | | | | |
| | 02/ 03 | 30 | 1 | 0 | 0 | 31 |
| | 03/ 04 | 14 | 0 | 0 | 4 | 18 |
| | 04/ 05 | 3 | 0 | 1 | 2 | 6 |
| | 05/ 06 | 7 | 0 | 2 | 1 | 10 |
| | 06/ 07 | 7 | 1 | 1 | 6 | 15 |
| | 07/ 08 | 4 | 1 | 3 | 5 | 13 |
| | 08/ 09 | 7 | 0 | 2 | 6 | 15 |
| | 09/ 10 | 5 | 0 | 4 | 5 | 14 |
| | **Per Universiteit** | | | | | |
| TUD | 02/ 03 | 30 | 1 | 0 | 0 | 31 |
| | 03/ 04 | 14 | 0 | 0 | 4 | 18 |
| | 04/ 05 | 3 | 0 | 1 | 2 | 6 |
| | 05/ 06 | 7 | 0 | 2 | 1 | 10 |
| | 06/ 07 | 7 | 1 | 1 | 6 | 15 |
| | 07/ 08 | 4 | 1 | 3 | 5 | 13 |
| | 08/ 09 | 7 | 0 | 2 | 6 | 15 |
| | 09/ 10 | 5 | 0 | 4 | 5 | 14 |

**Tabel M2.1 Voortgang mastercohort naar onderwijs-herkomst**
**M Geodetic engineering (66954)**
(voltijdse instroom)

| | Instroom uit eigen instelling (=100%) | | Instroom andere WO instelling (=100%) | | Instroom vanuit HBO (=100%) | | Instroom van buiten het HO (=100 %) | |
|---|---|---|---|---|---|---|---|---|
| | Cohort | Diploma | Ingeschr. | Diploma | Ingeschr. | Diploma | Ingeschr. | Diploma | Ingeschr. |
| | | Percentages | | | | | | | |
| | **Totaal Universiteiten** | | | | | | | | |
| | 02/ 03 | 90 | | | | | | | |
| | 03/ 04 | 100 | | | | | | 75 | |
| | 04/ 05 | 100 | | | | 100 | | 50 | |
| | 05/ 06 | 86 | | | | 100 | | 100 | |
| | 06/ 07 | 71 | 29 | 100 | | | | 50 | 17 |
| | 07/ 08 | 50 | 50 | | 100 | | | 60 | |
| | **Per Universiteit** | | | | | | | | |
| TUD | 02/ 03 | 90 | | | | | | | |
| | 03/ 04 | 100 | | | | | | 75 | |
| | 04/ 05 | 100 | | | | 100 | | 50 | |
| | 05/ 06 | 86 | | | | 100 | | 100 | |
| | 06/ 07 | 71 | 29 | 100 | | | | 50 | 17 |
| | 07/ 08 | 50 | 50 | | 100 | | | 60 | |
| | 08/ 09 | 57 | 43 | | | | | 33 | 67 |

*Study duration*

**Tabel M3.1 Studieduur masteropleiding naar onderwijs-herkomst**
**M Geodetic engineering (66954)**
(voltijdse instroom)

| | | Eigen universiteit | | Andere universiteit NL | | HBO | | Buiten HO | |
|---|---|---|---|---|---|---|---|---|---|
| | afstudeer cohort | Geslaagd absoluut | Duur opl. gemiddeld | Geslaagd absoluut | Duur opl. gemiddeld | Geslaagd absoluut | Duur opl. gemiddeld | Geslaagd absoluut | Duur opl. gemiddeld |
| | | | in maanden | | in maanden | | in maanden | | in maanden |
| | **Totaal Universiteiten** | | | | | | | | |
| | 02/ 03 | 15 | 6 | | | | | | |
| | 03/ 04 | 11 | 13 | | | | | | |
| | 04/ 05 | 14 | 20 | | | | | 2 | 22 |
| | 05/ 06 | 8 | 21 | | | | | 1 | 28 |
| | 06/ 07 | 5 | 11 | | | 1 | 26 | 1 | 27 |
| | 07/ 08 | 3 | 23 | | | 2 | 28 | 2 | 29 |
| | 08/ 09 | 4 | 24 | 1 | 28 | | | 3 | 27 |
| | 09/ 10 | 5 | 21 | | | | | 4 | 28 |
| | **Per Universiteit** | | | | | | | | |
| TUD | 02/ 03 | 15 | 6 | | | | | | |
| | 03/ 04 | 11 | 13 | | | | | | |
| | 04/ 05 | 14 | 20 | | | | | 2 | 22 |
| | 05/ 06 | 8 | 21 | | | | | 1 | 28 |
| | 06/ 07 | 5 | 11 | | | 1 | 26 | 1 | 27 |
| | 07/ 08 | 3 | 23 | | | 2 | 28 | 2 | 29 |
| | 08/ 09 | 4 | 24 | 1 | 28 | | | 3 | 27 |
| | 09/ 10 | 5 | 21 | | | | | 4 | 28 |

**Tabel M3.3 Instellingsverblijfsduur mastergeslaagden naar onderwijs-herkomst**
**M Geodetic engineering (66954)**
(voltijdse instroom)

| | | Eigen universiteit | | Andere universiteit NL | | HBO | | Buiten HO | |
|---|---|---|---|---|---|---|---|---|---|
| | afstudeer cohort | aantal geslaagd | verblijfs-duur (gem) | aantal geslaagd | verblijfs-duur (gem) | aantal geslaagd | verblijfs-duur (gem) | aantal geslaagd | verblijfs-duur (gem) |
| | | | in maanden | | in maanden | | in maanden | | in maanden |
| | **Totaal Universiteiten** | | | | | | | | |
| | 02/ 03 | 15 | 73 | | | | | | |
| | 03/ 04 | 11 | 82 | | | | | | |
| | 04/ 05 | 14 | 88 | | | | | 2 | 22 |
| | 05/ 06 | 8 | 78 | | | | | 1 | 28 |
| | 06/ 07 | 5 | 84 | | | 1 | 26 | 1 | 27 |
| | 07/ 08 | 3 | 107 | | | 2 | 28 | 2 | 29 |
| | 08/ 09 | 4 | 96 | 1 | 28 | | | 3 | 27 |
| | 09/ 10 | 5 | 96 | | | | | 4 | 28 |
| | **Per Universiteit** | | | | | | | | |
| TUD | 02/ 03 | 15 | 73 | | | | | | |
| | 03/ 04 | 11 | 82 | | | | | | |
| | 04/ 05 | 14 | 88 | | | | | 2 | 22 |
| | 05/ 06 | 8 | 78 | | | | | 1 | 28 |
| | 06/ 07 | 5 | 84 | | | 1 | 26 | 1 | 27 |
| | 07/ 08 | 3 | 107 | | | 2 | 28 | 2 | 29 |
| | 08/ 09 | 4 | 96 | 1 | 28 | | | 3 | 27 |
| | 09/ 10 | 5 | 96 | | | | | 4 | 28 |

**Tabel M6. Mastergeslaagden per jaar per instelling**
**M Geodetic engineering (66954) bij alle universiteiten**
(totaal van voltijdse en deeltijdse instroom samen)

| Cohort | Totaal | LEI | RUG | UU | EUR | TUD | TUE | UT | WU | UM | UvA | VU | RU | UvT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02/ 03 | 15 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 03/ 04 | 11 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 04/ 05 | 16 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 05/ 06 | 9 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 06/ 07 | 7 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 07/ 08 | 7 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 08/ 09 | 8 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 09/ 10 | 9 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Contact hours

Within the first year of the MSc programme the total study load of 60 ECs is covered by courses. As students choose their own set of courses from the list of convergence, core, application and elective courses, the number of contact hours will differ from student to student. On average both the lectures and guided labs cover 10-12 hours a week each. The remaining hours are reserved for self-study and paper assignments.
Within the second year of the MSc programme, the synthesis project has two scheduled meetings a week with the supervisors and extra guidance where necessary. The graduation project is guided by the supervisor, who regularly meets the student.

## Staff-student ratio

The ratio between the total number of full-time students enrolled and the total number of FTEs logged by the academic staff, is calculated for the revised MSc Geomatics *for the built environment* programme, starting in September 2012. The core programme (45 ECs), the synthesis project and graduation thesis supervision of the revised MSc programme will be offered by a teaching staff of 1 full professor (0.4 FTE), 2 associate professors (0.7 FTE), and 4 assistant professors (1.8 FTE). For some elements of the programme, 0.4 FTE of external lecturers will be appointment. The total number of FTEs logged by the academic staff involved in the core programme will be: 3.3 FTE. With 20 students the student-teacher ratio of the core programme is: 1:6.

## Personnel

*Overview of allocated staff 2011-2012*

| Name | Position | FTE | Degree | Expertise | Section |
|---|---|---|---|---|---|
| Berentsen, C.W.J. | UD | 0.9 | Dr.ir. | Ideal (Tracer) Dispersion, Single Phase Misible Flow & Non-equilibrum Two-phase Flow | Petroleum Engineering |
| Botha, C.P. | UD/ Assistant Professor | 1.0 | Dr. | Medical Visualisation | Computer Graphics and Visualisation |
| Dijkstra, J. | UD/ Assistant professor | 1.0 | Dr.ir. | Physical Modelling and Experimental Testing | Geo-engineering |
| Giesen, N.C. van de | Full Professor | 1.0 | Prof.dr.ir. | Water Resources Management | Water Resource |
| Gorte, B.G.H. | UD/ Assistant Professor | 1.0 | Dr.ir. | Optical and Laser Remote Sensing | Optical and Laser Remote Sensing |
| Gunter, B.C. | UD/ Assistant Professor | 1,0 | Dr. | Gravity | Physical & Space Geodesy |
| Haan, G. de | UD/ Assistant Profesoor | 1.0 | Dr.ir. | Web Mapping Services, 3D Point Clouds | Computer Graphics & Visualisation |
| Hrachowitz, M. | UD/ Assistant Professor | 1.0 | Dr. | Tracer Hydrology & Conceptual Hydrological Modelling | Water Resource |
| Hanssen, R.F. | Full Professor | 1.0 | Prof.dr.ir. | Geodesy and Radar Remote Sensing | Mathematical Geodesy & Positioning |
| Hindriks, K.V. | UD/ Assistant Professor | 1.0 | Dr. | Interactive Intelligence | Man-Machine Interaction |
| Hogendoorn, S.P. | Full Professor | | Prof.dr.ir. | Traffic Management Transport & Planning | Traffic Flow Theory and Simulation |
| Hooper, A.J. | UHD/ Associate Professor | 1.0 | Dr. | Satellite Geodesy & Geophysics | Mathematical Geodesy & Positioning |
| Houben, G.J.P.M. | Full Professor | 1.0 | Prof.dr.ir. | Web Information Systems | Web Information Systems |
| Jonker, C.M. | Full Professor | 1.0 | Prof.dr.ir. | Intelligent Systems & Interactive Intelligence | Interactive Intelligence |
| Klees, R. | Full Professor | 1.0 | Prof.dr. | Physical & Space Geodesy | Physical & Space Geodesy |
| Ledoux, H. | UD/ Assistant Professor | 1.0 | Dr. | Three- and higher-Dimensional Modelling, Spatial Data Structures & Point Clouds | GIS Technology |

| | | | | | |
|---|---|---|---|---|---|
| Lemmens, M.J.P.M. | UD/ Assistant Professor | 0.2 | Dr.ir. | Photogrammetry, Remote Sensing & GIS | GIS Technology |
| Lindenbergh, R.C. | UD/ Assistant Professor | 1.0 | Dr. | Interpolation Techniques and Laser Remote Sensing | Optical and Laser Remote Sensing |
| Loenen, B. van | UD/ Assistant Professor | 0.8 | Dr.ir. | Legal-administrative Aspects of Geographic Information (Infrastructures) | Geo-information and Land Development |
| Marel, H. van der | UD/ Assistant Professor | 1.0 | Dr.ir. | Global Satellite Navigation Systems, Space Systems, Data Analysis & Statistics and Testing. | Mathematical Geodesy & Positioning |
| Mayer, I.S. | UHD/ Associate Professor | 1.0 | Dr. | Design and application of gaming-simulation, policy excercises, serious gaming and virtual worlds | Policy, Organisation, Law & Gaming |
| Meijers, B.M. | Postdoc | 1.0 | Dr.ir. | GIS Technology | GIS Technology |
| Menenti, M. | Full Professor | 1.0 | Prof.dr. | Optical and Laser Remote Sensing | Optical and Laser Remote Sensing |
| Mostert, E. | UD/ Assistant Professor | 1.0 | Dr. | Water Management & Law | Water Resources Management |
| Nes, R. van | UHD/ Associate Professor | 0.8 | Dr.ir. | Transport | Transport & Planning |
| Ngan-Tillard, D.J.M. | UD/ Assistant Professor | | Dr.ir. | Engineering Geology & Rock Mechanics | Geo-engineering |
| Nieuwenhuizen, P.R. van | UD/ Assistant Professor | 1.0 | Drs. | Computer Graphics | Mathematical Physics |
| Oosterom, P.J.M. van | Full Professor | 1.0 | Prof.dr.ir. | GIS Technology | GIS Technology |
| Quak, C.W. | Researcher | 1.0 | Drs. | Geo-DBMS | GIS Technology |
| Sanders, F.M. | Full Professor | 0.6 | Prof.ir. | Infrastructure Planning | Infrastructure Planning |
| Savenije, H.H.G. | Full Professor | 0.8 | Prof.dr.ir. | Hydrology | Water Resource |
| Schrijnen, P.M. | UD/ Assistant professor | 0.9 | Ir. | Infrastructure Planning | Infrastructure Plannning |
| Snellen, M. | UD/ Assistant Professor | 1.0 | Dr.ir. | Marine Geodesy | Acoustic Remote Sensing |
| Stoter, J.E. | UHD/ Associate Professor | 0.5 | Dr. | 3D, Automated Generalisation & Information Modelling | GIS Technology |
| Tiberius, C.C.J.M. | UHD/ Associate | 1.0 | Dr.ir. | Satellite Navigation | Mathematical Geodesy & |

| | | | | | |
|---|---|---|---|---|---|
| | Professor | | | | Positioning |
| Tijssen, T.P.M. | UD | 1.0 | Drs. | GeoDBMS & Cartography | GIS Technology |
| Vellinga, T. | Full Professor | 0.4 | Prof.ir. | Ports and Waterways | Hydraulic Engineering |
| Verbree, E. | UD | 1.0 | Ir. | Location Based Services | GIS Technology |
| Verhagen, A.A. | UD | 0.9 | Dr.ir. | Probability and Observation Theory & Satellite Navigation | Mathematical Geodesy & Positioning |
| Verheij, H.J. | Lecturer | 0.2 | Ir. | Hydraulic Engineering | Hydrology |
| Vries, M.E. de | Researcher | 1.0 | Drs. | Geodata Integration & Dissemination | GIS-Technology |
| Wolters, M.A. | Lecturer | 0.2 | Ir. | Ports and Moterways | Hydraulic Engineering |
| Zlatanova, S. | UHD/ Associate Professor | 1.0 | Dr.Dipl.Ing. | 3D Modelling & Crisis Management | GIS Technology |

## Appendix 7: Theses and documents studied by the committee

- Subject-specific reference framework;
- Learning outcomes of the programme;
- Overview of the curriculum;
- Outline description of the curriculum components;
- Teaching and examination regulations;
- Allocated staff with names, positions, scope of appointment, level and expertise;
- Overview of the contacts maintained with the professional field;
- Reports on consultations with relevant committees/bodies;
- Test questions with corresponding assessment criteria and requirements (answer models) and a representative selection of actual tests administered (such as presentations, work placements, portfolio assessments) and assessments;
- List of the last 25 final projects or the final projects of the past two years (or portfolios/projects demonstrating the exit levels attained by the students);
- Reference books and other learning materials;
- Summary and analysis of recent evaluation results and relevant management information;
- Documentation regarding teacher and student satisfaction.

The committee studied and assessed a total of fourteen theses for the master's programme in Geomatics before the site visit. The theses were selected at random by the project leader and the chair of the committee.

*Selected master theses*

| | | | | |
|---|---|---|---|---|
| 1041967 | 4031881 | 4035321 | 1539264 | 4031911 |
| 1541749 | 1144308 | 4035593 | 4059564 | 1216635 |
| 1529951 | 1093371 | 1560050 | 4015576 | |

# Appendix 8: Declarations of independence

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**ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING**

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: H.F.L. Ottens

ADRES: Waldeck Pyrmontkade 9, 3583 TW Utrecht

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

**GEOMATICS**

AANGEVRAAGD DOOR DE INSTELLING:

**TU DELFT**

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Utrecht DATUM: 27 oktober 2012

HANDTEKENING:

1

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**ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING**

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Nico Sneeuw

ADRES: Kreuzhaldenstr. 18
70329 Stuttgart

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

**GEOMATICS**

AANGEVRAAGD DOOR DE INSTELLING:

**TU DELFT**

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Stuttgart DATUM: 27.10.2012

HANDTEKENING:

1

nvao
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**ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING**

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE P. van der Molen

NAAM: Legeweï 14

ADRES: 9245 VK Nij Beets

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

**GEOMATICS**

AANGEVRAAGD DOOR DE INSTELLING:

**TU DELFT**

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Nij Beets DATUM: 29-10-2012

HANDTEKENING:

1

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nederlands - vlaamse accreditatieorganisatie

**ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING**

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Wim de Haas

ADRES: W. Barentszstraat 84, Utrecht

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

**GEOMATICS**

AANGEVRAAGD DOOR DE INSTELLING:

**TU DELFT**

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Den Haag DATUM: 25 oktober 2012

HANDTEKENING:

W de Haas.

1

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nederlands - vlaamse accreditatieorganisatie

**ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING**

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Anne-Ruth Sneep

ADRES: 14 Rue de l'abbé de l'épée

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

**GEOMATICS**

AANGEVRAAGD DOOR DE INSTELLING:

**TU DELFT**

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Mont pellier DATUM: 26-09-2012

HANDTEKENING: ARC Sneep

1

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**ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING**

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Petra G.A. Helming

ADRES: Vulcaanstraat 34
7061 AZ Terborg

IS ALS ~~DESKUNDIGE~~ / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

**GEOMATICS**

AANGEVRAAGD DOOR DE INSTELLING:

**TU DELFT**

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Terborg DATUM: 22-10-2012

HANDTEKENING: PGAHelming

1