

## **Delft University of Technology**

**Cluster visitation**

**Bachelor and master programmes**

**Civil Engineering**

**Master programme**

**Transport, Infrastructure and Logistics**

**Limited Study Programme Assessment**



## Introduction

This is the assessment report of the bachelor and master degree programmes in Civil Engineering and the MSc programme in Transport, Infrastructure and Logistics offered by Delft University of Technology. The assessment was conducted by a visitation committee compiled by NQA and commissioned by Delft University of Technology. The visitation committee has been compiled in consultation with the study programme and was approved prior to the assessment process by NVAO.

In this report Netherlands Quality Agency (NQA) gives account of its findings, considerations and conclusions. The assessment was undertaken according to the *Assessment frameworks for the higher education system* of NVAO (6 December 2010) and the *NQA Protocol 2011 for limited programme assessment*.

The site visit took place on the 3<sup>rd</sup> and 4<sup>th</sup> of October 2012.

The visitation committee consisted of:

Mr. Prof. Dr. Ir. R.E.C.M. van der Heijden (chairperson, representative profession / discipline Transport and Logistics)

Mr. Prof. Dr. J.W. Kamphuis (representative profession / discipline Civil Engineering)

Mr. Ir. R.P. Mulder (representative profession / discipline Civil Engineering and Building Construction)

Mrs. S.M. Kleinendorst BSc (student member)

Mr. Drs. Ing. A.G.M. Horrevorts, senior NQA-auditor, acted as secretary of the visitation committee.

In a critical reflection report the programme management of the MSc and BSc programmes in *Civil Engineering* and the MSc programme in *Transport, Infrastructure and Logistics* assess the quality of both programmes. For every standard of the NVAO assessment framework a SWOT-analysis has been made. The critical reflection shows that the programme management has good knowledge of the strengths and weaknesses of the programmes offered.

Form and content of the critical reflection are in compliance with the requirements of the appropriate NVAO assessment framework and the requirements of the *NQA Protocol 2011*.

The visitation committee studied the critical reflection and visited the study programme. The critical reflection report and all other (oral and written) information have enabled the visitation committee to reach a well-deliberated judgement.

The visitation committee declares that the assessment of the study programmes was carried out independently.

Utrecht, 18 December 2012.

Chairman of the visitation committee

Prof. Dr. Ir. R.E.C.M. van der Heijden

Secretary



Drs. Ing. A.G.M. Horrevorts



## Summary

The visitation committee assesses the quality of the bachelor of science and master of science programmes in Civil Engineering of the Delft University of Technology as **good** and the master of science programme in Transport, Infrastructure and Logistics as **satisfactory**.

### *Standard 1, Intended learning outcomes*

#### **Civil Engineering**

The civil engineering domain covers the broad field of 'building for people and society'. The mission of the degree programmes in Civil Engineering is to educate future engineers to enable them to participate and to show leadership in the design, realisation, operation and maintenance of multidisciplinary projects in civil engineering. The programmes in Civil Engineering consist of a three-year BSc degree and a two-year MSc degree. It is the ambition of Delft University of Technology to meet or exceed the level of education provided by its counterparts in the major European countries and in the United States of America.

The final attainments of the study programmes in Civil Engineering (BSc and MSc) are described properly. They match with international standards in the domain of civil engineering and comply with the international description of academic standards (Dublin descriptors) for BSc and MSc levels. The profile of both programmes is well defined. There is a balanced mix between the scope of the domain of civil engineering: broad and in-depth knowledge of the fundamental basics of Civil Engineering. The BSc programme lays the foundation for further academic education on an MSc level, both in the Netherlands and abroad.

The MSc programme in Civil Engineering educates for careers in civil engineering where academics are needed who first and foremost have knowledge and skills of the classical engineer (profound knowledge of technical core disciplines), combined with an attitude of being sensitive to societal and environmental effects of technical solutions and being able to communicate on these issues. These are the so called soft skills of the engineer. The visitation committee would like to advise TUD to continue its strong focus on the technical aspects (the hard skills) of the programme of Civil Engineering.

The visitation committee assesses standard 1 for the bachelor and master programmes in Civil Engineering as **good**.

#### **Transport, Infrastructure and Logistics**

Transport has traditionally been considered a typical civil engineering discipline (road and railway engineering). Today, the domain Transport, Infrastructure and Logistics (TIL) consists of many scientific and engineering disciplines, ranging from policy engineering, urban planning and regional economics, via transport network planning and design, traffic and transport engineering, mechanical engineering, control, ICT and applied mathematics, to human factors, traffic and travel behaviour, and so forth.

TIL professionals work in a highly multidisciplinary and interdisciplinary environment, where they are increasingly required to look beyond their own specializations and justify their work not just in the light of their own expertise and peers, but also under the scrutiny of stakeholders from a much broader domain. This holds not just for practice but also for academia, in which transport is no longer dominated by civil engineers. The MSc programme TIL aims to offer a helicopter view and a common understanding of different engineering approaches and vocabularies applying a systems' approach. The deepening and broadening field of TIL asks for multidisciplinary and interdisciplinary transport engineers. TIL aims to educate those transport engineers.

The visitation committee observes that the final requirements of the TIL programme are well described and that they meet international standards of the domain of transportation, infrastructure and logistics. Also the academic level (MSc) is well defined. The visitation committee is of the opinion the TIL programme has high ambitions with its goal to offer an interdisciplinary study in 'transportation engineering'. The visitation committee however, observes that the interdisciplinary fundamentals of the programme are loosely described. The final requirement - *able to work in an interdisciplinary setting* - needs a more detailed description and elaboration. This objective should describe more clearly how the interaction between disciplines and integration of knowledge can be organised (with an own set of tools and theories on interdisciplinary studies). A more detailed elaboration will help the programme direction to make sharper choices regarding the content of the TIL programme.

The visitation committee assesses standard 1 for the master programme in Transport, Infrastructure and Logistics as **satisfactory**.

#### *Standard 2, Teaching and learning environment*

##### **Civil Engineering**

Students are well informed about the BSc and MSc programmes in Civil Engineering. All modules give proper information on the intended learning outcomes, the content of the modules, the forms of education, assessment methods and the number of contact hours and hours of individual study. The visitation committee observes that the BSc programme is being redesigned. In the present programme the applied science component has been emphasized (more than in the former programme). The committee agrees with this approach, as long as this does not negatively affect the current depth of (notably the technical) content of the programme. According to the visitation committee, the focus on the technical in-depth knowledge could have been better specified in the relation between the curriculum and the final qualifications of the BSc programme. In the MSc programme in civil Engineering this relation is well defined. The MSc programme consists of seven tracks, with specialisations offered within each track. These tracks provide in-depth specialisation within the relevant domain.

Both the BSc and the MSc programme in Civil Engineering pay ample attention to the academic level in terms of the content of the courses, the required research and design skills and the scientific orientation of the students. Students achieve knowledge and skills in various study components e.g. data analysis, model validation and reporting, problem

oriented learning, working on projects in teams, excursions and symposia, as well as individual research and design. The final thesis work in particular includes reflections on the academic research and design processes and addresses the issues of scientific reporting and presentation. Students are satisfied with the balanced mix of research oriented components and practice oriented components (such as the projects and graduation work).

Students are satisfied with the methods of instruction used in the programmes of Civil Engineering. The visitation committee is positive about the mix of instruction methods used: lectures and tutorials, assignments, case studies, internships and thesis work. The central theme throughout both the BSc and the MSc programmes is to teach each student how to deal with open-ended and often poorly defined design problems creatively and effectively.

Student supervision and guidance is considered an important feature of the educational approach. Students and supervisors meet on a regular basis. The visitation committee is positive about the way students are guided during their study and especially during their BSc and MSc thesis work. To improve the feasibility of the programme, many lectures in both the BSc and MSc programme are videotaped and available through *Collegerama*. This enables students to review a lecture or watch a missed lecture online. *Collegerama* is extremely popular among students.

The Civil Engineering programmes are delivered by a well-qualified staff. Most of the lecturers who teach in the BSc and MSc programmes are also active in research. The increase in student numbers in recent years, combined with the demand for more research output, limits the time lecturers have for making new ambitious improvements to the programme. A realistic assessment of resources is required, according to the faculty. The visitation committee agrees with the faculty's viewpoint.

The visitation committee is of the opinion that the facilities of Civil Engineering are well-equipped and more than adequate in comparison to other (international) schools.

According to the visitation committee, the quality of the BSc and MSc programmes is well-monitored by the faculty. Students play a vital role in the quality assurance system of the faculty. Content and focus of the programme (the appropriate balance between breadth and depth), feasibility of the study programme, study load, lead times of thesis work, student guidance and the quality and quantity of staff are topical issues in the discussions regarding the quality assurance of the programmes. The visitation committee observes that the faculty and its Board of Examiners are well aware of the importance of these discussions.

### **Transport, Infrastructure and Logistics**

Students are well informed about the MSc programmes in Transport, Infrastructure and Logistics. All modules give proper information on the intended learning outcomes, the content of the modules, the forms of education, assessment methods and the number of contact hours and hours of individual study.

All final qualifications are covered throughout the TIL programme by means of various didactical approaches, ranging from coursework (lectures) and individual practical work/assignments, to group assignments and projects. The visitation observes that there is a clear relation between the content of the programme and the final qualifications.

According to the visitation committee, the academic orientation of MSc TIL is made visible and operational in the curriculum. The content of modules and assignments meets master level standards. Students are satisfied with the balanced mix of research oriented components and practice oriented components (such as the projects and graduation work).

Students are satisfied with the methods of instruction used in the MSc programme in Transport, Infrastructure and Logistics. The visitation committee is positive about the mix of instruction methods used: lectures and tutorials, assignments, case studies, internships and thesis work. The central theme throughout the MSc programmes is to teach each student how to deal with open-ended and often poorly defined design problems creatively and effectively.

Students are satisfied with the way they are guided by the lecturers and informed about the programme. Students are very positive about the way students in heterogeneous groups work together on assignments and projects. In these work groups students learn from each other by teaching each other. The visitation committee is positive about the way students are guided during their study and especially during their MSc thesis work.

The teaching staff are strongly embedded in research and practice. All staff members have an academic background and many are involved in projects that combine academic research and business practice. The TIL programme is delivered by a well-qualified staff.

The visitation committee is of the opinion that the facilities of Transport, Infrastructure and Logistics are well-equipped and more than adequate in comparison to other (international) schools.

According to the visitation committee, the quality of the MSc programme in TIL is well-monitored by the programme management. Students play a vital role in the quality assurance system of the TIL programme. In 2010 – 2011 much work (in terms of quality assurance) has been done to overcome some weaknesses of the programme (feasibility, coherence of the programme and organisational setting within the three cooperating faculties). Measures to improve the programme have been implemented in 2011. Results of the changes cannot yet be ascertained, but it is plausible that the measures taken, contribute in a positive way to realising the objectives set for the new programme. According to the visitation committee, the programme direction is well aware of the sub-optimal organisational setting in which it has to operate (three cooperating faculties with their own autonomous policy making processes). The present learning environment of the MSc in TIL is the best that can be achieved under the present circumstances. The visitation committee has given the organisational aspects less weight in its final judgement than the realised quality of the programme (content, structure and quality of staff and facilities).

The visitation committee assesses standard 2 for the BSc and MSc programme in Civil Engineering and the MSc programme in Transport, Infrastructure and Logistics as **good**.

*Standard 3, Assessment and achieved learning outcomes*  
**Civil Engineering**

Students are informed about the manner of assessment via the educational information system Blackboard. Students find information on the learning objectives and means of assessment of each module in the study guide. Therefore, students are aware of what is expected of them. Various methods of assessment are used: assignments, written examinations, computer assessments, project presentations and the BSc and MSc thesis. Students are satisfied with the way they are informed on examinations and grading criteria.

According to the visitation committee the quality of projects the committee has reviewed, is high and compared to other (international) CE programmes more than satisfactory.

TU Delft has established a university assessment and examination policy that has been adopted by all programmes in order to formulate faculty assessment and examination policies. According to an internal audit of the assessment policy of the faculty of Civil Engineering the way of testing differs between lecturers. The internal audit report also states that the faculty works hard to improve its testing policy and testing practice. The visitation committee observes that the Examination Board of Civil Engineering is actively working on the implementation of the assessment and examination policy and that professionalization on testing is high on the agenda.

The visitation committee is positive about the way BSc and MSc students of the programme in Civil Engineering are guided during their thesis work, the feed back students get during the process of graduation and the assessment procedure of the theses.

The professional field (research institutes and academia, engineering and construction firms and consultants firms) is satisfied with the level and quality of the graduates of the CE programme. Dutch practice shows that almost all BSc degree holders continue their studies by following an MSc programme of their choice at TU Delft and many other universities in the Netherlands and abroad. BSc graduates who continue their studies in the MSc programme in CE have no difficulty in the transition from the BSc to the MSc programme and generally perform very well.

The visitation committee studied seven BSc theses and seven MSc theses of the CE programme. In all cases the visitation committee judged more or less the same as the examiners of the theses. In some cases the motivation for the judgement according to the assessment format could have been more specific. However, the visitation committee is satisfied with the grading of these theses.

### **Transport, Infrastructure and Logistics**

Assessment practice in the MSc TIL programme is similar to the practice in the MSc CE. TIL students are assessed for each module they follow in the TIL programme. Modes of testing are oral or written examinations, a review, paper or report, or a combination of the former methods. MSc TIL has a number of arrangements in place to ensure that the learning outcomes are on a par with the quality standards set by the steering committee of the TIL programme. Graduation committees see to it that the final thesis is properly assessed.

An extra safeguard for arriving at objective assessments, is the review of final thesis reports by the TIL Board of Examiners. According to the visitation committee, the assessment procedure guarantees that the thesis is being judged from different perspectives and that the final grade is as objective as possible.

The visitation committee is positive about the way MSc students of the programme in TIL are guided during their thesis work, the feed back students get during the process of graduation and the assessment procedure of the theses.

Overall, the MSc TIL was ranked 'good' by all alumni (on a scale: bad, moderate, good, very good). Among the points of critique and recommendations for improvement, alumni mentioned the relative lack of scientific depth. Both issues were the main motivations for the faculty to reorganise the programme in 2011.

The visitation committee studied seven MSc theses of the TIL programme. In all cases the visitation committee judged more or less the same as the examiners of the theses. In some cases the motivation for the judgement according to the assessment format could have been clarified in more detail. In general the visitation committee is satisfied with the grading of these theses. However, the visitation committee considers those theses with a mark of 8,5 - 9 or above, as being scored too favourably. MSc TIL has set itself high goals regarding interdisciplinarity (see standard 1). According to the committee, the TIL theses reviewed by the committee certainly meet MSc standards but do not yet show a sufficient top-level of interdisciplinarity. Therefore, according to the committee, there is still room for improvement in order to reach the high goals set in standard 1. The high ambition of TIL should be reflected in the grading of the thesis work.

The visitation committee assesses standard 3 for the BSc and MSc programmes in Civil Engineering as **good** and the MSc programme in Transport, Infrastructure and Logistics as **satisfactory**.

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# 1 Basic data of the study programme

## Administrative data of the study programme

|   |   |
|---|---|
| 1. Name study programme as in CROHO   | Civil Engineering<br>Transport, Infrastructure and Logistics  |
| 2. Registration number in CROHO   | 56952 BSc Civil Engineering<br>60352 MSc Civil Engineering<br>60361 MSc Transport, Infrastructure and Logistics   |
| 3. Orientation and level study programme  | BSc Civil Engineering (academic)<br>MSc Civil Engineering (academic)<br>MSc Transport, Infrastructure and Logistics (academic)  |
| 4. Number of study credits  | BSc Civil Engineering 180 EC<br>MSc Civil Engineering 120 EC<br>MSc Transport, Infrastructure and Logistics 120 EC  |
| 5. Graduation courses / 'tracks'<br>MSc Tracks in Transport, Infrastructure and Logistics<br>BSc tracks in Civil Engineering<br>MSc Tracks in Civil Engineering | None<br><br>None <ul style="list-style-type: none"> <li>• Building Engineering</li> <li>• Hydraulic Engineering (including the Erasmus Mundus track Coastal and Marine Engineering and Management [CoMEM] and a double degree programme in Hydraulic Engineering and Water Resources Management offered in conjunction with the National University of Singapore)</li> <li>• Structural Engineering</li> <li>• Transport &amp; Planning</li> <li>• Water Management (including a double degree programme in Hydraulic Engineering and Water Resources Management offered in conjunction with the National University of Singapore)</li> <li>• Geo-Engineering (joint track with MSc in Applied Earth Sciences)</li> <li>• Geoscience &amp; Remote Sensing (joint track with MSc in Applied Earth Sciences, as of 01-09-2012)</li> </ul> |
| 6. Variant(s)   | Fulltime  |
| 7. Location(s)  | Delft   |
| 8. Previous year of audit visit and date decision NVAO  | Previous visit: 8, 9 and 28, 29 March 2006<br>Decision NVAO: 9 October 2007   |

## Administrative institutional data

|                            |  |
|----------------------------|--|
| 9. Name institute          | Delft University of Technology           |
| 10. Status institute       | Funded                                   |
| 11. Result institute audit | Positive,<br>Decided on 21 November 2011 |

## Quantitative data regarding the study programme

### BSc Civil Engineering

Table 1 Intake and drop-out of students in the BSc programme in Civil Engineering

| Cohort     | Total intake     | Total drop-outs  | Drop-outs after BSc 1 |                 | Number of re-enrollers BSc 2 |     | Drop-outs BSc 2 and 3 |                 |     |
|------------|------------------|------------------|-----------------------|-----------------|------------------------------|-----|-----------------------|-----------------|-----|
| 2005-2006  | 240              | 108              | 45%                   | 47              | 20%                          | 193 | 80%                   | 61              | 32% |
| 2006-2007  | 209              | 63               | 30%                   | 48              | 23%                          | 161 | 77%                   | 15              | 9%  |
| 2007-2008  | 246              | 57               | 23%                   | 37              | 15%                          | 209 | 85%                   | 20              | 10% |
| 2008-2009  | 311              | 71               | 23%                   | 51              | 16%                          | 260 | 84%                   | 21 <sup>^</sup> | 8%  |
| 2009-2010  | 330              | 116 <sup>^</sup> | 35%                   | 100             | 30%                          | 230 | 70%                   | 16 <sup>^</sup> | 7%  |
| 2010-2011* | 297 <sup>^</sup> | 78 <sup>^</sup>  | 26%                   | 78 <sup>^</sup> | 26%                          | 219 | 74%                   | 0 <sup>^</sup>  | 0%  |
| 2011-2012* | 335 <sup>^</sup> | 23 <sup>^</sup>  | 7%                    | 23 <sup>^</sup> | 7%                           |     |                       |                 |     |

Table based on VSNU data, reference date 1 October

<sup>^</sup> TU Delft data, reference date 1 July 2012

Table 2 Number of graduates of the BSc programme in Civil Engineering

| Cohort    | Number of re-enrollers BSc 2 | Diploma in ≤ 3 years |     | Diploma in ≤ 4 years |     | Diploma in ≤ 5 years |     | Diploma in ≤ 6 years |     | Diploma in < 6 years |     |
|-----------|------------------------------|----------------------|-----|----------------------|-----|----------------------|-----|----------------------|-----|----------------------|-----|
| 2002-2003 | 161                          | 18                   | 11% | 47                   | 29% | 82                   | 51% | 113                  | 70% | 126                  | 78% |
| 2003-2004 | 141                          | 13                   | 9%  | 37                   | 26% | 68                   | 48% | 78                   | 55% | 83                   | 59% |
| 2004-2005 | 181                          | 11                   | 6%  | 33                   | 18% | 69                   | 38% | 81                   | 45% | 97 <sup>^</sup>      | 54% |
| 2005-2006 | 193                          | 29                   | 15% | 46                   | 24% | 77                   | 40% | 96 <sup>^</sup>      | 50% | 126 <sup>^</sup>     | 65% |
| 2006-2007 | 161                          | 19                   | 12% | 50                   | 31% | 92 <sup>^</sup>      | 57% | 112 <sup>^</sup>     | 70% |                      |     |
| 2007-2008 | 209                          | 29                   | 14% | 87 <sup>^</sup>      | 42% | 126 <sup>^</sup>     | 60% |                      |     |                      |     |
| 2008-2009 | 260                          | 32 <sup>^</sup>      | 12% | 98 <sup>^</sup>      | 38% |                      |     |                      |     |                      |     |
| 2009-2010 | 230                          |                      |     |                      |     |                      |     |                      |     |                      |     |

Table based on VSNU data, reference date 1 October

<sup>^</sup> TU Delft data, reference date 1 July 2012

Figures are cumulative. Percentage of re-enrollers in the BSc programme in Civil Engineering (students who continue their studies after BSc 1).

Table 3 Teaching staff in the BSc and MSc programme in Civil Engineering

|                                 | Teaching staff                  | Number of staff | Number of FTE |
|---------------------------------|---------------------------------|-----------------|---------------|
| BSc programme (major programme) | Full professor                  | 12              | 8,4           |
|                                 | Assistant / Associate professor | 14              | 11,1          |
|                                 | Senior lecturer                 | 15              | 13,6          |
| MSc programme (all modules)     | Full professor                  | 32              | 23            |
|                                 | Assistant / Associate professor | 56              | 46,5          |
|                                 | Senior lecturer                 | 29              | 21,5          |

This table shows only key lecturers, employed by the CEG Faculty. BSc programme service lecturers are not included in this overview.

The staff-student ratio for the BSc programme in Civil Engineering is: 1:36

**Table 4 Distribution of study load for the BSc programme in Civil Engineering, expressed in hours**

|                 | Contact hours      |                              |                 |          | Group work |          | Self-study       |        |           | Total study load |          |
|-----------------|--------------------|------------------------------|-----------------|----------|------------|----------|------------------|--------|-----------|------------------|----------|
|                 | Lectures tutorials | Practical training, projects | Laboratory work | Subtotal | Projects   | Subtotal | Individual study | Thesis | Electives |                  | Subtotal |
| Year 1          | 354                | 62                           | 65              | 481      | 110        | 110      | 1088             |        |           | 1088             | 1680     |
|                 | 21%                | 4%                           | 4%              | 29%      | 7%         | 7%       | 65%              |        |           | 65%              | 100%     |
| Year 2          | 362                | 24                           | 121             | 507      | 116        | 116      | 1058             |        |           | 1058             | 1680     |
|                 | 22%                | 14%                          | 7%              | 30%      | 7%         | 7%       | 63%              |        |           | 63%              | 100%     |
| Year 3 (30 EC)* | 64                 |                              | 16              | 80       | 99         | 99       | 257              | 280    | 124       | 661              | 840      |
|                 | 8%                 |                              | 2%              | 10%      | 12%        | 12%      | 68%              | 33%    | 15%       | 78%              | 100%     |
| Overall         | 743                | 86                           | 202             | 1031     | 325        | 325      | 2720             | 280    | 124       | 3124             | 4200     |
|                 | 18%                | 2%                           | 5%              | 25%      | 8%         | 8%       | 65%              | 7%     | 3%        | 74%              | 100%     |

\* BSc year 3 has a major of 30 EC and a minor of 30 EC. The 30 EC major consists of 12 EC modules, 8 EC elective modules and 10 EC BSc thesis.

Percentages are based on total study load per year and the major programme of 150 EC

## MSc Civil Engineering

**Table 5 Number of diploma's and origin MSc in Civil Engineering<sup>1</sup>**

| Cohort                 | TU Delft (=100%) |     | Other Dutch University (=100%) |     | HBO (=100%)     |     | Other than Dutch higher education (=100%) |     | Total drop-out |     |
|------------------------|------------------|-----|--------------------------------|-----|-----------------|-----|---|-----|----------------|-----|
| 2005-2006              | 172              | 84% |                                |     | 2               | 67% | 25  | 71% | 19+2+1+10      | 13% |
| 2006-2007              | 127              | 81% |                                |     | 10              | 26% | 26  | 65% | 11+4+20+13     | 20% |
| 2007-2008              | 71               | 40% | 2                              | 20% | 4               | 9%  | 46  | 78% | 7+2+17+5       | 11% |
| 2008-2009              | 63 <sup>^</sup>  | 50% | 1 <sup>^</sup>                 | 11% | 21 <sup>^</sup> | 37% | 29 <sup>^</sup>                           | 56% | 12+4+14+2      | 13% |
| 2009-2010              | 20 <sup>^</sup>  | 9%  |                                |     | 4 <sup>^</sup>  | 8%  | 26 <sup>^</sup>                           | 42% | 15+1+14+4      | 10% |
| 2010-2011 <sup>^</sup> | n/a              |     | n/a                            |     | n/a             |     | n/a                                       |     | 0+0+4+0        | 2%  |
| 2011-2012 <sup>^</sup> | n/a              |     | n/a                            |     | n/a             |     | n/a                                       |     | 0+0+5+2        | 4%  |

Number of students who currently have a diploma. Percentage shows the percentage of the cohort and the defined group.

Table based on VSNU data, reference date 1 October

<sup>^</sup> TU Delft data, reference date 1 July 2012

The staff-student ratio for the MSc programme in Civil Engineering is: 1:8

<sup>1</sup> See Annex III for additional information on diploma's and study length per group

**Table 6 Teaching staff in the BSc and MSc programme in Civil Engineering**

|                                 | Teaching staff                  | Number of staff | Number of FTE |
|---------------------------------|---------------------------------|-----------------|---------------|
| BSc programme (major programme) | Full professor                  | 12              | 8,4           |
|                                 | Assistant / Associate professor | 14              | 11,1          |
|                                 | Senior lecturer                 | 15              | 13,6          |
| MSc programme (all modules)     | Full professor                  | 32              | 23            |
|                                 | Assistant / Associate professor | 56              | 46,5          |
|                                 | Senior lecturer                 | 29              | 21,5          |

This table shows only key lecturers, employed by the CEG Faculty. BSc programme service lecturers are not included in this overview.

### MSc Transport, Infrastructure and Logistics

**Table 7 Number of diploma's by origin**

| Cohort     | TU Delft (=100%) | Other Dutch university (=100%) | HBO (=100%) | Other than Dutch higher education (=100%) | Drop-out of total number of students |
|------------|------------------|--------------------------------|-------------|---|--------------------------------------|
| 2005-2006  | 17 85%           |                                |             | 1 100%                                    | 3+0+0+0 15%                          |
| 2006-2007  | 18 86%           |                                |             | 7 100%                                    | 2+0+0+0 7%                           |
| 2007-2008  | 14 56%           | 0                              | 0           | 5 56%                                     | 4+1+0+3 21%                          |
| 2008-2009  | 14 40%           | 0                              | 0           | 1 17%                                     | 3+1+1+0 10%                          |
| 2009-2010  | 1 3%             | 0                              | 0           | 0   | 2+0+0+0 5%                           |
| 2010-2011* |                  |                                |             |   | 1+0+0+0 5%                           |

Table based on VSNU data, reference date 1 October

\* TU Delft data, reference date 31 August (end of year cohort)

**Table 8 Teaching staff MSc TIL**

| Staff in the MSc TIL            | Number of staff | Number of FTE |
|---------------------------------|-----------------|---------------|
| Full professor                  | 11              | 9,2           |
| Assistant / Associate professor | 17              | 22,8          |
| Senior lecturer                 | 18              | 13,7          |

Table shows only key lecturers, employed at the faculties of CEG, TPM and 3ME. All modules are included.

For the MSc in Transport, Infrastructure and Logistics the ratio is: 1:2

Table 9 Study load expressed in hours

|                               | Contact hours   |                              |            |              | Group work  |              |              | Self-study       |              |              | Total study load |          |
|-------------------------------|---|------------------------------|------------|--------------|-------------|--------------|--------------|------------------|--------------|--------------|------------------|----------|
|                               | Lectures tutorials  | Practical training, projects | Thesis     | Subtotal     | Group study | Projects     | Subtotal     | Individual study | Projects     | Thesis       |                  | Subtotal |
| Fundamentals (27 EC)          | 126<br>(17%)  | 56<br>(7%)                   |            | 182<br>(24%) |             | 154<br>(20%) | 154<br>(20%) | 392<br>(52%)     | 28<br>(4%)   |              | 420<br>(56%)     | 756      |
| Specialization P (26 EC□)     | 133<br>(18%)  | 14<br>(2%)                   |            | 147<br>(20%) |             | 189<br>(26%) | 189<br>(26%) | 182<br>(25%)     | 210<br>(29%) |              | 392<br>(54%)     | 728      |
| Specialization D (27 EC)      | 147<br>(19%)  | 42<br>(6%)                   |            | 189<br>(25%) | 40<br>(5%)  | 199<br>(26%) | 239<br>(32%) | 188<br>(25%)     | 140<br>(19%) |              | 328<br>(43%)     | 756      |
| Specialization O (26 EC□)     | 154<br>(21%)  | 77<br>(11%)                  |            | 231<br>(32%) | 28<br>(4%)  | 126<br>(17%) | 154<br>(21%) | 231<br>(32%)     | 112<br>(15%) |              | 343<br>(47%)     | 728      |
| Specialization E (27 EC)      | 112<br>(15%)  | 21<br>(3%)                   |            | 133<br>(18%) | 56<br>(7%)  | 203<br>(27%) | 259<br>(34%) | 259<br>(36%)     | 105<br>(14%) |              | 364<br>(48%)     | 756      |
| Electives (26-27 EC)          | <i>Diverse choice of elective modules, projects or internship</i> |                              |            |              |             |              |              |                  |              |              | 756              |          |
| Projects and seminars (40 EC) |   | 76<br>(7%)                   | 84<br>(8%) | 160<br>(14%) |             | 168<br>(15%) | 168<br>(15%) |                  | 36<br>(3%)   | 756<br>(68%) | 840<br>(75%)     | 1120     |

Hours are an approximation. Percentages are based on the total study load of the component

□ Two specializations have 26 EC (equivalent to 728 hours)



## 2 Assessment

The visitation committee describes the findings, considerations and conclusions of each standard of the NVAO assessment framework. The final judgement concerning the study programme will be presented in chapter 3. First the committee elaborates on how the MSc programme in Transport, Infrastructure and Logistics relates to other transport-related MSc tracks at TU Delft.

The interfaculty Master of Science degree programme in Transport, Infrastructure and Logistics (MSc TIL) was launched in September 2004. It was initiated by the faculties of:

- Technology, Policy & Management (TPM);
- Civil Engineering & Geosciences (CEG);
- Mechanical, Maritime & Materials Engineering (3mE).

The MSc TIL is a 2-year programme that combines and integrates components from the more specialized transport related MSc programmes at these three faculties:

- 3mE offers the track Transportation Engineering (TE), in the MSc programme Mechanical Engineering, including the specializations Transport Engineering & Logistics (TEL) and Production Engineering & Logistics (PEL). These specialisations focus on the planning, design and management of closed transport systems within industrial enterprises.
- CEG offers the track Transport & Planning (T&P), in the MSc programme Civil Engineering which covers the “classic” civil engineering discipline of transport devoted to the planning, design and management of “open” civil transport systems and networks.
- TPM offers the domain specialization Transport & Logistics (T&L) in the MSc programme Systems Engineering, Policy Analysis and Management (SEPAM), focusing on policy and management of both open and closed transport systems and logistics.

Besides these MSc tracks and specializations, two other transport-related MSc tracks / specializations are offered at TU Delft that are important for TIL, in the sense that they provide modules or other curriculum components. First, the MSc programme Aerospace Engineering offers the track Control and Operations, which includes elements of logistics, (traffic) control and planning related to TEL, T&P and SEPAM. Second, the MSc programme Architecture, Urbanism and Building Sciences offers the Urbanism track, which touches upon subjects closely related to spatial and infrastructure planning in T&P and (partially) SEPAM.

In the critical reflection it is motivated why the interfaculty MSc track TIL provides a welcome and necessary addition to the “palette” of transport related MSc tracks at TU Delft. The main reasons for launching the TIL programme relate to the inherent interdisciplinary nature of the transport, infrastructure and logistics field itself, the emerging need for interdisciplinary transport engineers in practice and the possible economy of scale in terms of MSc education at TU Delft. TU Delft considers a possible scenario for the future in which TIL actually serves as the umbrella MSc programme, in which the other faculty-specific MSc tracks/ specializations at TU Delft are offered as either separate tracks or specializations within TIL.

This offers possibilities for cost efficiency and quality improvement. Such a structure would also result in a more coherent picture of transport-related education at TU Delft for both future students and their future employers. The debate on this issue is still ongoing.

In the sub-heading *Standard 1*, the intended learning outcomes of the MSc TIL programme will be further discussed and judged, next to similar information for the BSc and MSc programmes in CE.

## **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.*

### *Findings*

#### **Civil Engineering**

The critical reflection report states that the civil engineering domain covers the broad field of 'building for people and society'. The report elaborates on what this means for the Dutch situation. Throughout Dutch history, flood protection and infrastructure have always been important and a priority for the Civil Engineering programme at Delft University of Technology. Nowadays, world population growth and global technological progress have triggered large-scale industrialisation resulting in new questions that need to be answered. The issues mentioned have a major impact on the climate and natural resources. These aspects are closely related to the civil engineering domain.

The mission of the degree programmes in Civil Engineering is to educate future engineers to enable them to participate and to show leadership in the design, realisation, operation and maintenance of multidisciplinary projects in civil engineering. Therefore, they are trained in the acquisition of established knowledge and know-how, in the development of new knowledge through research and the exploration of new fields of research. The programmes in Civil Engineering consist of a three-year BSc degree and a two-year MSc degree. The mission applies to both programmes in relation to the relevant degree level.

The main objectives of the programmes in Civil Engineering are described as follows:

1. The engineer should be a master of his/her scientific, technical and technological speciality
2. The engineer should be able to generate new information and knowledge through in-depth or multi-disciplinary research
3. The engineer should be able to put his/her knowledge into practice in interdisciplinary platforms, i.e. in discussions with economists, politicians, ecologists, interest groups, et cetera.

In the critical reflection report three core areas of civil engineering are distinguished:

- Water, also referred to as the "wet" domain:
- Structures (Bouw), also referred to as the "dry" domain:
- Transport

In civil engineering projects these areas are strongly interrelated and all activities in civil engineering have a direct impact on the environment. Consequently, civil engineering is closely related to environmental engineering. In each of the three areas, civil engineers can be found acting as specialists, designers and integrators. In current Dutch practice almost all BSc graduates continue their study (MSc programme), they seldom seek employment as a BSc-engineer. The BSc degree gives access to other MSc programmes, both in the Netherlands and abroad.

As stated in the critical reflection report, it is the ambition of Delft University of Technology to meet or exceed the level of education provided by its counterparts in the major European countries and in the United States of America. The current curriculum of the Civil Engineering programme (BSc and MSc) maintains, according to DUT, a level that is comparable to or higher than that of leading universities and the IDEA League partners. DUT underpins this view with a recent peer review of the programmes of the IDEA League Partners (Imperial College London, TU Delft, ETH Zürich, TH Aachen and ParisTech).

The final attainments of the study programmes in Civil Engineering (BSc and MSc) are described in annex 1 of this report. In the critical reflection report of CE TU Delft describes how the BSc and MSc levels (Dublin descriptors) are incorporated both in the undergraduate and graduate programmes of Civil Engineering. For instance, *knowledge and understanding* of the broad field of civil engineering in the BSc programme is covered by the fundamentals mathematics, mechanics and materials. *Research* regarding the CE fields is embedded in the modules. The MSc programme builds on the fundamentals laid by the BSc programme. The knowledge of the BSc level is further deepened in the MSc programme. Students are expected to have a thorough understanding of all the knowledge of the BSc programme and to specialise in a particular area by choosing an MSc track. Modules for teaching the fundamentals are offered within these fields of MSc specialisation.

BSc students *apply knowledge and understanding* (Dublin descriptor) in the laboratory courses and projects in which students put theory into practice. MSc students *apply knowledge and understanding* in the form of a design or a research-based assignment or project. MSc students must be creative in order to find solutions to the complex problems they are faced with in the multidisciplinary field of civil engineering. The MSc programme gives students the opportunity to tackle new and unfamiliar problems. The modules in the Master's programme focus specifically on the environmental and societal effects of the choices made by civil engineers. There can be a substantial degree of uncertainty, so students need to be prepared to work with incomplete information. Analysis (risk analysis, data analysis and system analysis) and research (data collection, experiments and modelling) are the main areas of emphasis within the MSc programme.

The Dublin descriptor *making judgements* comes in the fore in the integrated projects. In these projects students are faced with complex problems, which need to be solved by collecting and evaluating arguments, assumptions, abstract concepts and data in order to draw conclusions. The real-life problems that occur in the field of civil engineering challenge students to take a societal, scientific and ethical approach.

BSc students are taught to function in multidisciplinary teams and to communicate on a level that is accessible to both experts in the field and non-experts (Dublin descriptor *communication*). Written and oral reports are key elements in all of the modules throughout the programme, such as 'Integral Design' (Integraal Ontwerpen) and 'Structural Design' (Constructief Ontwerpen) in the first years of the programme, and also with regard to 'Introduction to Building Engineering and Environmental Engineering' (Inleiding Bouwmaterialen en Environmental Engineering) and the BSc thesis. In the MSc programme, communication primarily takes the form of peer presentations of assignments, the multi-disciplinary project, the internship and the MSc thesis. MSc graduates are able to communicate clearly to others about motives, considerations and conclusions. Many modules include final presentations or require students to write a report. Because the MSc programme is taught in English, students are expected to be able to communicate clearly in the English language.

The Dublin descriptor *learning skills* is integrated in the BSc and MSc assignments and study activities. The aim of the BSc programme is to challenge students to further their academic development independently. The BSc thesis is the final project in which they are expected to prove they possess such capabilities. MSc graduates have shown their ability to conduct research and solve complex issues individually in uncertain or unknown situations. The MSc programme teaches students to autonomously develop their professional qualifications and to broaden their knowledge.

The visitation committee observes that both the BSc and the MSc programme pay ample attention to general academic qualifications. Examples of those qualifications are: being able to combine high-level academic knowledge with strong analytical and critical thinking, being able to synthesise different components (for instance, technical, societal and environmental) in the design of civil engineering projects, be able to deal with ambiguity (i.e. how to deal with uncertainties and how to combine well-known methods and good practice with new research developments), the ability to work in teams and reflect on results. The BSc and MSc thesis ought to be an illustration of the achieved academic orientation of the programmes.

### **Transport, Infrastructure and Logistics**

The critical reflection report of the TIL programme states that the TIL domain is multidisciplinary and interdisciplinary by nature. The broad field of logistics is fragmented into many specialized sub-disciplines, each with its own vocabulary, paradigms and theories and associated choice of design, analysis and simulation tools. The MSc programme TIL aims to offer a helicopter view and a common understanding of different engineering approaches and vocabularies applying a systems' approach.

Transport has traditionally been considered a typical civil engineering discipline (road and railway engineering). Today, the domain Transport, Infrastructure and Logistics (TIL) consists of many scientific and engineering disciplines, ranging from policy engineering, urban planning and regional economics, via transport network planning and design, traffic and transport engineering, mechanical engineering, control, ICT and applied mathematics, to human factors, traffic and travel behaviour, and so forth. As a consequence, TIL professionals work in a highly multidisciplinary and interdisciplinary environment, where they

are increasingly required to look beyond their own specializations and justify their work not just in the light of their own expertise and peers, but also under the scrutiny of stakeholders from a much broader domain. This holds not just for practice but also for academia, in which transport is no longer dominated by civil engineers. Many PhD students who pursue a degree in transport have MSc's in applied mathematics, physics, mechanical engineering or social sciences, to name but a few. The current and next generation of professors in transport are much more diverse in terms of expertise, background and views than ever before. The deepening and broadening field of TIL asks for multidisciplinary and interdisciplinary transport engineers. TIL aims to educate those transport engineers.

The final attainments of the MSc programme in Transport, Infrastructure and Logistics are described in annex 1 of this report. The programme management describes how the MSc level is incorporated in the graduate programme TIL. In the *Overview of the Final attainment levels and Dublin descriptors*, the faculty illustrates that the Dublin descriptors are related to the modules. Below the three main objectives of the programme are described in more detail and related to the Dublin descriptors.

1. MSc TIL graduates are transport *generalists*, who have the *knowledge and understanding* to comprehend and analyse the complexity and interconnectedness of TIL systems and problems, and who speak and understand the language (terminology, viewpoints) of specialists from many different disciplines. TIL graduates are able to synthesize and apply knowledge from different domains and have the engineering and design creativity to apply such knowledge to complex TIL problems.
2. MSc TIL graduates are also *specialists* in one of the TIL sub-disciplines (policy, transport design, operations, logistics and transport engineering), - who can contribute to TIL solutions due to their specialized skills and knowledge of both the state of the art and the state of the practice in their speciality. They have a scientific attitude and way of thinking combined with analytical skills and engineering and design creativity.
3. MSc TIL graduates are competent to lead and/or work in *multidisciplinary professional teams* and organizations in the TIL field on complex interdisciplinary problems. They are aware of the possible ethical, social, environmental, aesthetic and economic implications of their work and have the insight to act and make judgements accordingly. They have the personal responsibility and initiative to function in complex and unpredictable professional environments and to maintain and update their knowledge through life-long learning. They are able to work in an international environment, supported by their social and cultural sensitivity, language and cooperation & communicational abilities, partly acquired through experience in team work and possibly experiences of study abroad.

In the critical reflection report TIL, the authors argue that there are no (undisputed) requirements and criteria against which the final qualifications of the MSc TIL programme can be benchmarked (domain specific requirements for TIL-engineers). However, according to the visitation committee, the TIL-study convincingly argues that the MSc TIL programme is on a par with the needs and requirements of national and international interdisciplinary transport educational practice. The MSc TIL programme is built along similar principles as transport-related MSc programmes worldwide. The programme management compared the MSc TIL programme with "transport" MSc programmes offered abroad. MSc programmes in

transport are still predominantly hosted by civil engineering schools in the form of separate MSc programmes, tracks or specializations within the (civil) MSc programme. However, there is a trend towards broader oriented (multidisciplinary) transport MSc tracks. An example is the intercollegiate 1-year MSc Programme in Transport and two smaller MSc specializations offered by the University College (London) and Imperial College (London) jointly. According to the reflection report, the objectives of this initiative are in many respects comparable to those of TIL. The intercollegiate programme combines quantitative civil transport subjects (modelling, design) with the broader context (business, economics, policy). Other comparisons have been made with KTH (Stockholm), EPFL (Lausanne), KUL (Leuven). The participating groups in the MSc TIL have working relations with these universities.

Some characteristics of the programme are mentioned below. The MSc TIL programme prepares students for practice in which they need to function in multidisciplinary teams of professionals, in the transport industry, consulting firms or public organizations. Since 2011, the programme also contains (for practice) relevant and recognizable specializations such as Policy, Design, Engineering/Logistics and Operations. These requirements are recognized by the Netherlands Ministry of Infrastructure and the Environment (its executive arm Rijkswaterstaat) and engineering consultancies (see for further details on the update and strengthening of the programme Standard 2).

The visitation committee observes that the final requirements of the TIL programme are well described and that they meet international standards of the domain of transportation, infrastructure and logistics. Also the academic level (MSc) is well defined. The visitation committee is of the opinion the TIL programme has high ambitions with its goal to offer an interdisciplinary study in 'transportation engineering'. The visitation committee however, observes that the interdisciplinary fundamentals of the programme are loosely described. The final requirement - *able to work in an interdisciplinary setting* - needs a more detailed description and elaboration. This objective should describe more clearly how the interaction between disciplines and integration of knowledge can be organised (with an own set of tools and theories on interdisciplinary studies).

### *Considerations*

The visitation committee has studied the final attainment levels of the BSc and MSc programmes in Civil Engineering and the MSc programme in Transport, Infrastructure and Logistics. The visitation committee observes that the final qualifications of the Civil Engineering programmes are described properly. They match with international standards in the domain of civil engineering and comply with the international description of academic standards (Dublin descriptors) for BSc and MSc levels. The profile of both programmes is well defined. There is a balanced mix between the scope of the domain of civil engineering: broad and in-depth knowledge of the fundamental basics of CE. The BSc programme lays the foundation for further academic education on an MSc level, both in the Netherlands and abroad.

The MSc programme Civil Engineering educates for careers in civil engineering where academics are needed who first and foremost have knowledge and skills of the classical engineer (profound knowledge of technical core disciplines), combined with an attitude of being sensitive to societal and environmental effects of technical solutions and being able to communicate on these issues (the so called soft skills of the engineer). The visitation committee would like to advise TUD to continue its strong focus on the technical aspects of the programme of Civil Engineering.

Mutatis mutandis the above can be said of the MSc programme TIL. However, with regard to the final requirement - *able to work in an interdisciplinary setting* - the visitation committee believes that this goal deserves more focus. A more detailed elaboration will help the programme management to make sharper choices regarding the content of the TIL programme.

#### *Conclusion*

Based on above mentioned considerations, the visitation committee comes to the judgement **good** for the bachelor and master programmes in Civil Engineering and **satisfactory** for the master programme in Transport, Infrastructure and Logistics.

## **Standard 2            Teaching-learning environment**

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

#### *Findings*

#### Contents of the curriculum: the link between the intended learning outcomes and the contents of the curriculum

##### **Civil Engineering**

The content of the BSc and MSc programme and the volume of the modules are described in the study guide. The study guide describes the learning objectives for each module, the forms of education, assessment methods and the number of contact hours and hours of individual study. The visitation committee studied the study guide and the digital information portal (Blackboard) and observed that all modules give proper information on the intended learning outcomes.

The visitation committee observes that the BSc programme is being redesigned. There is an ongoing discussion on the focus of the BSc programme (breadth and depth discussion). This discussion will culminate in the near future in a conclusive statement regarding the essential parts of the BSc programme. In the present programme the applied science component has been emphasized (more than in the former programme). The committee agrees with this approach, as long as this does not negatively affect the current depth of (notably the technical) content of the programme.

The visitation committee concludes that the relation between the curriculum and the final qualifications of the BSc programme can be made more specific. In the MSc programme this relation is well defined.

### **Transport, Infrastructure and Logistics**

In a table in the critical reflection report, the final qualifications (standard 1) are matched to the six basic TIL programme components: fundamentals, specializations, electives, seminars, inter-disciplinary project and thesis (for details see the programme outline of MSc in TIL annex 2). The table shows that all final qualifications are covered throughout the programme by means of various didactical approaches, ranging from coursework (lectures) and individual practical work/assignments, to group assignments and projects. Two thirds (80 EC) of the 120 EC programme is reserved for modules, which in most cases combine lectures and individual or group assignments, and in some cases, projects. One third of the programme (40 EC) consists of projects, including the interdisciplinary project (in groups), the TIL seminars (in larger groups) and the final thesis (an individual project). The visitation committee concludes that there is a clear relation between the programme and the final qualifications.

Through choosing specific electives, students can trade coursework components for an additional research project or a traineeship at a public or private organization in the TIL domain.

### Contents of the curriculum: knowledge and skills

#### **Civil Engineering**

##### **General**

Both the BSc and the MSc programme in Civil Engineering pay attention to the academic level in terms of the content of the courses, the required research and design skills and the scientific orientation of the students. First of all this is achieved by employing teaching staff who are active in research and design on a daily basis. Some lecturers also have part-time appointments with research institutes or act as consultants, enabling them to combine the practical and academic aspects within their courses. Secondly, the academic orientation in the BSc programme is part of study components regarding research skills (e.g. data analysis, model validation and reporting), problem-oriented learning, working on projects in teams, as well as individual research and design. The BSc thesis work in particular includes reflections on the academic research and design processes and addresses the issues of scientific reporting and presentation. Thirdly, excursions and symposia are organised to enable students to obtain realistic impressions of the context of civil engineering practice as well as current research and design issues.

Content in the MSc courses is frequently updated to ensure that students gain state-of-the-art knowledge and an understanding of the practical limitations of concepts, with lecturers referring to their own research and/or design experience. Many different aspects of the programme are brought together in the MSc thesis. The composition of the thesis evaluation committees, and the intensive supervision of the thesis work (see standard 3) ensure both

the proper academic level and the relevance of the work. Furthermore, there is ample attention for the societal relevance and impact of civil engineering in programme activities such as project work and internships and in courses such as ethics.

### ***BSc programme in Civil Engineering***

The BSc programme contains 'learning lines', such as the fundamentals in mathematics, mechanics<sup>2</sup>, integral design and structural engineering, in which knowledge is acquired progressively. Each ten-week lecturing period includes a mathematics and/or mechanics module, which teaches the fundamental basic knowledge required by the civil engineer. In addition to the fundamentals, the three domains of civil engineering Structures, Water and Transport are introduced in the BSc programme. Basic knowledge of structures and skills in integral design are required for all domains. Both study components are an essential part of the BSc major.

Each year includes an integral design project of 6 EC. The content and methods involved in this form of project-based education, contribute to the students' problem-solving skills, creativity, design skills and cooperation skills. In addition, projects are used for the development of presentation, reporting and planning skills. In the third year, students familiarise themselves with an MSc track they prefer to take in the MSc programme. Two elective modules are available for each MSc track. By the end of the third year students are supposed to make a well-considered decision with respect to an MSc track.

Students who excel academically can participate in an Honours Programme. The full Bachelor's Honours Programme includes 20 EC in addition to the normal Bachelor's programme of 180 EC. The faculty's ambition is to have 6 percent of its students enrolled in the BSc Honours Programme by 2016.

In addition to the major programme, the programme in Civil Engineering offers various minors. The civil engineer is no longer a general engineer who is capable of solving problems in any domain, but a team player with a specific focus or specialisation. The various individual programmes (minors, electives, choice of projects) produce civil engineers with an individual profile.

The minors have primarily a broadening character. The fifth semester concerns a minor of 30 EC. Students are free to choose a minor of their choice within TU Delft or at an other university. Minors offered by the faculty are:

- Management of Building Processes;
- The 'Delta-thinker': Water for Later;
- Transport, Infrastructure and Logistics;
- Bend and Break;
- Bridging minor: Water and Soil.

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<sup>2</sup> This term encompasses basic and applied mechanics, such as construction mechanics, fluid mechanics, soil mechanics and materials science.

Students may also choose an individual minor. However, permission to do so is required from the Board of Examiners, which will assess the level and final attainments of the minor programme concerned. TU Delft offers a host of minors through its 'Minor Market'. On this market students are informed about the compatibility of a minor with the BSc programme in Civil Engineering.

The visitation committee looked into the content of modules and assignments and concludes that the content meets the standards of the bachelor level. Students, interviewed by the committee, are satisfied with the balanced mix of knowledge oriented study components and practice oriented components (such as projects and practical work assignments).

**MSc programme in Civil Engineering**

The MSc programme consists of seven tracks, with specialisations offered within each track (see annex 2 of this report). These tracks provide in-depth specialisation within the relevant domain. Students opt for a specific track when they start the MSc programme. The track coordinator keeps a record of the enrolled students. The first year of the MSc focuses primarily on the track-related components. The second year focuses on the electives and the MSc thesis.

All MSc students follow 56 EC of track-related courses and 4 EC of an Ethics module. The track-related block can be divided into a compulsory core for the track and a complementary programme for the specialisation. In an overview of the MSc programme of CE all the electives and compulsory parts of the programme and tracks are listed. The details can be found in the track descriptions of the Teaching and Examination Regulations (see also annex 2 of this report)

| MSc Civil Engineering curriculum   |  |
|--|--|
| First semester   | Second semester  |
| Track specific modules (56 EC)<br>Ethics module (4 EC)   |  |
| Third semester   | Fourth semester  |
| Choice of electives (20 EC) or 2 out of 4 alternatives:<br>Traineeship (10 EC)<br>Multidisciplinary Project (10 EC)<br>Elective modules (10 EC)<br>Additional Research Project (10 EC) | MSc Thesis (40 EC)<br>Within the faculty or with a company |

Through the block of electives in the third semester, students can further profile themselves as integrators, designers or specialists. The elective block of 20 EC is composed of a choice of two out of four components: internship, multidisciplinary project, elective modules and an additional MSc thesis. Due to the choices students make, cross-links between different tracks can be established. This is common practice for students in the tracks Structural Engineering, Building Engineering and also for students in the tracks Hydraulic Engineering and Water Management. Within the domain of Transport & Planning, students combine courses with Transport and Logistics and Management, Technology and Policy.



The MSc programme concludes with a final project. Supervised by a committee, students undertake a research project, create a design that includes all of the required calculations, develop a method for analysing specific aspects or design a specific part of a system within the graduation track specialisation.

The MSc programme also offers an Honours programme. The Master's Honours Programme consists of 30 EC. The faculty's ambition is to have 6 percent of its students enrolled in the MSc Honours Programme by 2016.

Since the previous visitation, the 120 EC framework for the masters programme and its components have been implemented. Due to this new framework, a number of changes had to be implemented within the track programmes. The most important changes are:

- module sizes have been increased to modules of 4 or 6 EC, yielding a better structured programme and more flexibility to combine modules.
- clear mandatory modules were implemented to strengthen each track in combination with specialisation-related courses.

The visitation committee looked into the content of modules and assignments and observes that the content meets master level standards. Students, interviewed by the committee, are satisfied with the balanced mix of research oriented components and practice oriented components (such as the projects and graduation work).

### **MSc programme in Transport, Infrastructure and Logistics**

According to the visitation committee, the academic orientation of the programme is clear. TU Delft identified "transport" as one of the key themes in the Delft Research Initiatives (DRI's). Within one of the DRI's (DIMI: Delft Infrastructure and Mobility Initiative), the TU Delft Transport Institute (TI) was established in the autumn of 2011. The research focus of TU Delft on transport follows from the internationally well-established research tradition that TU Delft offers in the TIL domain<sup>3</sup>.

The MSc TIL has strong links with the PhD research school on Transport, Infrastructure and Logistics (TRAIL)<sup>4</sup> that is also housed at TU Delft. TRAIL trains PhD candidates and supports scientific and applied scientific research in the fields of mobility, transport, logistics, traffic, infrastructure and transport systems. Several TRAIL staff members also teach in the MSc TIL programme. Both communities regularly mingle and interact during, for example, seminars and master classes.

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<sup>3</sup> To illustrate this point: in the period 2007-2012 two of the contributing research groups received the maximum score (4 times "excellent") in recent international research accreditations

<sup>4</sup> TRAIL is a collaborative initiative of five Dutch universities, and has been accredited by the Royal Netherlands Academy of Arts and Sciences as a formal Research School since 1997. Within TRAIL, six universities collaborate: Erasmus University of Rotterdam, Delft University of Technology, Eindhoven University of Technology, Twente University and Radboud University Nijmegen. Twelve faculties and institutes (spanning the fields of economics, technology, policy and management and the social and behavioural sciences) form a strong concentration of scientific experts in the fields of traffic and transport. Over 200 researchers, of whom about 80 are PhD candidates, are active in TRAIL

According to the visitation committee, the academic orientation of MSc TIL is made visible and operational in the curriculum. In the introductory module, emphasis is placed on scientific thinking and assessment, asking the right questions and being critical when collecting evidence (literature), and general aspects of academic work (methodology, literature review, epistemology) related to transport. In projects they apply the knowledge and are expected to show creativity and scientific rigor in the way they pursue their subjects.

The four TIL specializations closely link to areas that both research groups at TU Delft and elsewhere consider key areas for present and future research and development.

All TIL teaching staff members have an academic track record. They integrate the latest scientific findings in their modules, teach research methodologies and stimulate scientific thinking by their students.

The interdisciplinary character of the programme is realised through:

- individual choices of students. The individual programme must include a minimum of at least three modules provided by each of the three constituting faculties and their programmes.
- students work together in at least two interdisciplinary projects. One is embedded in the introductory module; the other is the 7 EC interdisciplinary project.
- interdisciplinarity is promoted through the mandatory composition of the thesis committee (that includes representatives from at least two of the three faculties ).

The visitation committee looked into the content of modules and assignments and concluded that the content meets master level standards. Students, interviewed by the committee, are satisfied with the balanced mix of research oriented components and practice oriented components (such as the projects and graduation work).

#### Structure of the curriculum: didactic concept and methods

##### **BSc and MSc programmes in Civil Engineering and MSc programme in Transport, Infrastructure and Logistics**

The instruction method selected depends on the learning objectives of the subject in question. While lectures and tutorials mainly contribute to the development of expertise and skills, the assignments, case studies, internships and thesis work, teach each student how to deal with open-ended and often poorly defined design problems creatively and effectively. This is the central theme throughout both the BSc and the MSc programmes, adjusted according to the required level.

Students interviewed during the visitation are satisfied with the methods of instruction used in the programmes of Civil Engineering and Transport, Infrastructure and Logistics.

#### Structure of the curriculum: student supervision and guidance

##### **BSc and MSc programme in Civil Engineering**

Student supervision and guidance is considered an important feature of the educational approach, especially in the BSc programme. Prior to the beginning of the academic year,

students are informed about the various aspects of the programme. Each first-year student has a second-year student as a mentor and a staff member as a tutor. Each mentor group, which consists of about ten students, has frequent meetings with its mentor during the first teaching period. Later, the frequency of these meetings decreases (once or twice during each teaching period). The tutor has group meetings, as well as individual meetings with the students from the mentor group in order to monitor the educational process of each student and to quickly respond to any problems that may emerge. The student counsellor monitors all students and oversees the actions of mentors and tutors by maintaining close contact with them. This mentor-tutor-counsellor system gives information on progress and results of the group of students as a whole and the individual student. The student counsellor informs students about their progress and the likelihood of attaining the BSA threshold of 45 EC, a requirement for continuing their study.

In order to stimulate students to study regularly (and hence prevent delay in study progress) many courses offer one or more mid-term examinations during the lecture period. This gives students the opportunity to complete a module during the lecture period. A regular examination is still offered as a back-up. In addition, many lecturers offer an extra lecture of a module before the retake. Although, in general the faculty is satisfied with its quality control system, more attention will be paid to students who experience serious delays or drop out of the BSc programme.

Students and supervisors meet on a regular basis, mainly to guide students through the process of writing the BSc thesis and to avoid delays. In order to maximise the flexibility of the programme and avoid study backlogs, there are four entry points for starting the BSc thesis project each year.

In the MSc programme support is provided by the student counsellor and the track coordinator. The track coordinator helps students to plan their modules and start the final thesis process. The MSc thesis committee also advises students on the planning of electives or interesting courses in other faculties which may be relevant for their thesis. The faculty has a student counsellor for students entering the MSc programme with an HBO degree. These students take a bridging programme and also have a mentor and tutor to help them with study planning.

In the MSc programme students make many individual choices. There is a mandatory programme for each track. In addition, students compose their individual programmes. The track coordinators see to it that students choose a coherent combination of mandatory courses and courses that apply to specific specialisations. The track coordinator is the principal contact person for students with questions about the programme.

The Graduation Committee guides the MSc thesis process from beginning to end. This is an extensive process for students as well as the daily supervisor and the graduation professor. (see standard 3).

To improve the feasibility of the programme, many lectures in both the BSc and MSc programme are videotaped and available through *Collegerama*. This enables students to review a lecture or watch a missed lecture online. This system has been in operation for a few years. *Collegerama* is extremely popular among students, as the students interviewed by the committee, stated.

Delft University of Technology, and in particular the Department of Water Management within the Faculty of Civil Engineering and Geosciences, has joined the OpenCourseWare Consortium, in which leading universities from around the world offer free online access to course content. TU Delft OpenCourseWare ([www.ocw.tudelft.nl](http://www.ocw.tudelft.nl)) offers all course materials free to anyone with online access. OpenCourseWare includes lectures and lecture notes, as well as content such as old tests and video recordings.

The faculty has an International Office and an Internship Office. Civil Engineering students who want to study abroad, as well as international students who come to study at the faculty (in exchange programmes or in the full Master's programme) and students seeking an internship, can apply to the International Office and the Internship Office.

Students with a BSc degree from a foreign institution may enter the TU Delft MSc programme. These students are selected on the basis of their marks and therefore have a higher pass rate than that of regular Dutch students. Their results are generally good.

### **MSc programme in Transport, Infrastructure and Logistics**

There are three levels of coaching/counselling available to TIL students, depending on the type of help they require. For individual questions concerning modules, students can turn to the teaching staff involved. Scheduling questions and programme choices are usually dealt with by the programme coordinator. The programme coordinator advises students on choices to be made in the programme and also solves practical issues that concern the entire group of students.

The third option open to students, is to consult the academic counsellors. They give advice and mediate in study choices and changes, study planning, study financing, study delays, force majeure and exceptional circumstances. Academic counsellors also provide individual coaching and guidance for problems involving motivation, discipline, planning and scheduling, study choice, graduation, adapting to student life, and to the Dutch state of affairs. The academic counsellor can also refer students to other professionals, if needed.

MSc TIL students come from various backgrounds. Around 60 percent of the students have a TU Delft BSc in Systems Engineering, Policy Analysis and Management (*Technische Bestuurskunde*), Civil Engineering, Mechanical Engineering, Aerospace Engineering, Industrial Design and Architecture. A smaller group of students come from other Dutch universities or from a Dutch university of applied sciences (HBO). Finally, there is a relatively large group of students with a BSc degree obtained abroad, in 2011 predominantly from Greece and China.

The visitation committee interviewed students with different backgrounds and nationalities. Students were satisfied with the way they are guided by the lecturers and informed about the programme. Students are very positive about the way students in heterogeneous groups

work together on assignments and projects. In these work groups students learn from each other by teaching each other.

Most of the students who start the programme, finish it with a diploma. Drop-out rates are very low, especially for the international students. The average length of study of the cohorts 2005 – 2009 is 2 to 2,2 years.

### Staff quality

#### **BSc and MSc programme in Civil Engineering**

Most of the lecturers who teach in the BSc and MSc programmes are also active in research. Of the lecturers who teach in the BSc and MSc programmes, close to 100 percent hold a university degree. The faculty stresses the importance of integrating research and education. Therefore, many of the lecturers are full professors and/or have a PhD (In the BSc programme 63 percent and in the MSc programme 75 percent).

The pre-period and post-period evaluations provide information on the quality of teaching. Feedback is provided by the Programme Director, other lecturers, students and support staff. This results in better adjustment of the modules themselves and coordination between different modules.

New lecturers who are hired by the faculty are expected to complete the Basic Teaching Qualification (Basiskwalificatie onderwijs, BKO) programme. Around forty percent of the current lecturers to whom this applies have completed this programme. The Director of Education facilitates lecturers in the programme, to ensure that they can complete the BKO.

The Director of Education organises educational seminars for all teaching staff in the faculty. These seminars cover a variety of subjects, such as study success, teaching methods, service teaching, programming and modelling software. The departments also organise their own educational days to focus on the education they provide.

The increase in student numbers in recent years, combined with the demand for more research output, limits the time lecturers have for making new ambitious improvements to the programme. A realistic assessment of resources is required, according to the faculty. The visitation committee agrees with the faculty's viewpoint.

The BSc programme uses lecturers from other faculties (service teaching) for the mathematics modules, which amount to a total of 26 EC (around 20% of the major programme). Modules occasionally use guest lecturers from professional practice in order to familiarise students with the broad field of civil engineering. Many of the lecturers appointed by the faculty also have experience in professional practice to which they refer in their modules.

Based on the interviews with lecturers and students and the overview of the curriculum vitae of lecturers, the committee concludes that the CE programme is delivered by a well-qualified staff.

## **MSc programme in Transport, Infrastructure and Logistics**

The teaching staff are strongly embedded in research and practice. All staff members have an academic background and many are involved in projects that combine academic research and business practice. The majority hold PhD degrees and over 30 percent of the lecturers to which this applies have also completed the University Teaching Qualification (UTQ) programme (Basis Kwalificatie Onderwijs, BKO) or are in the process of completing it. Obtaining the BKO is mandatory for all new lecturers at TU Delft who have less than five years of teaching experience. The university has started a pilot programme titled Senior University Teaching Qualification (SUTQ), which is a follow-up to the Basic UTQ course. The pilot programme will be evaluated in 2012. Education is an important subject in the annual result and development evaluation of all academic staff members.

Evaluations show that students are positive about the quality of the teaching staff. They are also satisfied with the knowledge level of staff in the field of TIL. However, according to the evaluations, more attention should be paid to feedback, which is provided but sometimes to a limited degree.

Based on the interviews with lecturers and students and the overview of the curriculum vitae of lecturers the committee concludes that the TIL programme is delivered by a well qualified staff.

### Quality of study programme-specific facilities

#### **BSc and MSc programmes in Civil Engineering**

The educational programme in Civil Engineering uses the following facilities:

- Stevin Structural Engineering Laboratory for macro-structures
- Materials Science Laboratory and Micromechanics Laboratory
- Geotechnology Laboratory
- Fluid Mechanics Laboratory
- Water Management and Sanitary Engineering Laboratory
- Driving Simulator
- Transport and Planning Facilities
- Road and Rail Laboratory
- Recycling Laboratory
- Computational resources with domain-specific software

The BSc programme includes a number of laboratory experiments on:

- Road and Building Materials
- Structures in Concrete, Steel and Timber
- Soil Mechanics
- Fluid Mechanics

Laboratory facilities are also used by students following a minor and in both the BSc and MSc thesis projects. The direct link with on-going research demonstrates to students the 'state of the art' in a specific field. The high operating costs of large laboratories, such as the Stevin Laboratories, have resulted in a further reduction in facilities for programmes including Structural Engineering and Hydraulic Engineering in recent years.

The committee inspected the facilities and is of the opinion that despite the cut-backs mentioned, the facilities are well-equipped and more than adequate in comparison to other (international) schools.

### **MSc programme in Transport, Infrastructure and Logistics**

Transport-related research facilities used within the TIL programme are:

- Data laboratory such as:
  - The Regiolab Delft/DANTE repository. This elaborate GIS-based data warehouse contains all operational traffic data from main roadwork undertaken in the Netherlands since 2006.
  - A similar database is available and used for all train operations in the Netherlands.
  - Also on a more strategic level (mobility and travel patterns), a wealth of data are available and used in coursework and projects.
- Simulation software on all scales are important tools that students need to master and – more importantly – interpret and improve. Examples that are used in modules and projects are:
  - FOSIM, VISSIM, NOMAD and various other traffic simulation tools;
  - Omnitrans / Transcad and other assignment tools;
  - ARENA, and various other specialized discrete simulation platforms.
- Experimental facilities
  - There are four driving simulators at TU Delft (at Civil, Mechanical and Aerospace Engineering) These are used in some modules, and several TIL students have used them in their final thesis projects.
  - The Group Decision Room (TPM) is available; it provides digital group meeting facilities to support the different steps in a problem-solving or decision-making process. Examples of collaborative tasks that can be supported using the Group Discussion Room are strategy building, crisis management, project evaluation, risk assessment and planning.
- Thesis Edulabs
  - ITS–Edulab Delft is a collaboration between TU Delft and Rijkswaterstaat (RWS) in which MSc final thesis students, PhD students and professionals work together in the field of traffic management on concrete problems and subjects identified by RWS (ITS–Edulab is located at RWS).
  - A similar collaboration exists with Schiphol (the SIM thesis lab, located at Schiphol Airport).

The committee inspected the facilities and is of the opinion that the facilities are well-equipped and more than adequate in comparison to other (international) schools.

#### How the quality of the educational learning environment is guaranteed

Students play a vital role in the evaluation process of the modules by means of direct feedback in the pre-period and post-period evaluation meetings and through the board of studies. Below the specific situation for Civil Engineering and Transport, Infrastructure and Logistics has been described.

## **BSc and MSc programmes in Civil Engineering**

Both pro-active and reactive tools are used for performing quality control. The visitation committee has seen evidence of this. An example is the way the faculty monitored the modification of the BSc programme in recent years. Due to the introduction of the major-minor structure (30 EC minor in the fifth semester) the study load for students in the first year increased. To avoid a detrimental effect on the feasibility of the first two years the study load was more evenly spread over the first lecture period, mid-term assessments were introduced during the lecture periods and guidance has been intensified (see also the section on guidance and coaching). The lecturers regularly evaluate the study load distribution in a meeting before the start of the lecture period (pre-period evaluation). These meetings are prepared and attended by the director of studies, the lecturers and representatives of the students.

The faculty (driven by the VSNU performance indicators which are adopted by the TU Delft) has the ambition to reduce the drop-out rate for the BSc programme to 22 percent in 2015. It's foreseen that this ambition cannot be achieved with the current programme. Therefore, further improvements will be required. This process has already been set in motion: introducing fewer modules in a single block (and consequently fewer examinations), introducing other methods of assessment and reducing the number of examinations during the examination period. The visitation committee fully agrees with this approach. The faculty wishes to maintain the total number of students entering the BSc programme. According to the faculty, the current number of incoming students is in balance with faculty resources. A further rise in student inflow would, according to the faculty, cause serious problems with regard to facilities as well as educational support by staff and hence jeopardize the quality of education.

According to the visitation committee, the redesign of the BSc programme is well-monitored by the faculty. The discussion about the following issues has been given special attention: what will be the focus of the programme, what will be the appropriate balance between breadth and depth. The visitation committee observes that the faculty and its Board of Examiners are well aware of the importance of this discussion.

Module evaluations are performed following the final examination at the end of each lecture period (by EvaSys)<sup>5</sup>. The results are discussed with all instructors, the Director of Studies, the Advisor Quality Assurance and students. During these discussions, possible improvements are debated, as well as the quality of the entire lecture period (post-period evaluation). These discussions also take the success rate of the course into account. All courses are evaluated every three years, and possibly more frequently, if recent evaluations give reason for doing so. If it is found that the study load of a specific course is higher or lower than the nominal study load, a discussion is started with the responsible lecturer and the Director of Studies. Based on this discussion, improvements are usually proposed in order to resolve the discrepancy.

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<sup>5</sup> EvaSys is an automated web-based evaluation tool that is used throughout the university to evaluate BSc courses. Since 2011, it has also been used to evaluate MSc courses and modules.

Evaluating the quality of written examinations is part of the regular course-evaluation procedure. Stakeholders are the lecturers, students, Board of Studies, Director of Studies, Student Council and Advisor Quality Assurance. Their role will be described below.

The lecturer may identify a problem with the examination when marking the students' answers. This forms the reactive part of the examination quality assessment. The proactive role lies with the Board of Examiners. Students play an important part in the quality-control process. They provide feedback on for instance the examination and the Board of Studies takes action, in cooperation with the Director of Studies, if problems occur. The Commissioners of Education representing the student association 'Het Gezelschap Practische Studie' often attend the post-period evaluation meetings to share their experiences. The Board of Studies plays a role in the evaluation cycle by evaluating the course descriptions in the study guide (i.e. information on learning objectives, materials, literature and assessment should be described clearly). The academic year is also evaluated using quantitative evaluation data (intake, graduation and success rates for modules). Each year, the Education Advisor Quality Assurance and the Director of Studies report on the outcome of evaluations. These reports are discussed in the Board of Studies.

The organisational embedding of quality control in the MSc programme is comparable to the method described above (BSc programme).

#### Developments since the previous educational visitation (2007)

The previous self-evaluation was conducted in 2006. Since then, the BSc / MSc programme has been modified due to the introduction of a minor programme of 30 EC. Since the previous education assessment, the outline for all MSc tracks has been changed. The most important changes are:

- Module sizes have been increased to modules of 6 EC and 4 EC, yielding a clearer programme and more flexibility to combine modules.
- Clear mandatory modules were implemented to strengthen each track in combination with specialisation-related courses.

In the critical reflection, the programme management reflects on the changes made in the MSc track in Transport & Planning. The motives for these changes are, to strengthen the profile of Transport & Planning with respect to the MSc programme in Transport, Infrastructure & Logistics, to improve the programme and study load and to link education to new lines of research. The track now focuses on quantitative analysis and design of traffic and transport systems.

The MSc programme has been modified in recent years. Small courses have been replaced by 4 EC or 6 EC courses and the core programme of track-related courses has been strengthened. The in-depth specialisation within tracks was positively affected by these changes.

Furthermore a series of Master Classes with a focus on thesis work has been organised to support MSc students with their research. Together with closer supervision of students writing their master's theses, more and more students are able to complete their theses within the scheduled six-month period, or slightly longer. In the previous education assessment in 2007 the visitation committee made an observation on the relatively long lead times of the final thesis work. In this respect progress has been made.

### **MSc programme in Transport, Infrastructure and Logistics**

To ensure the quality of the MSc TIL programme, the TIL quality management processes focus on two intertwined levels: level 1: Quality management of TIL components and level 2: Quality management of the TIL programme. Criteria for measuring both levels are defined and measurements instruments have been developed and applied.

An important 'early warning' tool for the quality of the programme is the IWT meeting (interfaculty work group TIL). These meetings are organized by the student board (Dispuut Verkeer) in which students discuss issues related to the TIL programme. IWT reports its findings to the Opleidingscommissie TIL (OC TIL, the TIL board of studies). The OC TIL itself also monitors the quality of the programme. Other sources of information are exit evaluations, feedback from external partners in public or private organizations, regular contacts with TIL alumni, feedback from academic partners in the TU Delft.

The modules of the TIL programme are evaluated every three years, and more frequently if a recent evaluation necessitate this. Via the EvaSys evaluations, information about each module is gathered. A complete monitoring cycle that encompasses evaluations and feedback for all programme modules is available for the MSc TIL. The IWT meeting also discusses the quality of the individual modules. Particularly project related module components are discussed with the programme director or the coordinator

### Developments since the previous educational visitation (2007)

TIL was redesigned in 2011. This reorganization was based on the previous accreditation and a number of critical reviews in the last few years. For the new and old programme outline of the MSc in Transport, Infrastructure and Logistics (see annex 2). The previous educational visitation (2007) had two main points of concern:

- the need for strengthening the coherence between the educational/didactical concept of the programme in relation to its goals. This point relates to the difference between offering modules from multiple disciplines (*multidisciplinarity*) versus the integration of those viewpoints
- the need for successful implementation of the quality control system, and the organization (visibility, accessibility) of student counselling, particularly for foreign students.

Not all of these points were sufficiently addressed in the autumn of 2010 when a new team of programme management and coordination was installed. The visitation committee observes that the organisation responded (very) late to the observations made by the committee in 2007. In 2010 – 2011 much repair work (in terms of quality assurance) has been done.

In the period January–March 2011, TIL staff discussed this situation. According to a SWOT analysis (*SWOT analysis of the TIL Programme before September 2011, dated February 2012*) both students and staff are satisfied with the interfaculty nature of the TIL programme. Among others, the freedom of choice for students and the interdisciplinary components of the programme are highly valued by the students. On the other hand, students also argued that due to the freedom of choice, they had to spend considerable time and effort designing an individual programme that not only suited their interests and talents, but was also feasible to follow (given the knowledge requirements of the chosen modules and complex scheduling). Moreover, there was a lack of possibilities to really specialize (in the form of a coherent package of modules and projects). The threats that both students and the new management team identified are closely related to the identified weaknesses: a lack of coherence and scheduling difficulties. One additional perceived threat relates to limited resources. According to the Board of the MSc programme in TIL the present number of incoming students (30–40 students annually), may not be enough to sustain the current organizational structure of the MSc TIL programme and comply with the programme's quality demands.

This SWOT analysis resulted in the setting up of two main objectives for the academic year 2011 – 2012.

First, the programme should be restructured in such a way that programme feasibility is guaranteed intrinsically through proper scheduling.

Second, programme coherence should be strengthened to ensure that the TIL programme offers not only breadth, but also sufficient methodological and scientific depth. With these objectives in mind, the MSc TIL programme was restructured in the period February–September 2011 according to the following principles.

The number of specializations was reduced from 12 (averaging 14 EC) to 4 (of 26–27 EC). Approximately a full year (fundamentals + specializations + several shared components) of this new programme is now completely scheduled. In terms of programme management, the exam and educational regulations were updated (and simplified) to match this new MSc programme. The quality assurance system has also been improved, simplified and formalized. With these measures, steering student study paths now focuses on a macro level (structure, contents, quality) instead of a micro level (feasibility of individual programmes in the old situation). A second organizational improvement is that all support (public relations, administration, educational affairs) has been formally transferred to the Faculty of CEG.

More than 30 students entered the programme in its new form in September 2011, while around 60 are still working within the old structure, although some have implemented some of the new arrangements in their programmes. In September 2011, the faculty started evaluating every component of the programme. This evaluation process is on-going.

The visitation committee endorses the measures to improve the programme. Results of the changes cannot yet be ascertained, but it is plausible that the measures taken, contribute in a positive way to realising the objectives set for the new programme. However, some organisational problems are persistent. For instance, scheduling in the second year of the new programme remains difficult.

Part of the TIL programme depends on the courses offered (MSc tracks) by other faculties. Changes made in the portfolios of MSc modules of these faculties might affect the TIL programme. Also the scheduling of short-term internships (highly valued by students and staff) in relation to specializations, is not always possible. The visitation committee concludes that the MSc programme TIL encounters the usual problems of a matrix organisation. The participating faculties are autonomous entities. Notwithstanding the will to cooperate, faculties take decisions that are not necessarily beneficial to the smooth running of the TIL programme organization. Cooperation has been successful so far due to the enthusiasm and the will of the deans and staff involved at all three faculties to collaborate. However, according to the critical reflection, faculty reorganizations (e.g. cuts in teaching staff, refocus of Research and Education portfolio) pose a potential threat to the future and day-to-day operation of the MSc programme TIL. According to the visitation committee, a lot can be gained by having the programme concentrate on a limited number of programmes that the students can choose from. The committee advises to focus on the depth of the programme and not on the breadth.

#### *Considerations and conclusion*

##### Coherent educational learning environment

In this section the committee discusses in which way the four elements of the educational learning environment: content of the curriculum, structure of the curriculum, quality of staff and quality of facilities, form a coherent entity.

##### **BSc and MSc programmes in Civil Engineering**

The visitation committee is very positive about the way the four elements of the learning environment are being put into practice by the faculty (BSc and MSc programme). The committee observes that the balance in the BSc programme between breadth and depth has the attention of the programme management as well as the Board of Examiners. The committee recommends not to reduce the current depth of the programme.

##### **MSc programme in Transport, Infrastructure and Logistics**

According to the visitation committee, the learning environment of the MSc in TIL is the best that can be achieved under the present circumstances. The programme direction is well aware of the volatile organisational setting in which it has to operate (see subheading Standard 2, quality control of this report). Due to the enthusiastic engagement and creativity of the CE programme staff, programme director, deans and staff of the cooperating faculties, the organisation is able to overcome the present organisational flaws. The visitation committee has given the organisational aspects less weight in its final judgement than the realised quality (content, structure and quality of staff and facilities).

Based on above mentioned considerations the visitation committee comes to the judgement **good** for the bachelor and master programmes in Civil Engineering and for the master programme in Transport, Infrastructure and Logistics.

## 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.*

### *Findings*

#### Assessment system

##### **BSc and MSc programmes in Civil Engineering**

Students are informed about the manner of assessment via the educational information system Blackboard. Students find information on the learning objectives and means of assessment of each module in the study guide. Therefore, students are aware of what is expected of them. Various methods of assessment are used: assignments, written examinations, computer assessments, project presentations and the BSc and MSc thesis. The Director of Education, the Board of Studies and the Board of Examiners see to it that a balanced mix of assessments is applied.

Module examinations are assessed numerically on a scale ranging from 1.0 to 10.0, evaluated in single decimals and rounded off to half-numbers. A mark of 6 is the lowest pass mark, thus making 5.8 the lowest mark on the decimal scale that will lead to a pass mark. Marks below 5.8 constitute a fail. The final BSc diploma is awarded only when a student has passed all module examinations.

Some modules also use mid-period assessments, which contribute to the final mark. In this way, the study load is distributed more evenly, while freeing study time for other modules that are still assessed during the regular examination period. In the 2011-2012 BSc programme, this system has been applied to the first lecture period, with promising results. It is expected that this will further increase the success rate amongst first-year students.

The faculty provides computer-aided self-study (COZ) in mathematics and mechanics. Digital assignments have to be completed during the lecture period. The faculty also publishes exercises from previous examinations, along with detailed answers. In most cases, the lecturer reserves some time towards the end of the lecture period in order to discuss previous examination questions with the students. The lecturer teaching the course prepares the examination questions and indicates the number of points that can be obtained for each sub-question.

Practical and project work is assessed through oral presentations and/or written reports and, in some cases, the attitude, initiative and independence of the students are assessed as well. Both individual and group works are assessed in such a way that individual marks are given to each student. According to the committee, the quality of the projects is high and compared to other (international) CE programmes, more than satisfactory.

The visitation committee discussed the assessment practice with students. Students are satisfied with the way they are informed on examinations and grading criteria.

### **BSc final assessment CE**

The BSc thesis work is related to the student's envisaged MSc track in CE to be followed. Students select a proposal from the special website for BSc thesis work. Two lecturers of different sections draw up a proposal. Each student is supervised by one of the lecturers. Weekly meetings are held to safeguard progress and the students receive guidance if necessary.

The Bachelor's thesis is assessed in accordance with the '*Manual for the BSc Thesis in Civil Engineering*', which describes the procedure and the method of assessment. According to the visitation committee, this manual gives proper directions to students and lecturers on the process and assessment of the thesis. At the end of each lecture period, students present their work before an audience of peers, attending staff and lecturers. The findings of the responsible lecturers are communicated and explained orally to the students. The lecturers also submit their findings in writing on the assessment form. In this way students receive feed back during the graduation process and can improve or correct (parts of) their thesis.

The BSc thesis coordinators for each track meet several times a year to evaluate the procedure along with and the obtained results and to advise the Director of Education whenever adjustments are required.

### **MSc final assessment CE**

The approach in the MSc in CE differs from that used in the BSc. The groups of students are much smaller and personal study programmes create heterogeneous groups of students. The assignments are larger, and students are expected to study at MSc level and have a certain degree of autonomy in their study choices. Lecturers are able to guide these groups in a more interactive manner by means of individual feedback and peer review. Opportunities for field work are offered and students sometimes participate in the research of the lecturers. Oral examinations are used for smaller-sized groups.

The MSc thesis is assessed by a thesis committee. The committee that assesses the thesis work (written report, presentation and content of the work), consists of at least three lecturers from at least two different sections, in order to guarantee objectivity. One of the committee members acts as a daily supervisor. A full professor is chairman of the committee. Committee meetings and frequent consultation with the daily supervisor ensure ample feedback and guidance. The assessment is based primarily on the work produced and the written report with a focus on the following aspects:

- originality and creativity;
- productivity;
- analytical ability;
- synthetic ability;
- approach method;
- answer or result with respect to the thesis research or design question (deliverables);
- written and oral presentation and response to questions.

Procedures for the MSc thesis are described in the *Graduation Protocol* and the *Rules and Guidelines* of the Board of Examiners.

TU Delft has established a university assessment and examination policy that has been adopted by all programmes in order to formulate faculty assessment and examination policies. In order to develop an assessment and examination policy for CE, the faculty conducted an initial evaluation of course descriptions, and developed a framework for testing policy (*Kader voor toetsbeleid*). Recently CE published a policy document on assessments (*Systeem van toetsing van de opleidingen Civiele techniek en Technische Aardwetenschappen, September 2012, draft version*). According to the visitation committee, this document makes clear how the faculty guarantees the quality of assessing the learning outcomes and the final attainment level of the programme. It is envisaged that this policy will be fully implemented by mid 2013.

In late June 2012, the central office of TU Delft conducted an internal audit of the faculty's assessment policy. The audit report states that within the faculty of Civil Engineering the way of testing differs between lecturers. It also states that the faculty works hard to improve its testing policy and testing practice. The visitation committee endorses this view.

The visitation committee discussed the assessment and examination policy document with the Examination Board of both CE and TIL. The visitation committee observed that these boards are actively working on the implementation so that this policy can be put into practice. The proactive role of the Board of Examiners is demonstrated in the recently published report on the '*Quality Review of the MSc thesis*' in which several MSc thesis reports of CE were reviewed by a subcommittee of staff members from different tracks. The review resulted in almost the same marks for the MSc thesis reports concerned. The Board of Examiners (BoE) also reviewed all the theses graded with a 6,0 or 6,5 in the period October 2009 – October 2011. Furthermore, the BoE stimulates lecturers to follow trainings on methods of testing and test construction. The BoE said that transparency of testing assumes an idea of consensus among lecturers on the policy of assessment and examination. There are different ways to realise this. For instance, it is a requirement for every lecturer that he/she obtains the *Basiskwalificatie Onderwijs* (this is a didactical qualification for lecturers). Furthermore, discussions are organised on the final requirements of CE and TIL in order to reach a more common and better specified set of final requirements for both programmes. The present definitions are considered rather global and therefore risk being multi-interpretable. The committee supports the initiative of the BoE to work them out in greater detail. The visitation committee concludes that professionalization on testing is high on the agenda of both CE and TIL and that the policy is being put in practice.

### **MSc programme in Transport, Infrastructure and Logistics**

Like CE, the MSc TIL programme adopted the TU Delft assessment and examination policy. The faculty of Civil Engineering and Geosciences coordinates the implementation of this policy in the MSc TIL programme in the three cooperating faculties of TIL.

The objectives of these shared policies are (a) to give an accurate reflection of whether students have actually met all the stipulated learning objectives and final qualifications of the programme, and (b) to formalize and make transparent how the quality of assessments and examinations are guaranteed.

Assessment practice in the MSc TIL programme is similar to the practice in the MSc CE. TIL students are assessed for each module they follow in the TIL programme. Modes of testing are oral or written examinations, a review, paper or report, or a combination of the former methods.

In projects like the interdisciplinary project and the final thesis grading is based on four components, which coincide with the final qualifications mentioned in standard 1. Criteria are described in the critical reflection and in the examination rules.

MSc TIL has a number of arrangements in place to ensure that the learning outcomes are on a par with the quality standards set by the steering committee of the TIL programme. First the graduation committees see to it that the final thesis is properly assessed. Each TIL graduation committee consists of at least three TIL staff members from at least two of the contributing faculties to ensure that multidisciplinary (integration across at least two TIL domains) is realized. The chair of the graduation committee is a full professor affiliated with one of the three contributing TIL research groups (T&P at CEG; TEL at 3mE and T&L at TPM), at least two other staff members (both daily supervisors) from two contributing faculties and if a student undertakes his/her thesis study externally, also a supervisor at the host organization (e.g. Rijkswaterstaat, Schiphol, etc.). In each thesis project, at least four formal meetings take place: a kick-off meeting, a mid-term meeting, a green-light meeting and the thesis defence. The two daily supervisors meet their students every two or three weeks.

Thesis reports are assessed according to standardized assessment forms and judged against a set of criteria such as: the scope and complexity of the problem, application of theories/methods, use of literature, quality of reasoning, the degree of interdisciplinarity / multidisciplinary, and balance between technical / mathematical / engineering / socio-technical context (the TIL calibre) and critical judgement of own research, design and results.

There are additional elements that determine the final grade given to the thesis project such as the communication and presentation of the work during formal and informal meetings, the defence (presentation and examination meeting), the thesis process itself (timing and planning, level of independence, incorporation of feedback), etc. The thesis supervisor (the examiner) carries final responsibility for ensuring that the graduation committee reaches consensus about the final grade on the basis of all these aspects.

An extra safeguard for arriving at objective assessments, is the review of final thesis reports by the TIL Board of Examiners. In the spring of 2012, the Board randomly selected ten reports to be graded by three independent reviewers. The average grade given by the reviewers differed by less than half a point from the final grade given by the graduation committee, with one exception (regarding a thesis with an exceptionally high mark). This thesis review proves that overall the assessment procedures within MSc TIL function well and that the final grades for the thesis projects are based on consensus amongst peers as to the final attainment levels. In a number of the reviewed TIL theses, both reviewers and the graduation committee were critical about the interdisciplinary character of the work presented, but impressed with the scientific depth and methodological quality.

According to the visitation committee, the assessment procedure guarantees that the thesis is being judged from different perspectives and that the final grade is as objective as possible.

### Realisation of the intended learning outcomes

#### **BSc and MSc programmes in Civil Engineering**

The professional field (research institutes and academia, engineering and construction firms and consultants firms) is satisfied with the level and quality of the graduates. The Foundation for the Education of Civil Engineers (Stichting OCIB) is periodically asked to evaluate the BSc and MSc programmes of CE. Civil Engineering alumni are employed across the whole domain as integrators, designers and specialists, and they also go on to hold senior positions. In the business world they mainly fulfil management positions, or are employed as professional specialists, often working on topical and unique projects. Employers are particularly satisfied with their analytical ability and problem-solving attitude. They also value the way in which young civil engineers can be deployed flexibly in large-scale design, construction, finance and maintenance contracts.

A recent study in this area by the Association of Dutch Builders (Vereniging van Nederlandse Constructeurs) shows that in the view of the professional field, structural engineering graduates across the whole breadth of the discipline have sufficient skills to comply with demands made by businesses and government.

Dutch practice shows that almost all BSc degree holders continue their studies by following an MSc programme of their choice at TU Delft and many other universities in the Netherlands and abroad. Therefore, it is not easy to assess the academic level of the BSc programme on the basis of reactions from the industry. BSc graduates who continue their studies in the MSc programme in CE have no difficulty in the transition from the BSc to the MSc programme and generally perform very well. Experience so far shows that the TU Delft students are eagerly accepted abroad. This demonstrates the good harmonisation between the BSc programme and (foreign) BSc and MSc programmes.

The visitation committee studied seven BSc theses and seven MSc theses of the CE programme. The visitation committee judged these theses according to the following criteria: problem definition and relevance of the thesis for the CE domain, quality of the problem definition, the applied methodology and justification of the methods used, use of data and accuracy of academic reasoning, quality of conclusions and recommendations, compliance with the BSc or MSc level (Dublin descriptors), and finally the judgement of the thesis work by the examiners. In all cases the visitation committee judged more or less the same as the examiners of the theses. In some cases the motivation for the judgement according to the assessment format could have been more specific. However, the visitation committee is satisfied with the grading of these theses.

### **MSc programme in Transport, Infrastructure and Logistics**

The critical reflection of TIL refers to an evaluation among nine alumni (spring of 2012). The evaluation shows that alumni from the TIL programme are well equipped to enter the employment field. The group of respondents is heterogeneous and consists of two PhD students at TU Delft and employees of Arcadis and DHV (engineering consultants), DuraVermeer Infra (a large contractor), NACO (airport consultants), NedTrain (Dutch railways), CEVA Logistics and the Ministry of Infrastructure and Environment. This small cross section is not representative but gives some insight in the final outcomes of the TIL programme. Alumni regard the interdisciplinary project, the thesis project, the TIL seminars and various more specialized modules, the scientific attitude and being encouraged to think analytically, as very useful. In the category 'least useful' alumni mainly cited specialization modules that are not relevant to their current field of employment.

Overall, the MSc TIL was ranked 'good' by all alumni (on a scale: bad, moderate, good, very good). Among the points of critique and recommendations for improvement, alumni mentioned the relative lack of scientific depth (both issues are discussed in Standard 2 and were the main motivations for the faculty to reorganise the programme).

The visitation committee studied seven MSc theses of the TIL programme and judged the theses according to the following criteria: problem definition and relevance of the thesis for the domain of TIL, quality of the problem definition, used methodology and justification of the methods applied, use of data and accuracy of academic reasoning, quality of conclusions and recommendations, compliance with the MSc level (Dublin descriptors), and finally the judgement of the thesis work by the examiners. In all cases the visitation committee judged more or less the same as the examiners of the theses. In some cases the motivation for the judgement according to the assessment format could have been clarified in more detail. In general the visitation committee is satisfied with the grading of these theses. However, the visitation committee considers those theses with a mark of 8,5 - 9 or above, as being scored too favourably. MSc TIL has set itself high goals regarding interdisciplinarity (see standard 1). According to the committee, the TIL theses reviewed by the committee certainly meet MSc standards but do not yet show a sufficient top-level of interdisciplinarity. Therefore, according to the committee, there is still room for improvement in order to reach the high goals set in standard 1. The high ambition of TIL should be reflected in the grading of the thesis work.

#### *Conclusion*

Based on the above mentioned considerations the visitation committee comes to the judgement **good** for the bachelor and master programmes in Civil Engineering and **satisfactory** for the master programme in Transport, Infrastructure and Logistics.

### 3 Final judgement of the study programme

#### *Assessments of the standards*

The visitation committee comes to the following judgements with regard to the standards:

| Standard   | BSc CE | MSc CE | MSc TIL      |
|--|--------|--------|--------------|
| 1 <i>Intended learning outcomes</i>                | Good   | Good   | Satisfactory |
| 2 <i>Teaching-learning environment</i>             | Good   | Good   | Good         |
| 3 <i>Assessment and achieved learning outcomes</i> | Good   | Good   | Satisfactory |

#### *Considerations*

Weighing of the judgements with regard to the three standards based on the justification for the standards and according to the NVAO assessment rules:

- The final conclusion regarding a programme will always be “unsatisfactory” if standard 3 is judged “unsatisfactory”.
- The final conclusion regarding a programme can only be “satisfactory” if at least two standards are judged “satisfactory”; one of these must be standard 3.
- The final conclusion regarding a programme can only be “good” if at least two standards are judged “good”; one of these must be standard 3.
- The final conclusion regarding a programme can only be “excellent” if at least two standards are judged “excellent”; one of these must be standard 3.

#### *Conclusion*

The visitation committee assesses the quality of the  
bachelor of science programme in Civil Engineering as **good**;  
master of science programme in Civil Engineering as **good**;  
master of science programme in Transport, Infrastructure and Logistics as **satisfactory**.



## 4 Recommendations

### Standard 1

#### *Civil Engineering*

The committee recommends to continue further specifying the relation between curriculum and final qualifications for the new BSc programme.

The MSc programme Civil Engineering educates students for a career in civil engineering where academics are needed who first and foremost possess the knowledge and skills of a classical engineer (profound knowledge of technical core disciplines), combined with a sensitivity for societal and environmental effects of technical solutions and the ability to communicate these issues (developing so-called soft skills of the engineer). The visitation committee advises TUD to continue to focus on the technical aspects of the programme of Civil Engineering. An engineer develops and designs. This must be recognisable in the final results of the students.

#### *Transport, Infrastructure and Logistics*

Mutatis mutandis the above can be said of the MSc programme TIL. However, the visitation committee would like to express its view with regard to the final requirement *able to work in an interdisciplinary setting*. The visitation committee observes that in the programme, the interdisciplinary fundamentals are loosely described. Interdisciplinary skills however, are a main feature and goal of the TIL programme. According to the visitation committee, this goal deserves more focus and needs to be outlined in greater detail. This programme objective should describe more clearly how the interaction between disciplines and integration of knowledge can be conceptualized and analytically organised (with a core set of tools and theories for interdisciplinary study in the field of TIL).

### Standard 2

#### Civil Engineering

The BSc programme in Civil Engineering is under (re)construction. Choices will have to be made regarding feasibility of the study programme and breadth and depth of the curriculum content. The visitation committee recommends continued focus on the depth of the programme. This is a current valuable feature that distinguishes the programme in CE from those at other universities in the Netherlands and abroad. Traditional engineering competencies like in-depth knowledge of mathematics, mechanics and design are the basis for further mastering the professional skills of an academically trained engineer.

In addition to choices regarding feasibility, a realistic assessment of resources is also required (staff capacity) to safeguard the improvements that need to be implemented in the coming years.

*Transport, Infrastructure and Logistics*

Taking into consideration the availability of limited resources, it is advisable to accentuate the TIL profile and structure the programme around fewer modules to further strengthen its academic depth and avoid widening the scope of the study programme.

**Standard 3**

*Transport, Infrastructure and Logistics*

Describe in more detail the assessment criteria for judging the interdisciplinary components of the thesis work of the MSc programme in TIL.

## 5 Annexes



## **Annex 1: Final qualifications of the study programmes**

### **Civil Engineering and Transport, Infrastructure and Logistics.**

#### **BSc programme in Civil Engineering**

##### **A. General competences**

Students gaining a degree upon completion of the BSc programme in Civil Engineering are expected to be able to demonstrate the following learning outcomes:

1. A basic understanding of scientific knowledge, analysis and research methods that build upon the underlying fundamental principles of mathematics, mechanics and materials and the ability to apply these to the field of civil engineering
2. The ability to interpret and apply methods and paradigms of scientific civil engineering activities, meaning:
  - a. Understanding common models and results of relevant studies required for engineering, design and implementation of technical systems
  - b. The ability to apply methods and techniques and to integrate, evaluate and expand knowledge and understanding, with the aim of solving civil engineering problems and carrying out projects
  - c. The ability to collect and evaluate arguments, assumptions, abstract concepts and data in order to draw conclusions and contribute to the solution of complex issues
3. Knowledge about the main developments and issues within the field of civil engineering formed by the themes of water, structures, and transport; awareness of the relationships with other disciplines (including public administration, law, economics and ecology) and the ability to describe and evaluate technical and societal implications
4. The ability to work in teams on research and design projects with an integral character
5. The ability to communicate information, ideas, problems and solutions to specialists and non-specialists
6. Awareness and understanding of the ethical, aesthetic, ecological, social and economic impacts of interventions on safety and the environment
7. The academic ability to independently develop further professional growth
8. Awareness of uncertainty, ambiguity and limits in knowledge and information.

##### **B. Skills and competences in a particular field of expertise include:**

1. A systematic understanding of the principles of the field
2. Basics of the design and research methods in the field of civil engineering
3. Initial training in the use of theoretical knowledge and methods of research and modelling
4. Basic knowledge of the domains of civil engineering and the coherence between the domains
5. An analytical way of thinking as expected in a particular field
6. Awareness of the relationships with other disciplines.

## **MSc programme in Civil Engineering**

Students gaining a degree upon completion of the MSc programme in Civil Engineering are expected to be able to demonstrate the following learning outcomes:

1. A thorough understanding of scientific knowledge, analysis and research methods that build upon the underlying fundamental principles of mathematics, mechanics and materials and the ability to apply these to the field of civil engineering.
2. The ability to independently interpret paradigms and apply and generate methods of scientific civil engineering activities, specifically:
  - a. Understanding formal models and results of relevant studies required for the engineering, design and implementation of technical systems
  - b. The ability to apply and create methods and techniques and to integrate, evaluate and expand knowledge and understanding, with the aim of solving complex civil engineering problems and carrying out projects
  - c. The ability to collect, evaluate and generate arguments, assumptions, abstract concepts and data in a variety of ways in order to draw conclusions and contribute to the solution of complex issues, in an international setting
  - d. The ability to initiate new developments in research, engineering and/or design.
3. Knowledge about developments and issues related to a specific MSc track, awareness of the relationships with other disciplines (including public administration, law, economics and ecology) and the ability to describe and evaluate technical and societal implications
4. Understanding of the multidisciplinary nature of civil engineering and the ability to perform well in design and research teams working on integrated projects
5. The ability to express ideas, theories, complex problems and solutions clearly, both verbally and non-verbally, to a variety of groups including experts and non-experts, in the English language
6. Awareness and understanding of and the ability to make considerations based on academic principles regarding the ethical, aesthetic, societal, ecological and economic impact of interventions on safety and the environment
7. The academic ability to independently develop further professional growth
8. Awareness of uncertainty, ambiguity and limits in knowledge and information.

## **Final attainment levels MSc programme in Transport, Infrastructure and Logistics:**

Master's graduates will:

1. be capable of being analytical in their work, on the basis of a broad and deep scientific knowledge;
2. be able to synthesize knowledge and to solve problems in a creative way when dealing with complex issues;
3. possess the qualities needed for employment in circumstances requiring sound judgement, personal responsibility and initiative, in complex and unpredictable professional environments;
4. be able to assume leading roles, including management roles, in companies and research organizations, and be able to contribute to innovation;

5. be able to work in an international environment, helped by their social and cultural sensitivity and language and communication abilities, partly acquired through experience of team work and any study periods abroad;
6. possess an awareness of the possible ethical, social, environmental, aesthetic and economic implications of their work and the insight to act accordingly;
7. possess an awareness of the need to update their knowledge and skills.

In addition, Master's graduates should possess the following kinds of competence:

1. required core knowledge and understanding in their field of study;
2. knowledge of methods and technical practice in their field of study; training in theoretical knowledge and methods, including modelling;
3. advanced knowledge of specific areas in their field of study;
4. specific attitude and way of thinking expected in a particular subject;
5. awareness of connections with other disciplines and ability to engage in interdisciplinary work.

The programme's final attainment levels are to prepare successful participants for an active role in society that is related in some way to the transport field.

MSc TIL-domain specific final-qualifications for MSc TIL students are:

### **1. Knowledge and Understanding of the TIL-domain**

#### **a. Scientific Disciplines:**

Has a profound understanding of the TIL-domain. Has demonstrated broad understanding of the scientific disciplines that relate to the TIL-domain. Has systematic knowledge about the socio-technical context of TIL-systems. Has a broad understanding of the required knowledge in respect of research and design related to the TIL-domain.

#### **b. Inter-disciplinary:**

Understands insightfully how to act in an interdisciplinary manner and how to bridge and integrate the knowledge between several disciplines and the temporal and techno-social context of TIL-systems.

#### **c. Contribute:**

Is able to make considerable research and/or design contributions to the TIL-domain through original research and/or design that extends the traditional frontiers of knowledge towards integrative TIL-knowledge by means of developing a substantial body of work, corresponding with the level of national and international refereed publications.

### **2. Application of knowledge and understanding within the TIL-domain**

#### **a. Scientific Approach:**

Has a critical attitude and is able to apply a systematic scientific approach characterised by the development and application of theories, methods, models and coherent interpretations (both in doing research and designing) in the TIL-domain.

- b. **Problem Solving:**  
Is competent in applying problem solving abilities in new or unfamiliar environments within broader, multi-disciplinary and/or inter-disciplinary contexts related to the TIL-domain.
- c. **Doing Research:**  
Has demonstrated the ability to acquire new scientific knowledge in respect of the TIL-domain through a substantial process of research by means of the development of new knowledge and new insights in a purposeful and methodological way.
- d. **Designing:**  
Has largely demonstrated the ability to apply a substantial design process by means of applying synthesizing activities aimed at the realization of new or modified artefacts, processes and/or systems within the TIL-domain, with the intention of creating value in accordance with predefined TIL-domain-related requirements and desires.

### **3. Judgemental skills**

Has the ability to gather, integrate and interpret relevant, incomplete or limited data, information and knowledge, and understands the complexities in the TIL-domain to reason about and reflect on possible social, scientific and ethical responsibilities linked to the application of this data, information and knowledge to form judgements.

### **4. Communicational and co-operational skills**

- a. **Communication:**  
Has the competence to clearly and unambiguously communicate information, ideas, problems, problem solving approaches, their origins and possible solutions to both audiences of specialists (peers within the TIL-domain, the larger scholarly population) and non-specialists (society in general).
- b. **Co-operation:**  
Has the competence to effectively work with and for others on complex problems of the TIL-domain in inter-disciplinary teams (colleagues and non-colleagues) and arenas (several organizations that have influence on the outcome "together") by judging the background, positions, desires, cultural habits, and the political and strategic behaviour of the members of these teams and arenas.

### **5. Learning skills**

- a. **General Learning:**  
Has developed considerable learning skills necessary to undertake further study autonomously.
- b. **Relational Learning:**  
Has developed broad appreciations to judge, gather and apply relevant and "new" knowledge to its existing body of knowledge as a result of interdisciplinary teamwork working on complex problems to reach feasible solutions.

## Annex 2: Study programmes

### Programme outline Civil Engineering

The degree programmes in Civil Engineering consist of a three-year BSc programme (in Dutch) and a two-year MSc programme (in English). Both programmes are based on four lecturing periods of ten weeks.

In the modules and projects in both the BSc and the MSc programme, attention is paid to societal problems and the way in which Civil Engineering can contribute to solving them. Such problems require an integral approach and skills to combine the knowledge acquired in the separate modules. Examples include sustainability, lifecycle management, integral water management, impact on health, traffic congestion, the quality of the built environment and environmental management.

#### **BSc programme**

The BSc programme of 180 EC is offered in three years. The first 120 EC are covered by a fixed

programme, with a 30 EC minor in the third year. The last semester of the BSc primarily concerns the MSc orientation and the BSc thesis work along with a few generic modules.

- 60 EC first year (*propedeuse*) / introduction
- 60 EC core major modules
- 30 EC minor
- 20 EC track-related electives
- 10 EC BSc thesis

A substantial part of the BSc programme is used for the engineering fundamentals, such as mathematics and mechanics. As an introduction to Civil Engineering, the programme is divided into three domains:

**Water**, also referred to as the “wet domain”

**Structures** (*Bouw*), also referred to as the “dry domain”

**Transport**

The BSc programme concludes with the awarding of a BSc diploma in Civil Engineering. In addition, a special Honours Programme is available to students who excel academically. The focus in this additional programme is on individual and in-depth development for exceptional students.

#### **MSc programme**

The 120 EC programme consists of the following main components:

- 60 EC track-related courses
  - 20 EC combination of elective components:
    - 10 EC free electives at MSc level and/or
    - 10 EC additional thesis and/or
    - 10 EC internship and/or
    - 10 EC multi-disciplinary project
- [20 EC free electives is also allowed]

- 40 EC MSc thesis work

In the MSc programme a more refined division is used within the Civil Engineering domain. The MSc tracks, each with their own specialisation, cover the whole domain. This subdivision also follows the structure of the three domains of Civil Engineering.

Students will opt for a specific MSc track when they start the MSc programme.

Specialisations are offered within each track. An overview is provided below.

The MSc programme concludes with the awarding of an MSc diploma in Civil Engineering.

The selected track is also mentioned on the diploma.

In addition, a special Honours Programme is available to students who excel academically.

A special certificate may be issued for supplementary components amounting to at least 16 EC. These additional credits must be a coherent entity with sufficient depth and high standards.

#### Tracks and specialisations within the MSc programme in Civil Engineering

| Track   | Specialisation   |
|---|--|
| Water Management  | <ul style="list-style-type: none"> <li>- Sanitary Engineering</li> <li>- Hydrology</li> <li>- Water Resources Management (including Hydraulic Engineering and Water Resources Management, double degree programme in conjunction with the National University of Singapore)</li> <li>- Water Management and Engineering (joint track with Hydraulic Engineering)</li> </ul>  |
| Hydraulic Engineering   | <ul style="list-style-type: none"> <li>- Coastal Engineering</li> <li>- Erasmus Mundus track in Coastal and Marine Engineering and Management [CoMEM]</li> <li>- Rivers, Ports and Waterways</li> <li>- Environmental Fluid Mechanics</li> <li>- Hydraulic Structures and Flood Risk</li> <li>- Double Degree in Hydraulic Engineering and Water Resources Management, double degree programme in conjunction with the National University of Singapore</li> <li>- Water Management and Engineering (joint track with Water Management)</li> </ul> |
| Geo-Engineering<br>(joint track with MSc programme in Applied Earth Sciences)             | <ul style="list-style-type: none"> <li>- Geomechanics</li> <li>- Geotechnical Engineering</li> <li>- Underground Space Technology</li> <li>- Engineering Geology</li> <li>- Environmental Engineering</li> </ul>   |
| Geoscience & Remote Sensing<br>(joint track with MSc programme in Applied Earth Sciences) | No specialisations   |
| Structural Engineering  | <ul style="list-style-type: none"> <li>- Structural Mechanics</li> <li>- Materials and Environment</li> <li>- Concrete Structures</li> <li>- Steel and Timber Structures</li> <li>- Road and Railway Engineering</li> <li>- Hydraulic Structures</li> </ul>  |
| Building Engineering  | <ul style="list-style-type: none"> <li>- Building Technology &amp; Physics</li> <li>- Structural Design</li> <li>- Design and Construction Processes</li> </ul>  |
| Transport & Planning  | No specialisations   |

For all MSc tracks and its specialisations detailed information is made available to students on:

- the focus of the track
- specific objectives of the track
- specific skills for the specialisation
- details on the master level of the track

### **Programme outline MSc in Transport, Infrastructure and Logistics.**

#### **The old TIL programme**

The TIL programme structure for all students who entered the programme in and before 2010 consisted roughly of the following components:

- 24 EC in four mandatory essentials (one TIL-specific introductory module and three foundation modules from the participating faculty MSc tracks).
- 16 EC of mandatory TIL-specific projects and seminars.
- Between 26 and 36 EC from initially three and later two (of 12) specialization packages, each between approximately 12–16 EC worth of modules, projects, etc., drawn from each of the three contributing MSc programmes/tracks. To ensure an interdisciplinary character, a number of rules and regulations impose restrictions on which combinations of packages can be chosen.
- To ensure an interdisciplinary character, the basic rationale is that throughout the programme students gain at least 12 EC from each faculty-specific MSc programme/track.
- 30 EC in a final thesis project with contributions from at least two of the three faculties.

## The new TIL programme

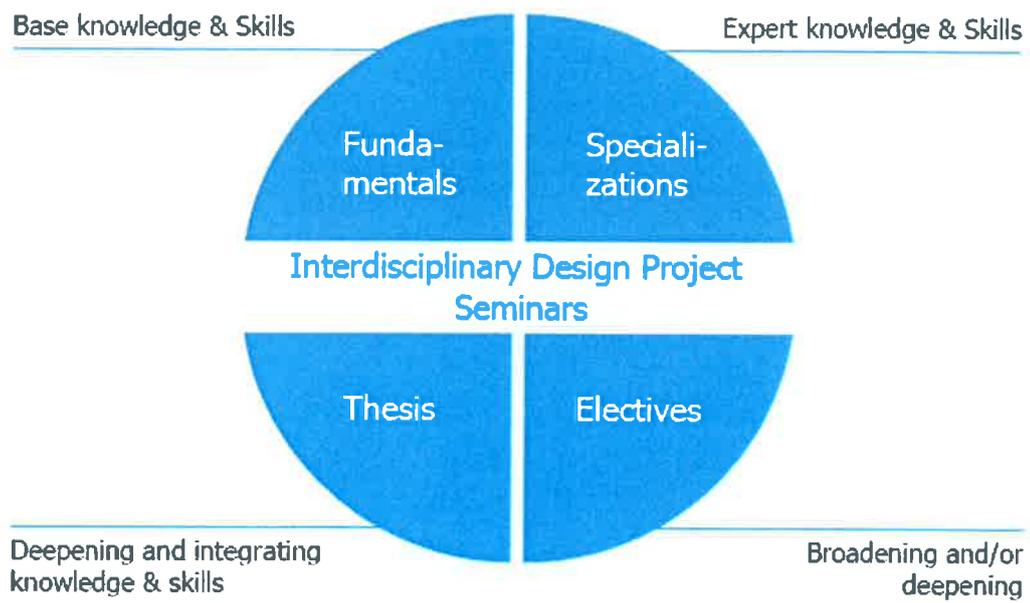
### Programme cohesion and overall structure

Figure 3 outlines the functional structure of the new MSc TIL programme, which consists of six parts. There are three types of courses (80 EC) in the programme: fundamentals, specializations and electives. They contribute to the interdisciplinary character of the programme.

- **Fundamentals** (27 EC): foundation courses from each of the three participating faculties and one shared introduction module covering the entire TIL field. They give a broad and systematic insight into the design and analysis of TIL facilities, TIL systems, TIL arenas and their environment.
- **Specializations** (26-27 EC): packages of courses with a common theme or application domain. Students must, according to their interests, choose one out of four specializations:
  - **Specialization P – Policy: Infrastructure, Planning and Environment**, focusing on transport, spatial and environmental policy development and assessment as well as on infrastructure and spatial planning;
  - **Specialization D – Design: Transport Systems and Networks**, focusing on transport service and infrastructure network design in the context of urban design, spatial planning and regional economy;
  - **Specialization O – Operations: Traffic, Technology and Control**, focusing on the operational management and control of traffic in transport systems and the technologies and methodologies facilitating this and
  - **Specialization E – Engineering: Transport, Logistics and Supply Chains**, focusing on control and optimization of transportation and production systems and the supply chains to which these belong.
- **Electives** (26-27 EC): separate courses that students can choose to help them to satisfy their specific knowledge needs. They are available from all contributing MSc programmes and should be chosen one of each programme:
  - **Electives T&P – Transport & Planning**, provided by the MSc programme Civil Engineering, track Transport and Planning;
  - **Electives T&L – Transport & Logistics**, provided by the MSc programme Systems Engineering, Policy Analysis and Management, domain specialization Transport and Logistics;
  - **Electives TEL&PEL – Transportation Engineering**, provided by the MSc programme Mechanical Engineering, track Transportation Engineering, specialization Transport Engineering and Logistics and specialization Production Engineering and Logistics;
  - **Electives TIL – Other TIL fields**, provided by various MSc programmes, including TIL related fields such as air transport, maritime transport, systems and control, etc. and
  - **Free electives and projects**, optional choice of elective projects (research project or internship) and free electives

The remainder of the programme consists of full projects, together with seminars (40 EC). Projects and seminars is made up out three parts:

- **TIL Seminars** (3 EC): arena of the MSc TIL community, organized for and by MSc TIL students; a bi-weekly activity in which all MSc TIL students actively participate in discussions about a wide range of TIL related topics.
- **Interdisciplinary Design Project** (7 EC): a complex interdisciplinary group design task; a final test in interdisciplinary collaboration in a project context to analyze a complex TIL-related situation and to develop design alternatives.
- **Thesis Project** (30 EC): an individual graduation project; a final individual research or design project to see if the student masters the TIL field.



**Figure 3** Functional outline of the MSc TIL Programme



### **Annex 3: Expertise members audit panel and secretary**

#### **BSc Civil Engineering, MSc Civil Engineering and MSc Transport, Infrastructure and Logistics**

##### De heer prof. dr. ir. R.E.C.M. van der Heijden, voorzitter

De heer Van der Heijden is ingezet vanwege zijn voorzitterscapaciteiten (diverse adviescommissies en sinds 2011 als decaan van de Faculteit Managementwetenschappen van de Radboud Universiteit) en zijn inzicht in het vakgebied Civiele Techniek en Technische Bestuurskunde, in het bijzonder Transportbeleid en Logistieke Organisatie. De heer Van der Heijden heeft jarenlange onderwijservaring (van universitair (hoofd)docent tot hoogleraar) bij de Technische Universiteit Delft en de Radboud Universiteit Nijmegen. De heer Van der Heijden beschikt tevens over internationale deskundigheid gezien zijn deelname aan internationale congressen, zijn bijdrage aan talloze internationale tijdschriftartikelen en publicaties. De heer Van der Heijden beschikt over auditdeskundigheid door o.a. zijn deelname als voorzitter van de onderwijsvisitaties Civiele Techniek (Delft/Enschede) in 2006 en Verkeerskunde (U Hasselt te België) in 2012 en enkele onderzoeksvisitatiecommissies.

Voor deze visitatie heeft de heer Van der Heijden onze handleiding voor panelleden ontvangen en in een voorbereidende vergadering is hij aanvullend geïnstrueerd over het proces van visitatie en accreditatie in het hoger onderwijs en over de werkwijze van NQA.

##### *Opleiding:*

|           |   |
|-----------|---|
| 1986      | Academische Promotie, Technische Universiteit Eindhoven |
| 1975-1981 | Bouwkunde, Technische Universiteit Eindhoven            |
| 1969-1975 | Atheneum-B, Katholiek Gelders Lyceum Arnhem             |

##### *Werkervaring*

|            |   |
|------------|---|
| 2011-heden | Decaan Faculteit Managementwetenschappen, Radboud Universiteit Nijmegen   |
| 2008-2010  | Vic-decaan Faculteit Managementwetenschappen / Directeur Institute for Management Research, Radboud Universiteit Nijmegen   |
| 2002-2011  | Hoogleraar Planologie, Faculteit Managementwetenschappen, Radboud Universiteit Nijmegen / sectiehoofd Geografie, Planologie & Milieu 1994-2002      Hoogleraar Transport en Logistiek, Faculteit Techniek, Bestuur & Management, Technische Universiteit Delft / enige tijd vice-decaan |
| 1992-1994  | Universitair hoofddocent, Faculteit Technische Bestuurskunde, Technische Universiteit Delft   |
| 1987-1992  | Universitair (hoofd)docent, Faculteit Civiele Techniek, Technische Universiteit Delft   |
| 1981-1987  | Junior Onderzoeker / post-doc Faculteit Bouwkunde, Technische Universiteit Eindhoven  |

##### *Overig:*

- Afgelopen dertig jaar werkzaam in wetenschappelijk onderzoek aan drie universiteiten (als onderzoeker, aanvrager, coördinator, adviseur, directeur onderzoeksinstituut).
- Ervaring academisch onderwijs (docent, ontwikkelaar, coördinator, evaluator), zowel Ba, als Ma, als post-initieel, t.a.v. Urbanistiek (TU Eindhoven), Civiele Techniek, Technische Bestuurskunde, Planologie (Radboud Universiteit), Postdoctoraal onderwijs en gastcolleges. Verwerving grote subsidies/projecten.

- Betrokken bij academische promoties: sinds 1994 18 keer als promotor en ca. 30 keer lid van promotiecommissies (TUD, TUE, TU Twente, UvA, Radboud Universiteit, RU Utrecht).
- Diverse externe functies: t.b.v. wetenschappelijke gremia, organiseren congressen/studiedagenbegeleidingscommissies specifieke projecten.
- Adviesraden/commissies: o.a. Commissie voor de Milieueffectrapportage, Veiligheidscommissie HSL, Raad voor de Verkeersveiligheid, Transportongevallenraad, Verkeerscoördinatiecentrum Oost, VNG-adviescommissie Externe Veiligheid, RLI-adviescommissie Logistieke Kracht van Nederland
- Groot aantal lezingen en congresbijdragen (nationaal en internationaal)
- Talloze wetenschappelijke publicaties.

*Meest recente publicaties (overige op aanvraag):*

Internationale tijdschriftartikelen

- R. van Duin & R. van der Heijden: Towards governance on noise between municipality and terminal operator by the use of simulation modeling, *Journal of Computation Science*, vol. 3 (2012), pp. 216-227
- A. Samsura, E. van der Krabben, R. van der Heijden: Bargaining for value capturing: a game-theoretical analysis and experimental approach, accepted for publication in *Environment and Planning* (2013)
- V. van der Vlies & R. van der Heijden: Urban planning and rail transport risks: coping with deadlocks in Dutch urban development projects, resubmitted for second review *Safety Science* (2013)
- R. Argioli, R. van der Heijden, I. Bos & V. Marchau: The impact of intelligent transport systems on office location attractiveness: testing the predictive validity of a location choice model, accepted for publication in *European Journal for Transport and Infrastructure Research (EJTIR)*, vol 13 (2013)

Nederlandstalige tijdschriftartikelen

- R. van der Heijden & T. Platz (2010): De Rijn als transportader: nieuwe vervoersconcepten kunnen rol versterken, in: *Geografie*, juni 2010, pp. 38-41
- J. Voets e.a. (inclusief R. van der Heijden): Flexibel Plan werd ambtelijk en juridisch, *Ruimte*, dec. 2010, pp. 12-19
- V. Marchau, R. van der Heijden & K. Brookhuis: Intelligente ondersteuning van voertuigbesturing in het wegverkeer, *Tijdschrift Vervoerswetenschap*, jrg. 46 (2011), pp. 130-131
- B. de Peuter, W. Bervoets, R. van der Heijden e.a.: Op zoek naar draagvlak voor een nieuw ruimtelijk beleid in Vlaanderen, *Ruimte & Maatschappij*, vol. 2, nr. 3, pp. 25-48

De heer prof. dr. J.W. Kamphuis

De heer Kamphuis is ingezet vanwege zijn werkvelddeskundigheid op het gebied van civiele techniek en water (onderzoek in kustwaterbouw en kustmanagement) en vanwege zijn inzicht in de internationale ontwikkelingen in dit werkveld. De heer Kamphuis was 33 jaar als Professor verbonden aan Queen's University, Kingston, Canada en doceerde daarnaast in andere landen. Ook was hij hoofd van Queen's University Coastal Engineering Research Laboratory. Hij heeft ruime ervaring in het geven van colleges en kent alle aspecten van Bachelor/Master opleidingen. De heer Kamphuis is auteur van de publicatie "Introduction to Coastal Engineering and Management", dat wordt gebruikt in Bachelor/Master classes over de gehele wereld.

Voor deze visitatie heeft de heer Kamphuis onze handleiding voor panelleden ontvangen en in een voorbereidende vergadering is hij aanvullend geïnstrueerd over het proces van visitatie en accreditatie in het hoger onderwijs en over de werkwijze van NQA.

*Opleiding:*

1965 PhD Civil Engineering, Queen's University, Kingston, ON, Canada, K7L 3N6

*Werkervaring:*

2001 – heden Emeritus Professor, Queen's University, Kingston Specialty - Coastal Engineering  
1974 – 2001 Professor, Queen's University, Kingston  
1968 – 2001 Director, Coastal Eng. Research Lab., Queen's University  
1970 – 1974 Associate Professor, Queen's University  
1968 – 1970 Assistant Professor, Queen's University  
1965 – 1968 Research Officer, Nat. Research Council of Canada, Ottawa  
1966 – 1968 Lecturer - Carleton University, Ottawa

*Overig:*

2001 – heden Visiting Lecturer on contemporary engineering topics at many universities, organizations and technical conferences  
2001 – heden Coastal engineering consultant through J.W. Kamphuis Associates Limited  
1999 – 2000 Visiting Researcher, Delft Hydraulics, Delft, Netherlands  
1996 – 1997 Visiting Professor of Coastal Engineering, Delft University of Technology, Netherlands  
1993 IAHR Lecturer, National University, Singapore  
1993 Invited Lecturer, AWACS Short Course on Coastal Management, Townsville, Australia  
Visiting Professor of Coastal Engineering, Laval University, Quebec City, Canada  
1985 Visiting Professor of Coastal Engineering, Delft University of Technology, Netherlands  
1984 United Nations Development Program Lecturer to Pune, India  
1983 – heden Founder and president of J.W Kamphuis Associates Limited  
1980 – 1984 Associate Dean of Engineering (Research), Queen's University.  
1973 Nuffield Visiting Professor of Coastal Eng. to Australia

*Publicaties:*

- "*Introduction to Coastal Engineering and Management*", (2000), World Scientific, Singapore, 437 pp. Rewritten 2<sup>nd</sup> Edition (2010) (>4000 legal copies in circulation + many pirated copies).
- Over 140 research publications, covering, for example: wave mechanics and long waves, coastal sediment transport and morphology, coastal protection, marinas, hydraulic modelling, numerical modelling, environment, coastal management, water quality and fish habitat.
- More than 50 published invited lectures on coastal sediment transport, shore processes and shore protection, physical and numerical modelling of coastal areas.
- Seven book chapters on physical modeling of coasts, coastal engineering practice, education and history.
- Many lecture notes on coastal engineering and management.
- More than 150 engineering reports prepared for clients of J.W. Kamphuis Associates Limited. These cover numerical and hydraulic modelling of coasts, coastal systems, shore protection and coastal sediment transport, tidal inlet improvements, design of marinas, design of artificial islands for oil exploration, erosion of cohesive soils, ice forces. Many reports are in connection with litigation. The reports were produced for clients in Canada, and the United States, as well as, for example, in Norway, UK, Netherlands, Israel, Kuwait, Sharjah, Dubai, Australia, New Zealand, Singapore.

*Onderwerpen van onderzoek:*

- Hydraulic modelling of coastal sediment transport.
- Numerical modelling of coastal sediment transport and coastal morphology.
- Long wave motion in the swash zone and in experimental facilities.
- The study of design wave of structures in shallow water.
- The development of equipment to improve water quality in marinas.
- The study of fish habitat near coastal structures.
- The study of uncertainty in design.
- The relationship between coastal engineering practice and education.
- The study of design and resilience into coastal projects.

*De heer ir. R.P. Mulder*

De heer Mulder is ingezet vanwege zijn werkveldeskundigheid op het gebied van bouwkunde en civiele techniek. Hij is algemeen directeur NPC, dat als consultancy- en projectmanagementbureau gericht is op het ontwikkelen, verbouwen, inrichten en beheren van stations(gebieden) en –locaties. Hij is verantwoordelijk voor de integratie van NPC in DHV Groep en neemt deel in senior management DHV. Hij is lid van het Nederlands Instituut voor Landbouwkundig Ingenieurs - Project Management Institute (PMI)- Nederland. Voor deze visitatie heeft de heer Mulder onze handleiding voor panelleden ontvangen en in een voorbereidende vergadering is hij aanvullend geïnstrueerd over het proces van visitatie en accreditatie in het hoger onderwijs en over de werkwijze van NQA.

*Opleiding:*

Landbouwkundig ingenieur, Tropische bodemkunde, tropische bosbouw en economie -  
Landbouwuniversiteit Wageningen.

Executive Development Program (certificaat), Cursus in business management - Universiteit  
Neyenrode, Breukelen

*Werkervaring:*

2009-heden Directeur NPC / Directeur businessunit Rail en Stations (DHV R&M)  
Directeur Mobiliteit DHV  
Directeur Ontwerp & Realisatie  
Directeur Project Consult (DHV)  
Directeur Project Consult International (DHV)  
Directeur Stedelijke Ontwikkeling (DHV)

*Overig:*

- Specialisme: Verkeer, Rail, Contract, Engineering, Financiën, Projectmanagement.
- Lidmaatschap Nederlands Instituut voor Landbouwkundig Ingenieurs
- Lidmaatschap Project Management Instituut (PMI-)Nederland

*Nevenfuncties:*

- Lid Bouw Informatie Raad (BIR)
- Lid OCIB
- Lid Externe Kredietcommissie Cordaid

Mevrouw S.M. Kleinendorst BSc

Mevrouw Kleinendorst is ingezet als studentlid. Zij volgt de wo-masteropleiding Mechanical Engineering aan de Technische Universiteit Eindhoven, waar zij secretaris is geweest van het bestuur van de studievereniging van Werktuigbouwkunde. Mevrouw Kleinendorst is representatief voor de primaire doelgroep van de opleiding en beschikt over studentgebonden deskundigheden met betrekking tot de studielast, de onderwijsaanpak, de voorzieningen en de kwaliteitszorg bij opleidingen in het domein. Voor deze visitatie is mevrouw Kleinendorst aanvullend individueel geïnstrueerd over het proces van visitatie en accreditatie in het hoger onderwijs en over de werkwijze van NQA.

*Opleiding:*

- 2011 – heden Master Mechanical Engineering, Computational and Experimental Mechanics, Mechanics of Materials  
2007 – 2011 Bachelor Werktuigbouwkunde, Technische Universiteit Eindhoven  
2001 – 2007 VWO (Gymnasium), Udens College HAVO/VWO Uden

*Overig:*

- 2010 –2011 54e bestuur der Werktuigkundige Studievereniging Simon Stevin, Eindhoven, Secretaris  
2010 –2011 Europese Reiscommissie van W.S.V. Simon Stevin, Eindhoven, Commissaris Externe Betrekkingen  
2008 –2010 Bijzondere Activiteitencommissie (BACo) van W.S.V. Simon Stevin, waarvan een jaar als Voorzitter  
2008 – heden verscheidene andere commissies binnen de studievereniging, zoals de Galacommissie, de Almanakcommissie en de Onafhankelijke Financiële Adviescommissie (OFAC).  
Aug-sep 2011 Studiereis naar Japan met bijbehorende Case Study bij Shell.

De heer drs. ing. A.G.M. Horrevorts

De heer Horrevorts is ingezet als panellid NQA. Hij bezit auditorkwaliteiten vanwege jarenlange visitatie-ervaring en cursussen gevolgd bij INK en Lloyd's Register. Door zijn ervaring heeft de heer Horrevorts tevens deskundigheid in de beoordeling van afstandsonderwijs. In 2000 volgde hij de postgraduate course 'Institutional Management and Change in Higher Education' aan het Centre for Higher Education Policy Studies (CHEPS), Universiteit Twente en Open University, Engeland. De heer Horrevorts heeft in het najaar van 2010 deelgenomen aan de training van de NVAO en is gecertificeerd secretaris.

*Opleiding:*

De heer Horrevorts studeerde Metaalkunde aan de HTS te Utrecht en Sociale Geografie aan de Vrije Universiteit te Amsterdam.

*Werkervaring:*

Na de studie HTS werkzaam als ontwikkelingswerker / leraar in het technisch beroepsonderwijs op de Filippijnen.

Van 1985 tot 1992 werkzaam als projectleider 'ontwikkelingseducatie' in een project van de stichting Tool, HBO-raad en Nuffic. Ontwikkelen van educatief materiaal in samenwerking met HTS-en. Thema: Techniek en samenleving / internationalisering / ontwikkelingsamenwerking.

Van 1993 tot 2000 was de heer Horrevorts werkzaam bij de Nuffic als programmamedewerker hoger (beroeps)onderwijs en ontwikkelingssamenwerking. Hij beheerde onderwijsprojecten aan universiteiten in de Filippijnen, India en Bangladesh.

Van 2000 tot 2003 was hij werkzaam bij de HBO-raad, afdeling Kwaliteitszorg. Hij was secretaris van diverse visitatiecommissies: CMV, SJD, Technische Natuurkunde, Voortgezette opleiding Theater, Tuinbouw en Akkerbouw en de visitatiecommissie Landelijke Publieke Omroep.

De heer Horrevorts is sinds januari 2004 auditor bij de Netherlands Quality Agency (de verzelfstandigde afdeling Kwaliteitszorg van de HBO-raad).

## Annex 4: Program for the site visit

3 oktober 2012

| Tijdstip                                     | Programmaonderdeel   | Deelnemers   |
|--|--|--|
| 09.00 – 09.15                                | Ontvangst en kennismaking<br>(Panel + Opleidingsmanagement<br>opleidingen CT en TIL)   | Prof.dr. Marcel Stive (vice-decaan)<br>Prof.ir. Frank Sanders<br>Opleidingsdirecteur BSc en MSc Civiele<br>Techniek,<br>Dr.ir. Hans van Lint<br>Opleidingsdirecteur MSc TIL,<br>Mw. drs. Ellen Touw, hoofd afdeling O&S<br>CiTG<br>Loes Tijmenssen, adviseur kwaliteitszorg en<br>curriculumontwikkeling                                 |
| 09.15 – 12.30                                | Paneloverleg<br>Materiaalbestudering + bespreking<br>- KR<br>- Studiemateriaal<br>- Studentmateriaal<br>- Alle geselecteerde scripties       |  |
| 12.30 – 13.30                                | Lunch  | Panel  |
| 13.30 – 15.00                                | Paneloverleg<br>Materiaalbestudering + bespreking  | Panel  |
| 14.00 – 14.30<br>Spreekuur en<br>rondleiding | - Studiemateriaal<br>- Studentmateriaal<br>- Alle geselecteerde scripties  | Rondleiding wordt verzorgd door Karel<br>Karsen, Pascal de Smidt   |
| 15.00 – 15.45                                | Blik Inhoud I Ba CT: afstuderen<br>Panel en <b>docentbegeleiders</b> van de<br>Ba van wie het panel de scripties heeft<br>bestudeerd         | Docentbegeleiders<br>Dr.ir. Paul Visser<br>Ir. Karel Terwel<br>Dr.ir. Martin Tenpierik<br>Dr.ir. R. van Nes  |
| 16.00 – 16.45                                | Blok Inhoud II Ba CT: afstuderen en<br>afstudeerproces<br>Panel en de <b>studenten</b> Ba van wie het<br>panel de scripties heeft bestudeerd | Studenten<br>Thijs Robijns, cohort 06/07<br>Martin van Splunter, cohort 09/10<br>Steven Delemarre, cohort 04/05  |
| 17.00 – 17.45                                | Blok Inhoud III: Ba CT<br>Panel en studenten propedeuse en<br>tweede en derde jaar.  | <i>BSc jaar 1:</i><br>Amy Kerkhof, Cohort 11/12; 47EC<br>Silke Tas, Cohort 11/12; 60EC<br><i>BSc jaar 2:</i><br>Karin Bremer, Cohort 10/11; 86EC<br>Mike Aurik, Cohort 10/11; 120EC<br><i>BSc jaar 3:</i><br>Steven Oomen, Cohort 09/10; 184EC<br>Vincent van der Sleen, Cohort 08/09; 180EC<br>Jelle van der Zwaag, Cohort 09/10; 180EC |
| 17.45 – 18.30                                | Bespreking resultaten dag 1  | Panel  |

4 oktober 2012

| Tijdstip                         | Programmaonderdeel  | Deelnemers   |
|----------------------------------|---|--|
| 08.30 – 09.00<br>Ma CT           | Blok Inhoud I: afstuderen<br>Panel en <b>docentbegeleiders</b> van de Ma van wie het panel de scripties heeft bestudeerd            | Docentbegeleiders<br>Prof.dr. Andrei Metrikine<br>Dr.ir. Wim van Horsen (3ME)<br>Dr.ir. Peter-Jules van Overloop<br>Dr. Rudy Negenborn (TBM)<br>Ir. Roel Schipper  |
| 09.05 – 09.35<br>Ma TIL          | Blok Inhoud I: afstuderen<br>Panel en <b>docentbegeleiders</b> van de Ma van wie het panel de scripties heeft bestudeerd            | Docentbegeleiders<br>Prof.dr. Bert van Wee<br>Dr.ir. Rob van Nes<br>Prof.Dr.-Ing. Ingo Hansen<br>Dr. Wijnand Veeneman<br>Prof. dr. Ir. Bart van Arem<br>Dr. Ir. Hans van Lint  |
| 09.45 – 10.15<br>Ma CT           | Blok Inhoud II: afstudeerfase<br>Panel en de <b>studenten</b> Ma van wie het panel de scripties heeft bestudeerd                    | Ir. Hayo Hendrikse<br>Ir. Arend van Breukelen<br>Mw. Ir. Bianca van Agtmaal  |
| 10.20 – 10.50<br>Ma TIL          | Blok Inhoud II: afstudeerfase<br>Panel en de <b>studenten</b> Ma van wie het panel de scripties heeft bestudeerd                    | Mw. Ir. Aafke den Hollander<br>Ir. Jeroen Wolff<br>Ir. Holger Breukink<br>Liselotte Kroon, Cohort 09/10 laatste fase afstuderen  |
| 11.00 – 11.45<br>Ma CT<br>Ma TIL | Blok Inhoud III: programma<br><b>(Gezamenlijk gesprek)</b><br>Panel en <b>studenten jaar 1 en 2</b>                                 | <b>MSc CE</b><br>Remco Nijzink BSc, Cohort 07/08, <i>track Watermanagement</i><br>Peter Eigenraam, Cohort 08/09, <i>track Building Engineering</i><br>Ali Sedaghat, Cohort 07/08, <i>track Hydraulic engineering</i><br><br><b>MSc TIL</b><br>Mw. Melanie van Saase BSc, Cohort 11/12<br>Aaron Lee, Cohort 11/12<br>Mw. Lara Zomer BSc, Cohort 11/12 |
| 12.00 – 12.45<br>Ba / Ma CT      | Gesprek met docenten<br>Panel en vertegenwoordiging<br><b>docententeams</b> : spreiding naar studie jaren, tracks en speciale taken | Mw. dr.ir. Miriam Coenders (docent MSc)<br>Ir. Paul Wiggeraad (docent BSc en MSc)<br>Prof.dr. Huub Savenije (docent BSc en MSc)<br>Ir. Tjerk Zitman (docent BSc)<br>Ir. Roel Schipper (docent BSc en MSc)<br>Prof.dr. Michael Hicks (docent BSc en MSc)  |
| 12.45 – 13.30                    | Lunchpauze / overleg  | <b>Panel</b>   |
| 13.30 – 14.15<br>Ma TIL          | Gesprek met docenten<br>Panel en vertegenwoordiging<br><b>docententeams</b> : spreiding naar studie jaren, tracks en speciale taken | Dr.ir. John Baggen (TBM/CiTG)<br>Mw. dr.ir. Winnie Daamen<br>Dr. Hans van Ham (TBM)<br>Dr.ir. Jaap Ottjes (3ME)<br>Dr. Rob Goverde<br>Dr. Ir. Hans van Lint  |

| <b>Tijdstip</b>                               | <b>Programmaonderdeel</b>  | <b>Deelnemers</b>  |
|---|--|--|
| 14.15 – 15.00<br>Ba / Ma CT<br>Ma TIL         | Gesprek met opleidingsmanagement<br><b>(Gezamenlijk gesprek</b> Panel en opleidingsmanagementteams)                                  | Prof.ir. Frank Sanders, opleidingsdirecteur BSc en MSc CT/CE<br>Dr.ir. Hans van Lint, opleidingsdirecteur MSc TIL<br>Mw. Drs. Ellen Touw, hoofd afdeling O&S CiTG<br>Prof. dr. Ir. Bert Geerken, decaan  |
| <b>Parallelsessie (panel splitst zich op)</b> |  | <b>Deelnemers</b>  |
| 15.15 – 15.45<br>Ba en Ma CT<br>Ma TIL        | Blok Borging<br><b>(Gezamenlijk gesprek)</b><br>Panel en <b>examencommissie, toetscommissie</b>                                      | <b>Examencommissie CT/TA</b><br>Prof.dr.ir. Timo Heimovaara<br>Prof.ir. Ton Vrouwenvelder<br>Mw. mr. Luuk Minnigh<br><br><b>Examencommissie TIL</b><br>Prof.dr.ir. Gabri Lodewijks (3ME)<br>Prof.dr.ir. Bart van Arem<br>Prof.dr.ir. Karel Brookhuis (TBM)                                     |
| 15.15 – 15.45<br>Ba en Ma CT<br>Ma TIL        | Blok Borging<br><b>(Gezamenlijk gesprek)</b><br>Panel en <b>opleidingscommissies</b>   | <b>Opleidingscommissie CT</b><br>Prof.dr.ir. Wim Uijtewaal, voorzitter<br>Ir. Hans Welleman, docentlid<br>Mw. Lotte de Vos, studentlid 11/12<br>Mw. Ir. Tanja Euser, studentlid 07/10<br><br><b>Opleidingscommissie TIL</b><br>Dr. Jan Anne Annema<br>Dr. Rudy Negenborn<br>Mw. Pauline Eggink |
| 15.45 – 16.15                                 | Eventueel extra gesprekken   | N.v.t.   |
| 16.15 – 17.15                                 | Beoordelingsoverleg panel  | Panel  |
| 17.15 – 18.00<br><br>17.45 start afronding    | Tweede gesprek opleidingsmanagementteams, Opleidingsmanagementteams van de Ba + Ma CT en de Ma TIL<br><br>Mondelinge terugrapportage | Prof.ir. Frank Sanders, opleidingsdirecteur BSc en MSc CT/CE<br>Dr.ir. Hans van Lint, opleidingsdirecteur MSc TIL<br>Mw. Drs. Ellen Touw, hoofd afdeling O&S CiTG<br>Prof. dr. Ir. Bert Geerken, decaan  |

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## Annex 5: Documents examined

|            |   |
|------------|---|
|            | Self evaluation report BSc and MSc programmes in Civil Engineering and appendices         |
| Appendix A | Report on the institutional quality assurance assessment (NVAO Instellingstoets TU Delft) |
| Appendix B | Teaching and Examination Regulations (TER)  |
| Appendix C | Rules and Guidelines Board of Examiners BSc and MSc Civil Engineering                     |
| Appendix D | Implementation Regulations for the bachelor's and master's degree in Civil Engineering    |
| Appendix E | Final attainment levels and Dublin Descriptors  |
| Appendix F | Overview of the MSc programme in Civil Engineering  |
| Appendix G | Bachelor and Master Theses of programmes in Civil Engineering                             |
| Appendix H | Graduation procedures   |
| Appendix I | Lecturers BSc and MSc Civil Engineering   |
| Appendix J | Framework for assessment policy (kader voor toetsbeleid) concept                          |
| Appendix J | Format assessment and examination policy / Toetsbeleid TU Delft                           |
| Appendix K | Overview of contacts from the professional field  |

|            |  |
|------------|--|
|            | Self evaluation report MSc programme in Transport, Infrastructure and Logistics and appendices |
| Appendix A | Report on the institutional quality assurance assessment (NVAO Instellingstoets TU Delft)      |
| Appendix B | Teaching and Examination Regulations MSc TIL   |
| Appendix C | Rules and Guidelines Board of Examiners MSc TIL  |
| Appendix D | Implementation Regulations for the master's degree in TIL 2011-2012                            |
| Appendix E | Modules and final attainment levels  |
| Appendix F | SWOT analysis old TIL programme  |
| Appendix G | TIL Navigator 2011-2012 (programme overview)   |
| Appendix H | Framework for assessment policy (kader voor toetsbeleid) concept                               |
| Appendix H | Format assessment and examination policy / Toetsbeleid TU Delft                                |
| Appendix I | Overview of contacts from the professional field   |
| Appendix J | TIL Alumni Questionnaires 2012   |
| Appendix K | Graduation procedures  |

### Additional available documents during the site visit

#### **Examencommissie**

- Jaarverslag Examencommissie CT over studiejaar 2010-2011
- Notulen Examencommissie CT
- Jaarverslag Examencommissie MSc TIL over studiejaar 2011-2012
- Jaarverslag Examencommissie MSc TIL over studiejaar 2010-2011
- Notulen Examencommissie MSc TIL
- Bevindingen Examencommissie Thesis met resultaat 6.0 en 6.5
- Bevindingen Examencommissie Thesis algemeen

#### **System of Assessment,**

- concept versie 6 september 2012

### ***Opleidingscommissie***

- Notulen opleidingscommissie CT over studiejaar 2009/2010; 2010/2011; 2011/2012
- Notulen opleidingscommissie TIL over studiejaar 2009/2010; 2010/2011; 2011/2012

### ***Kwaliteitszorg (evaluaties, voorblok en nablok)***

- Evaluatieresultaten BSc CT vakken: 2009/2010; 2010/2011; 2011/2012
- Evaluatieresultaten MSc vakken CT: 2010/2011; 2011/2012
- Evaluatieresultaten MSc TIL: 2010/2011; 2011/2012
- Notulen van voorblok- en nablok bijeenkomsten
- Samenvattingen op A4

### ***Educational year reports***

- Onderwijsjaarrapportages over de studiejaar: 2007-2008; 2008-2009; 2009-2010

### ***BSc CT***

- overzicht nieuwe curriculum, conceptversie

### ***Scripties selectie panel***

### ***Hard copy MSc handbook / MSc wegwijzer 2011-2012***

### ***Report 'Logistieke kwaliteit'***

### ***Information on Fraude***

### ***Lesmateriaal en toetsmateriaal van vakken***

#### ***CIE4495 Fundamentals***

- Questions and answers
- 3 Gecorrigeerde tentamens

#### ***CT2710 Transport en planning***

- Questions and answers

#### ***CT1031 – Constructiemechanica 1***

- Tentamen leerdoelen en uitgangspunten
- Onderwijsmateriaal – voorbeeld website
- Uitwerkingsformulier tentamen
- Beoordeelde tentamens
- Boek: Hartsuijker (2005). Toegepaste Mechanica, deel 1 - Evenwicht. Academic Service.
- Boek: Hartsuijker (2005). Engineering Mechanics, volume 1 - Equilibrium. Springer

#### ***CT1021 – Dynamica***

- Gang van zaken omtrent tentamen
- Tentamen
- Uitwerking tentamen
- Beoordeelde tentamens
- Boek: Hibbeler (2010). Dynamica. Pearson Education.

**CIE 4061 – Multidisciplinary project**

- Report: Waterproof Manado
- Report: Vung Tau – Go Cong Dam Vietnam
- Report: Surgido de Batabano Harbor
- Report: Marina Martin Garcia

**CIE4130 – Probabilistic Design in Civil Engineering**

- Examination and answer model
- Corrected exams
- Lecture notes

**CT1062 and CT2061 – Integraal ontwerpen (in CT)**

- Examples of drawings
- Process report
- Final Reports
- Lecture material (2 books)

**CIE 4450 – Integrated Water Management**

- Course information
- Group assignment report 1 (grade 6,5)
- Group assignment report 2 (grade 9)

**CIE 5804 – Innovations in Dynamic Traffic Management**

- Exam
- Grades
- Corrected exams
- Group assignment report 1 (grade 6,5)
- Group assignment report 2 (grade 7,5)

**TIL 4030 – Interdisciplinary Fundamentals**

- Questions and answers
- Re-exam
- Group assignment report 1 – The A3 in 2030 (grade 7,5)
- Group assignment report 2 – Landside accessibility of Lelystad Airport (grade 9,0)
- Group assignment report 1 – The Dutch Airport Bridge (grade 8,5)
- Group assignment report 1 – How to increase the accessibility of the NTUA Campus (grade 7,5)

**CIE4305 – Coastal Dynamics I**

- Questions and answers
- Exam with answer model
- Three exams, grades of 2,5; 6,0; 10,0
- Quality Analysis
- Exam with answer model
- Book: Coastal Dynamics I

**CT2022 – Dynamica van Systemen**

- Exam with answers
- Corrected exams, grades 8,0; 6,0; 5,0.
- USB with lecture notes and lecture material

**CT3310-09 – Stroming in Waterlopen**

- Questions and answers
- Exam with answers
- Corrected exams, grades 8,0; 6,0; 4,0
- Lecture notes

**CT2011 – Watermanagement**

- Questions and Answers
- Corrected Exams
- Corrected additional assignment
- Lecture material (2 books)
- USB with additional information

**CIE3150 – Concrete Structures II**

- General information
- Lecture material
- Compulsory exercises (corrected)

**TIL 5050 – Interdisciplinary Project**

- Group assignment report: The 'reliability' of TIC
- Group assignment report: Port of Westland
- Group assignment report: Directly from Greater London to Randstad (Holland) by train
- Group assignment report: Possibilities for integrated network management in Beijing
- Group assignment report: Reducing external effects of logistics concerning inner city construction activities
- Handleiding
- Cijferoverzicht 11-12

**CT 3061 – Systems engineering**

- Ontwerpopdracht
- Beoordelingskader
- Groepsrapportages (cijfer 8,4; 6,5; 6,5)
- Individuele rapporten (6 stuks)
- Antwoordmodel tentamen
- Cijferlijst
- Drie tentamens

**CIE 5110 – Concrete science and technology**

- Question and answers
- Book: Neville (2011). Properties of Concrete. Pearson
- Lecture notes: Reinhardt (1985). Beton, als constructiemateriaal, eigenschappen en duurzaamheid. TU Delft.

**CT3300 – Use of Underground Space**

- Course information
- Corrected assignments grades 8,0; 7,0; 6,0; insufficient

**CIE4821 – Traffic Flow**

- Examination with answers
- Corrected Exams
- Examination with answers June 2012
- Corrected assignments, grades 5,0; 6,0; 8,5

**CT2310 – Inleiding waterbouw**

- Tentamen 28 juni 2012
- Uitwerking antwoordmodel
- Normering
- Gecorrigeerde tentamens

**10 stageverslagen MSc CT**

## Annex 6: Summary theses

Summary of the students whose theses have been examined by the visitation committee. According to NVAO's rules only student numbers are included.

| <b>Student number</b> |
|-----------------------|
| 1322583               |
| 4009460               |
| 1220942               |
| 1315005               |
| 1327402               |
| 1365878               |
| 1373722               |
| 1212893               |
| 1091387               |
| 4039610               |
| 1258761               |
| 4046803               |
| 1329480               |
| 1535803               |
| 1219685               |
| 1213466               |
| 4022130               |
| 1522620               |
| 1320629               |
| 1180673               |
| 4038703               |

In addition the visitation committee interviewed two students deputizing for students who were unavailable during the site visit.

|         |
|---------|
| 1303740 |
| 1312170 |



## Annex 7: Declaration of Comprehensiveness and Accuracy

Netherlands Quality Agency



### Verklaring van volledigheid en correctheid van de informatie

Betreffende de visitatie van de

Opleiding: Cluster Civiele Techniek

Instelling: Technische Universiteit Delft

Visitatie datum: 3 en 4 oktober 2012

Ondergetekende: Prof. ir. Frank Sanders

vertegenwoordigend het management van de genoemde opleiding,

in de functie van: Directeur Onderwijs

verklaart hierbij dat alle informatie ten behoeve van de visitatie van de genoemde opleiding in volledigheid en correctheid ter beschikking wordt gesteld, waaronder informatie over alternatieve afstudeerroutes die momenteel en/of gedurende de afgelopen 6 jaar (hebben) bestaan, zodat het visitatiepanel tot een op juiste feiten gebaseerde oordeelsvorming kan komen.

Handtekening:

Datum:

18-12-2012

