Werktuigbouwkunde
3TU OW 2012

Faculty of Engineering Technology,
University of Twente

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CONTENTS

This report was finalised on 29 November 2012.

Report on the bachelor's programme Mechanical Engineering and the master's programme Mechanical Engineering of University of Twente

This report takes the NVAO's Assessment framework for limited programme assessments as a starting point.

Administrative data regarding the programmes

Bachelor's programme Mechanical Engineering

Name of the programme:	Mechanical Engineering
CROHO number:	56966
Level of the programme:	bachelor's
Orientation of the programme:	academic
Number of credits:	180 EC
Specialisations or tracks:	-
Location(s):	Enschede
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2013

Master's programme Mechanical Engineering

Name of the programme:	Mechanical Engineering
CROHO number:	60439
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specialisations or tracks:	Profiles: Design & Construction; Organisation and Management; Research and Development
Location(s):	Enschede
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2013

The visit of the assessment committee Werktuigbouwkunde 3TU OW 2012 to the Faculty of Engineering Technology of University of Twente took place on 14 September 2012.

Administrative data regarding the institution

Name of the institution:	University of Twente
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	applied (pending)

Quantitative data regarding the programmes

The required quantitative data regarding the programmes are included in Appendix 5.

Composition of the assessment committee

The committee that assessed the bachelor's programme Mechanical Engineering and the master's programme Mechanical Engineering consisted of:

- Prof. dr. J.K.M. De Schutter, professor of Mechanical Engineering, KU Leuven;
- Prof.dr. J.J. ter Meulen; emeritus professor Applied Physics, Radboud University Nijmegen;
- Prof. dr. M. Vantorre, professor of Maritime Technology, Ghent University;
- Ir. G.Calis, former Corporate Head Office Stork B.V.;
- S.E.M. Janssen BSc, master student of Mechanical Engineering, Eindhoven University of Technology.

The committee was supported by Dr. M.J.H. van der Weiden, who acted as secretary.

Appendix 1 contains the curricula vitae of the members of the committee.

Working method of the assessment committee

Preparation
The assessment of the bachelor's programme Mechanical Engineering and the master's programme Mechanical Engineering of University of Twente is part of a cluster assessment of ten mechanical engineering degree programmes offered by three universities. The entire cluster committee consists of nine members. The kick off meeting for the cluster assessment was held on 4 September 2012. During this meeting the committee members received an introduction into the assessment framework and evaluation procedures and the committee agreed upon its general working method. For each visit a subcommittee was composed with the necessary expertise to evaluate the programme. Furthermore, the domain-specific requirements and the most recent developments concerning the mechanical engineering domain were discussed. These domain-specific requirements and the actual context form the starting point for the evaluation of the quality of the degree programmes.

In advance of the assessment of the programme the programme management prepared a self-evaluation report. This report was sent to QANU and, after a check by the secretary of the committee to ensure that the information provided was complete, forwarded to the committee members. The committee prepared the site visit by studying the self-evaluation report and a number of bachelor and master theses. The secretary of the committee selected theses randomly from a list of all graduates of the last two years per programme, i.e. fourteen master theses and fifteen reports of bachelor project F. The following stratification is used: five theses for each degree programme with low grades (6-6.5), five theses with middle ranged grades (7-8) and five theses with high grades. QANU asked the programmes to send the theses including the assessment by the supervisor and second examiner and divided them among the subcommittee members. Each committee member thus assessed three theses per programme.

When a thesis was assessed as questionable or unsatisfactory by a committee member, a reassessment was done by another committee member. In the case that more than 10% of the theses were assessed as questionable or unsatisfactory by two committee members the selection of theses for the programme would be extended to 25. This was not the case.

Site visit
The committee members formulated questions raised by studying the self-evaluation report in advance. These questions were circulated within the committee.

The committee visited the programmes on 14 September 2012. The programme of the site visit, which is included in Appendix 6, was developed by the committee's secretary in consultation with the programme management and the chair of the committee. The committee interviewed students, teachers, alumni, the programme management and representatives of the Faculty Board, the Board of Examiners and the student and teacher members of the Educational Committee. An open office hour was scheduled and announced but no one made use of it.

During the site visit the committee studied additional material made available by the programme management. Appendix 7 gives a complete overview of all documents available during the site visit. The last hours of the site visit were used by the committee to establish the assessments of the programme and to prepare the oral presentation of the preliminary findings of the committee to the representatives of the programme.

Report
The secretary wrote a draft report based on the findings of the committee. The draft report has been amended and detailed by the committee members. After approval of the draft report by the committee it was sent to the Department for a check on facts. The comments by the Department were discussed in the committee, which resulted in some changes in the report, and, subsequently, the committee established the final report.

The assessment was performed according to the NVAO (Accreditation Organisation of the Netherlands and Flanders) framework for limited programme assessment (as of 22 November 2011). In this framework a four-point scale is prescribed for both the general assessment and assessment of each of the three standards. The committee used the following definitions for the assessment of both the standards and the programme as a whole.

Decision rules

Generic quality
The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.

Unsatisfactory
The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

Satisfactory
The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

Good
The programme systematically surpasses the current generic quality standards across its entire spectrum.

Excellent
The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

Summary judgement

Bachelor programme Mechanical Engineering
This report presents the findings and considerations of the Werktuigbouwkunde 3TU committee on the bachelor's programme Mechanical Engineering at the University of Twente. The committee bases its assessment on information from the self-evaluation report, additional information obtained from the discussions during the visit, the selected theses, and the documentation that was available for inspection during the site visit. For this programme, the committee has identified positive aspects as well as ones that could be improved. After considering them, the committee reached the conclusion that the programme meets the requirements for basic quality that form the condition for re-accreditation.

Standard 1: Intended learning outcomes
The intended learning outcomes of the bachelor programmes are based on the internationally accepted ABET standards. In addition, the 3TU have added criteria to this domain-specific frame of reference to emphasise future developments in science and society.

Bachelor graduates have a disciplinary foundation in science, engineering and technology, are aware of the importance of other disciplines and of the temporal and social context, are able to investigate and design under supervision, have learned a scientific approach and have developed intellectual and communicative skills. The learning objectives have been formulated in terms of academic competences, an outcome of a 3TU project. In an annex to the self-evaluation report the programme has provided an overview of the intended learning outcomes, the academic competences and how the individual curriculum elements contribute to them. This shows that the final qualifications for the bachelor programme are in line with the international standards as described in the Dublin descriptors.

The committee concludes that the bachelor programme in Mechanical Engineering is clearly designed as an academic programme. It provides a solid disciplinary foundation and has a strong focus on research and on developing a scientific and critical attitude.

Standard 2: Teaching-learning environment
Characteristic for the bachelor programme is Project Led Education (PLE). In parallel to the courses, students work in groups of eight students on project assignments. The PLE philosophy requires that students are not just presented with knowledge in courses but discover it for themselves in the project assignment. In this way they learn more about the integration and coherence of the theories they have been taught in the courses. They also develop a much higher degree of independence and initiative, which in the eyes of the staff members is clearly visible in the way students handle the graduation assignments. Alumni also mention PLE as the most useful of their education. The final project of the bachelor programme is a group project (project F), in which 75% of the assessment is based on the student's individual performance.

The learning objectives of the bachelor programme are translated well into the courses, PLE projects and a minor. The Course Information and Assessment Plans are useful documents for students, staff and individual lecturers. The academic education takes place mainly in the PLE projects and is focused on personal and social skills. Social issues such as sustainability are addressed in project C, but, generally speaking, do not seem to play a prominent role in the bachelor programme. Research skills and academic writing are taught in project ITO, the last project in the bachelor programme. The committee is of the opinion that this is rather late and recommends that more structural attention is paid to formal academic skills earlier in the programme. The committee advises to also pay more attention to social issues and the role of the mechanical engineer.

The committee finds the feasibility of the programme to be realistic even though very few students finish in the nominal time. The structure of the programme allows students who want to obtain their degree within the allotted time to do so. Compared to similar programmes in the Netherlands the bachelor output is relatively good. Measures taken to reduce the average length of study are the mentor system, 'harde knip', a modular structure per 2013-2014 and summer courses. The committee supports the department's policy to achieve a better and faster selection in the first year. In addition, a culture change is needed: for students on the one hand to invest more time in their studies from the very beginning and on the other hand to be aware that 'good' is 'good enough' and that meeting deadlines is a fact of life in a professional career too.

The teaching staff of Mechanical Engineering is well qualified and committed, with strong links to industry. They are good teachers, as pointed out by the course evaluations. The staff/student ratio is 1:25 and the teaching load is on average 40%, which the committee considers reasonable.

The department has very good facilities in laboratories, lecture halls and project rooms and they are used intensively. The study guidance and counselling are very well organised and the PLE tutors and mentors play an active role.

The quality assurance system works well. All courses are regularly evaluated by student questionnaires and the results, including the lecturer's response, are published and discussed by the Educational Committee. The department has followed up on the recommendations of the previous assessment committee.

Standard 3: Assessment and achieved learning outcomes
The assessment policy is very explicit and the assessment system is very well implemented. Test plans are available for courses and projects, response formats are worked out in detail and guide the evaluation of all types of assessments, including oral exams and re-sits. Exams are cross-checked and verified by colleague lecturers prior to the exam date. Elaborate feedback is provided to students. The Board of Examiners is clearly in control.

The committee examined a representative sample of bachelor theses and found the marking to be fair and consistent. On the basis of the theses, the committee concludes that graduates achieve an academic bachelor's level. This conclusion is confirmed by the experiences recounted by the alumni who are satisfied with the basic knowledge and engineering skills they learned in the programme, but especially with the mind-set and approach they learned from PLE.

The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Bachelor's programme Mechanical Engineering :

Standard 1: Intended learning outcomes	good
Standard 2: Teaching-learning environment	good
Standard 3: Assessment and achieved learning outcomes	satisfactory
General conclusion	satisfactory

Master programme Mechanical Engineering

This report presents the findings and considerations of the Werktuigbouwkunde 3TU committee on the master's programme Mechanical Engineering at the University of Twente. The committee bases its assessment on information from the self-evaluation report, additional information obtained from the discussions during the visit, the selected theses, and the documentation that was available for inspection during the site visit. For this programme, the committee has identified positive aspects as well as ones that could be improved. After considering them, the committee reached the conclusion that the programme meets the requirements for basic quality that form the condition for re-accreditation.

Standard 1: Intended learning outcomes

The intended learning outcomes of the master programme are based on the internationally accepted ABET standards. In addition, the 3TU have added criteria to this domain-specific frame of reference to emphasise future developments in science and society.

Master graduates have taken the bachelor qualifications a step further and are able to design and conduct research independently, on the basis of extended (inter)disciplinary knowledge and skills. They are able to be the leaders in their field, both in industry and in research contexts. The learning objectives have been formulated in terms of academic competences, an outcome of a 3TU project. In an annex to the self-evaluation report the programme has provided an overview of the intended learning outcomes, the academic competences and how the individual curriculum elements contribute to them. This shows that the final qualifications for the master programme are in line with the international standards as described in the Dublin descriptors.

The committee concludes that the master programme in Mechanical Engineering is clearly designed as an academic programme. It provides a solid disciplinary foundation and has a strong focus on research and on developing a scientific and critical attitude.

Standard 2: Teaching-learning environment

The master programme is an individualised programme. At the start of the programme a student chooses a competence profile and a specialisation area. Together with his/her graduation professor he/she puts together a programme, consisting of courses, an internship, individual space and a graduation project. Many students find an internship abroad. The coherence of the programme is safeguarded by the rules set by the Board of Examiners and by the programme coordinator. The committee considers the learning objectives of an academic master programme to be well reflected into the science based approach of the courses and the graduation project, and in the individualised set-up of the programme.

The committee finds the feasibility of the programme to be realistic even though very few students finish in the nominal time. The structure of the programme allows students who want to obtain their degree within the allotted time to do so. For the master programme the main effect is to be expected from a culture change: students should be aware that 'good' is 'good enough' and that meeting deadlines is a fact of life in a professional career too. Staff should try to fit their expectations of graduation theses to the 40 EC allotted to them. The committee advises to monitor the time invested by students in their graduation thesis on a regular basis.

The teaching staff of Mechanical Engineering is well qualified and committed, with strong links to industry. They are good teachers, as pointed out by the course evaluations. The staff/student ratio is 1:25 and the teaching load is on average 40%, which the committee considers reasonable.

The department has very good facilities in laboratories, lecture halls and project rooms and they are used intensively. The study guidance and counselling are very well organised.

The quality assurance system works well. All courses are regularly evaluated by student questionnaires and the results, including the lecturer's response, are published and discussed by the Educational Committee. The department has followed up on the recommendations of the previous assessment committee.

Standard 3: Assessment and achieved learning outcomes

The assessment policy is very explicit and the assessment system is very well implemented. Test plans are available for courses and projects, response formats are worked out in detail and guide the evaluation of all types of assessments, including oral exams and re-sits. Exams are cross-checked and verified by colleague lecturers prior to the exam date. Elaborate feedback is provided to students. The Board of Examiners is clearly in control.

The master thesis is assessed by a master examination committee consisting of at least three members: the graduation professor, the daily supervisor and an independent examiner from another specialisation area. Marks are given for the thesis, presentation, oral defence, problem-solving approach and mastering of the theory behind the problem. The final mark is not necessarily the average of the five components.

The committee examined a representative sample of master theses and found the marking to be fair and consistent. On the basis of the theses, the committee concludes that graduates achieve an academic master's level.

This conclusion is confirmed by the experiences recounted by the alumni and by the appreciation of students during their internships and of graduates, expressed by companies. Graduates find relevant jobs at an appropriate level within a fairly short time, and they are satisfied with the knowledge basis and engineering skills they learned in the programme, but especially with the mind-set and approach they learned from PLE.

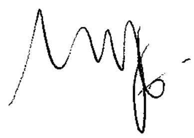
The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Master's programme Mechanical Engineering:

Standard 1: Intended learning outcomes	good
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Assessment and achieved learning outcomes	good
General conclusion	good

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

Date: 29 November 2012



Prof. dr. J.K.M. De Schutter	Dr. M.J.H. van der Weiden

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

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

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

1.1. Findings

This section contains the committee's assessment on the profile and orientation of the programme (1.1.1), the domain-specific framework of reference (1.1.2) and the intended learning outcomes (1.1.3).

1.1.1. Profile and orientation of the programme

The Department of Mechanical Engineering describes its 'product' as a young man or woman who has earned a degree to be proud of, who has his or her feet strongly on the ground and who can take the lead in 'changing the world'. To achieve this, the department uses two distinctive features in its programmes: Project Led Education (PLE) in the bachelor programme and 'the three O's' in the master programme.

PLE implies that, in parallel to the coursework in the bachelor programme, students learn to apply the newly acquired theoretical knowledge to engineering problems in project groups of on average eight students. In this way they learn to integrate and select course materials and other information, resulting in a broad view on mechanical engineering and a better preparation for a position in the professional field. In the master programme students choose one of the three O's as a competence profile: Research and Development (Onderzoek en ontwikkeling), Design and Construction (Ontwerpen en construeren) or Organisation and Management (Organiseren). This way the bachelor programme guides (PLE) and the master programme focuses (3 O's) the students, preparing them for different roles in society (3 O's) where they are able to work in multidisciplinary teams on a sound basis of theoretical knowledge (PLE).

The self-evaluation report states that the graduates should have a level of competence at least equivalent to that of the graduates of other well-reputed universities in western countries. They must be able to make a difference and become leaders in their fields. The self-evaluation report adds that engineering programmes of the University of Twente (UT) always have had a relatively strong focus on the societal aspects and implications of technological developments. Social leadership skills are interwoven in the projects and immediately applied in a mechanical engineering setting. Every student must take some social science courses. The committee agrees that these aspects are important and need to be addressed in a mechanical engineering programme, but did not find much evidence of this focus on societal aspects and the implications of technological developments during the site visit. The committee therefore advises to pay more attention to this aspect.

The committee has discussed the PLE concept with the management, staff and students and concludes that this is a strong point of the programme. Staff has managed to keep the concept 'fresh' over the years by using new assignments and problems almost every year and by trying to find interesting problems with practical applicability. A new impulse will be provided because the university has decided to extend the PLE-concept to all other bachelor programmes as from the 2013-2014 academic year and has invited the Mechanical Engineering staff to play a leading role in helping the other departments to implement this. The management appreciates this show of trust in the PLE concept and indicated that it has a positive effect on the team spirit among staff.

1.1.2. Domain-specific framework of reference

The three collaborating programmes in Mechanical Engineering at the University of Twente (UT), the Eindhoven University of Technology (TU/e) and Delft University of Technology (TUD) have decided to use the ABET (Accreditation Board for Engineering and Technology) criteria as the basis for their domain-specific framework of reference, and to add the definition documents of the OECD (Organisation for Economic Co-operation and Development) and ASME (American Society of Mechanical Engineers).

The ABET criteria define the necessary elements of the curriculum: 'The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyse, design, and realise physical systems, components or processes; and prepare students to work professionally in both thermal and mechanical systems areas.' The Tuning-AHELO Conceptual Framework of Expected/Desired Learning Outcomes in Engineering, published by the OECD in 2011, adds an emphasis on engineering skills in practice (theory and application), analysis (products, processes and methods) and design (apply knowledge to develop designs). ASME looks at what is expected of the future mechanical engineer (2028) who will be confronted with the challenges faced by society in developing sustainability, engineering large and small-scale systems, the competitive edge of knowledge, collaborative advantages, the nano-bio future, regulating global innovation, the diverse faces of engineering, designing at home and engineering for the other 90%. For a full description of the domain-specific framework of reference, see Appendix 2.

A benchmark of the three Dutch programmes and three foreign programmes (ETH, KTH, University of Michigan) shows that the disciplinary focus of the Dutch programmes is quite comparable. The UT has a slightly smaller focus on mathematics and numerical methods. The committee feels that the co-operation between the three universities of technology (the 3TU-cooperation) is a strong point. The committee advises to use this co-operation to maintain a common basis for the programmes in mechanical engineering and make student exchange between the three departments possible, while also allowing specific emphases per institute. The committee found that the benchmark of the three foreign institutions did not have much added value because it did not go beyond a comparison of the elements of the curriculum contents. The committee is of the opinion that analyses of the perceived strengths of these institutes related to the assessment standards would contribute significantly to the self-evaluation and could possibly serve as indicators for the future development of the Twente programmes.

1.1.3. Intended learning outcomes

The final qualifications for the bachelor and the master programmes are described in terms of intended learning outcomes. The self-evaluation report distinguishes between the mechanical engineering competences and the psychological, social and personal competences. The mechanical engineering competences include a broad and profound technical scientific knowledge of mechanical engineering disciplines at the bachelor level, and an advanced knowledge at the master level; thorough knowledge of methods, paradigms and tools to analyse and interpret data at the bachelor level, and the ability to design and develop at the master level. The psychological, social and personal competences include the ability to communicate effectively with professionals, to work in multidisciplinary teams, to evaluate the impact of his/her work and to take professional responsibility, and to maintain and improve his/her academic and professional competence. See Appendix 3 for a full overview.

The intended learning outcomes have been related to the Criteria for Academic Bachelor's and Master's Curricula, originally developed at the TU/e and subsequently adopted by the 3TU. These criteria require that a graduate is competent in one or more scientific disciplines, in doing research and in designing. Furthermore the criteria require that the graduate has a scientific approach, possesses basic intellectual skills, is competent in co-operating and communicating, and takes account of the temporal and social context. They are a more detailed description of the Dublin descriptors.

In an annex to the self-evaluation report the programme has provided an overview of the relationship between the intended learning outcomes and the academic competences. It has also added a comprehensive overview of the different programme elements (courses, projects, internship, thesis) that contribute to the intended learning outcomes. All course descriptions of the bachelor and the master programme, made available during the site visit, contain learning objectives.

On the basis of this information the committee concludes that the final qualifications for the bachelor and the master programme are in line with the international standards as described in the Dublin descriptors.

1.2. Considerations

The international standards for the bachelor and master level are reflected in the intended learning outcomes, both in general terms (Dublin descriptors) and more specifically for the domain of Mechanical Engineering (ABET, OECD, ASME). On the basis of the documentation provided and the discussions with students and staff the committee concludes that both the bachelor and the master programme have a solid profile, combining an academic focus with a multidisciplinary approach and social skills. The criteria for academic education, an elaboration of the Dublin descriptors by the 3TU, have been translated into competences and checked against the courses and other curriculum elements to ensure that they are indeed part of the curriculum.

On this basis the committee is confident that the graduates of the bachelor and the master programme meet the accepted international standards and should indeed be able to be the leaders in their field that the programme aims to deliver.

1.3. Conclusion

Bachelor's programme Mechanical Engineering: the committee assesses Standard 1 as good.
Master's programme Mechanical Engineering: the committee assesses Standard 1 as good.

Standard 2: Teaching and learning environment

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

2.1. Findings

This section on the teaching and learning environment examines whether the curriculum, staff and facilities enable students to achieve the intended learning outcomes. Aspects that will successively be discussed are: the structure of the curriculum (2.1.1), didactic principles (2.1.2), feasibility (2.1.3), staff (2.1.4), programme-specific facilities (2.1.5) and programme-specific quality assurance including the improvement measures that have been made in response to the previous evaluation (2.1.6).

2.1.1. Structure of the curriculum

The three-year bachelor curriculum offers foundation courses in mathematics, material science, mechanics and modelling. In the first year four BEAM (Bachelor Engineering Applied Mathematics)-blocks are provided to help students to get a thorough understanding of the mathematical concepts and skills and to apply this in other courses. In parallel to the courses students work in groups (8-10 students) on projects. The project themes are based on the engineering disciplines and on particular aspects of engineering design. In the first year projects are Design and Production, Design and Mechanics, and Energy and Sustainability. They require maximum integration of knowledge and competences, including carrying out research, problem-solving, abstracting, generalisation etcetera. Each year the assignments become more complex. A new element in the second-year project Design for Consumers is the requirement to integrate aspects of ergonomics, styling and marketing.

In the first two years all courses are obligatory. In the first half of the third year students choose a minor to broaden their perspective and knowledge. This can be done in the Netherlands or abroad, in or outside the field of mechanical engineering or as an internship in the professional field. This last option is recommended for students who choose for a professional career after completing their bachelor programme. The minor must contribute to the capacities of the student as a future mechanical engineer. If students want to choose a 'free minor' they need the approval of the Board of Examiners. Every student who chooses a minor within the domain 'engineering' must take some social science courses.

The final projects in the bachelor programme, Dynamics and Mechatronics (project F) and Scientific Research (project ITO), serve to broaden the students' technical knowledge and research skills. Together these projects form the final assessment of the bachelor programme. In project F different solutions are possible for the problem presented. Each group writes a report on their solution of the assignment and individual members present and defend it to their colleagues and an exam committee, consisting of three lecturers. For project ITO students are introduced to the basics of three of the department's research areas and are tested on this in an exam. Then, small groups formulate a research question related to a given problem and a reflection on literature. Subsequently, this research question is investigated using some preliminary research carried out by the project group or obtained from the literature. After that, an individual paper is written and presented at the ITO conference day.

The students told the committee that the relationship between the two parts of ITO (courses plus exam, research project plus report) and the examination requirements were not clear enough. They appreciated the usefulness of the assignment to do a literature study and to write an individual paper; these are new skills and a good preparation for the master programme. The staff members explained to the committee that the first part of ITO is necessary to provide the knowledge basis for the project work and that the group work can only proceed well if all students have demonstrated to have the same good level of background knowledge. The mechanisms that are in place to make sure that students pass the exam first, but avoid study delays for students who are on schedule with the rest of their coursework, convinced the committee.

Academic skills are mainly defined as personal and social skills, particularly in terms of the roles a student learns to take in group work. This includes the preparation to choose one of the competence profiles in the master programme. Students learn communication skills such as reporting and presenting, which are important elements of academic skills. To provide a link to the professional field guest lecturers from industry are regularly invited. Students can choose an elective course on ethics but this is not obligatory. Reflection on social aspects is touched upon in the PLE projects, for example reflection on sustainability is part of the first-year project Energy and Sustainability. Learning to critically reflect on scientific literature and the social impact of a scientific development is not an explicit part of the bachelor programme, except in project ITO. This, however, is the seventh criterion of the intended ACQA learning outcomes. The committee, therefore, expressed its surprise about this rather narrow interpretation of academic skills during the site visit in its meetings with lecturers. These explained that the research skills are indeed focused at the end of the bachelor programme in project ITO, and that students find it very difficult to take the time to formulate a good question before trying to solve the problem. They tend to jump to the practical problem-solving programme directly. The staff members agreed with the committee that a scientific approach is also necessary for designers and managers, but maintained their position that critical reflection is an implicit part of all curriculum elements. The committee appreciates the strong personal, communicative and social skills training in the projects but advises to pay structural attention to more formal education in academic skills earlier in the programme. The committee recommends that the issues of critical reflection and social impact also be addressed explicitly in the earlier projects.

The committee found the Course Information and Assessment Plans to be useful documents for students, staff and individual lecturers. They provide clarity about the learning objectives to the students and enable good coordination between courses and lecturers.

Master students choose a competence profile (one of the three O's) and a specialist area. Together with their graduation professor they compose an individual programme that consists of:

- 25 EC competence profile courses (20 within and 5 outside the chosen profile);
- 15-20 EC core courses and 0-10 EC in-depth courses in the specialisation area;
- 15-20 EC internship;
- 40 EC graduation project in the specialisation area.

Compared to the bachelor programme, the courses in the master programme are much more oriented toward fundamental research and research methodology. In many specialised courses students must process and evaluate recent scientific literature for their assignments.

The internship does not have to be in the specialisation area but does require the approval of the graduation professor. The learning objectives of the internship are quite distinct from those of the coursework and the graduation project. The initiative lies with the student who must define what he/she wants to learn, related to the selected competence profile. The individual learning objectives must be approved in advance and are evaluated by the company where the internship took place and an internal staff member. The internship shows the students how theoretical knowledge is applied in practice and also what professional work entails. Most students find this a very motivating part of the curriculum and staff members note that, thereafter, they are much more involved in their studies: 'the penny has dropped' and they are much more goal oriented.

The graduation project is conducted inside the Faculty, often as part of a PhD project, or at a research institute or in industry, or abroad. The nature of the assignment depends on the chosen competence profile and varies from scientific research to applied research and the design of a prototype. The staff members explained to the committee that graduation projects in industrial companies are possible if the scientific quality can be guaranteed. This is almost never the case with small companies because they often are focused only on the solution of the problem they have put forward as a graduation assignment. They usually cannot afford the extra time for the learning process of the graduating student.

The cohesion of the master programmes is supported by a list of recommended combinations of profile, specialisation and courses. Not all combinations are possible, especially for the competence profile Organisation and Management the list of specialist areas that can be selected is more limited. Each individual study programme and requests for changes during the programme need the formal approval of the Programme Director on behalf of the Board of Examiners. The committee heard in the meetings with lecturers and students that this system works well and finds the possibility of individual choices within clear guidelines suitable for a master programme. The committee also appreciates the attention paid to the required academic level of the graduation projects.

2.1.2. Didactic principles

Characteristic of the bachelor programme is the PLE approach. All students and staff members with whom the committee has spoken during the site visit mentioned the advantages and positive effects of this group work.

Groups of eight students work on project assignments, guided by a tutor who is a staff member of the department. The amount of work needed to complete the assignment fits with the number of students in the group. For each project new groups are constituted with other combinations of students. Students learn to integrate knowledge from different areas, be aware of their role in group work, to reflect on it and to extend their repertoire. They also learn to reflect on each other and thus to address or avoid 'free rider' behaviour of group members. They are assessed by the tutor on a 50-50% combination of group and individual work.

New staff members who act as tutors in project groups often must learn to keep their distance and let the students do the work. This is crucial, however, because the PLE philosophy requires that students are not presented with knowledge but discover it for themselves on the basis of the project assignment. In this way they learn more about the integration and coherence of the theories they have been taught in the courses. They also develop a much higher degree of independence and initiative, which in the eyes of the staff members is clearly visible in the way students handle the graduation assignments.

The committee agrees with the staff and the students that PLE is a strong point of the Mechanical Engineering programme of the University of Twente.

The combination with lectures and self-study and the ample opportunities for students to fit the programme to their specialisation interests and future career plans are suitable for an academic programme.

2.1.3. Feasibility

The curriculum is a demanding programme and very few students manage to graduate in the allotted time. The average study length for the bachelor and master programme combined is approximately seven years. Nevertheless, the committee considers the programme to be feasible within five years. Students and alumni admit that it is possible to finish on time if they work hard, i.e. spend an average of forty hours per week on their study.
The department tries to structure the programme and its rules and regulations in such a way that students are stimulated and motivated to focus on their study and keep up with the pace of the programme. In order to ensure that students only participate in exams after sufficient preparation and do not use the first exam possibility to check out the difficulty of the exam questions, it is not permitted to have a third exam attempt unless the Board of Examiners allows this on the basis of a motivated request. Tutors monitor the group processes in the PLE groups and try to keep up a brisk working speed by identifying and supporting the natural leaders in the groups. Motivation is the crucial issue and the staff and student counsellors try to differentiate between the student who can but do not want to finish the programme in time, and those who want to but cannot keep up. These groups require a different approach, but in both cases the department aims to clarify the potential of each student as early as possible.

In the master programme study delays frequently occur because students and their supervisors want to take more time for the graduation project. The workload for the graduation project used to be the equivalent of 45 EC and not all staff members have adapted their expectations and guidance to the new load of 40 EC. The committee advises to stress to staff and students that a graduation project can and should be completed within a maximum of eight months. In their professional careers graduates must also be able to meet deadlines. Another factor for study delay is that study periods are spent abroad. Approximately 10% of the master students do so. These periods abroad often require much more preparation time. With respect to the bachelor programme students mentioned that the entrance requirements for projects (having passed the required theoretical exam) sometimes cause delays but on the other hand they agreed that fruitful project work is only possible if all students have more or less the same level of knowledge. The committee has taken note of the role of the Board of Examiners in adapting the regulations in individual cases to avoid unnecessary study delays and finds this a useful method.

Apart from the reasons mentioned above, the main cause of study delay is the individual choices made by students. Many spend much time on extra-curricular activities in the student association, sports committees, jobs etcetera, and justify this because these provide learning opportunities as well, be it in other areas. Students give a higher estimate of the hours they actually study than the staff indicates. The committee advises to monitor this and include it in the course evaluations.

Generally speaking, the students do not see the need to try and keep to the nominal schedule of the programme. On the one hand they agree that it is useful to stimulate students in the first year to keep up with the study from the very beginning. On the other hand they do not agree with the introduction of measures such as a binding study advice in the 2013-2014 academic year or the 'harde knip' per September 2012. That is the requirement that students must have completed the bachelor programme before they are allowed to start their master courses. Both staff and students expected a significant effect from the introduction of the 'langstudeerdersboete' by the government to shorten the average study duration but new political developments have led to the withdrawal of this measure.

The committee appreciates the extra mathematics courses that are provided to incoming students of the Departments of Mechanical Engineering, Construction Engineering and Industrial Design (including an advice on the basis of their scores to enrol in the study they propose or not). The committee also finds the summer courses, organised to bridge the gap for international students, useful and suggests that these should explicitly address the analytical and academic skills that may not always have been part of their bachelor programme. The committee appreciates as well giving students an extra opportunity to complete enough credits to earn their bachelor degree.

The new bachelor programme, starting in 2013-2014, will have a modular structure and more integration between courses and projects within 15 EC units per module. Combined with the PLE approach this is expected to ensure a higher motivation of students and therefore lead to less study delay and higher success rates. The committee hopes this will be the case and expects that the modular approach will be helpful.

2.1.4. Staff

The academic staff of the department is at an appropriate level, quantitatively and qualitatively. The student/staff ratio is 25:1. On the average, staff members spend 40% of their time on teaching. The committee appreciates that most staff members have good contacts with industrial and technological companies. Besides, they have frequent contacts with companies through the internships and graduation projects of their students. The department has a large number of externally funded projects with PhD students. Several master courses and most graduation projects are linked to PhD projects.

In a recent personnel survey a relatively large number of staff members complained about the high work load and the lack of appreciation for their work from the management. Discussions during the site visit with the management and the lecturers clarified that some staff members felt overloaded by the re-design of the bachelor programme (as of 2013-2014) and formalised exam regulations. The management put forward that in effect neither one will change much: the new university-wide bachelor programme will be based on the PLE approach introduced by the Faculty of Engineering Technology in the bachelor programme in mechanical engineering, and thus expresses explicit support for the faculty's work over the past years. The new regulations are a formalisation of practices that have already been implemented within the faculty. The staff members also indicated that the teaching load is not spread evenly, because their courses and PLE projects are always in the same period. The committee advises to monitor the teaching load of the staff members on a regular basis.

While some distance may be felt towards the central administration and the Board of the university, the Faculty Dean and the Board of the Department explicitly express that teaching is the most important element in the work of staff members. In the past, academic careers were almost exclusively based on research output, but the emphasis has been changed toward teaching. The staff members mentioned during the site visit that they see and appreciate this policy change.

The University Teaching Qualification (UTQ) is required from new staff members, from those who are considered for a promotion and from staff members who perform below standard expectations (e.g. after continued low scores in course evaluations). Course evaluations show that there are at present no staff members in the latter category. Staff members with more than twenty years of teaching experience are exempt from the UTQ-obligation. Even in the absence of complaints about teaching quality, the committee thinks the UTQ could be very useful also for experienced lecturers. The committee advises to look for a creative and efficient approach based on best practices, e.g. afternoon sessions or workshops, where staff members can reflect together on their teaching methods and build their portfolio.

2.1.5. Programme-specific facilities
The Faculty of Engineering Technology provides staff and students with good facilities for teaching and training. The laboratories, workshops, project rooms and multifunctional lecture rooms that were seen by the committee during the site visit, are well-equipped and there are many spaces for individual and group study. The committee was impressed by the wind tunnel and virtual reality room. The laboratories and rooms can be easily adapted to new project assignments.

The coaching and counselling provided to students is well considered. Every first year bachelor student is assigned a mentor who is on the staff of the mechanical engineering programme. The mentors meet with their students four times throughout the year, and more often if needed. Each mentor monitors six or seven students. They are usually lecturers in the first year programme and/or tutors in the first PLE project. They invite students for a first meeting in the second week of the programme. The mentor knows the students' grades after the first quarter and can refer a student to the student counsellor if necessary.

The student counsellor tries to differentiate as soon as possible between the students who have the potential but not the motivation to complete the programme, and those who have the motivation but not the potential. Students for whom the level proves to be too high can be referred to the Saxion University of Professional Education and proceed there without study delay. Some students switch to other bachelor programmes of the university. Most students come to the student counsellor on their own initiative, while some are referred by their mentor.

2.1.6. Programme-specific quality assurance
Quality assurance is taken seriously by the programme. Each year the Evaluation Committee makes a plan of the courses which should be evaluated. These courses are then evaluated by students and the results are published, including the response of the responsible lecturer and, if necessary, plans to improve the course next year. The evaluation response rates are on average 30%, sometimes very low (9%) and higher (51%) if students experience problems. During the site visit students described this procedure as an effective method of quality control. The committee recommends to investigate how the response rates can be raised.

In response to the previous assessment in 2006 several measures have been taken and are described in detail in the self-evaluation report. The committee especially appreciates the introduction of 'Course information and assessment plans' for all courses. The committee recognises this as a sign of the department's drive towards continuous improvement.

2.2. Considerations

The committee has investigated the different aspects of the teaching and learning environment to assess whether the intended learning objectives can be achieved. The meetings with management, students, staff and the educational committee gave clear information about the implementation of the bachelor and master programmes.

The bachelor programme is well-structured and provides the necessary foundation in theory and skills. The detailed course descriptions enable the staff to coordinate the learning objectives and contents of their courses. Project Led Education (PLE) is characteristic for the UT programme in Mechanical Engineering. The projects help the students not only to connect theory to real life design problems but also to develop personal and social skills. The tutors play an important role, are able to keep track of the students' progress and can, if necessary, refer a student to the student counsellor. The committee values PLE as a strong point of the programme, but advises to pay more attention earlier in the programme to academic skills such as critical reflection on scientific literature, formulating research questions and writing an academic report.

The master programme is highly individualised and based on the choice of one of three competence profiles (research, design and organisation). Under the guidance of their graduation professor students select a coherent set of coursework, internship and graduation project. The committee finds this a suitable approach for the master programme where the individual student's plan for a career should be a leading consideration.

The teaching and supporting staff are strongly involved with the students and their progress. The committee recognised the commitment of lecturers, even in times of heavy workload, and advises the management to monitor the workload regularly. The co-operation between the student counsellors and the mentors in the first year works well. The committee appreciates the policy to distinguish as early in the programme as possible between students who are capable but not motivated and students who are motivated but not capable, and take appropriate measures to either stimulate them or refer them to e.g. the Saxion University of Professional Education.

The average length of study remains a concern, although it is better than for similar programmes in the Netherlands. The feasibility of the programme is in order, even though only a minority of the students finishes on time. The students indicate that they often give priority to other activities, such as the student association, sports, study trips or jobs. The committee expects that new measures such as the Binding Study Advice (BSA) and the 'harde knip' will lead to improved study behaviour. The programme staff has taken sufficient measures to help students with study delays. In addition, the committee advises to emphasise to staff and students that 'good' is 'good enough' and that finishing a project on time is also an important learning objective.

2.3. Conclusion

Bachelor's programme Mechanical Engineering: the committee assesses Standard 2 as good.
Master's programme Mechanical Engineering: the committee assesses Standard 2 as satisfactory.

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

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

3.1. Findings

This section consists of two parts. First, it deals with the committee's findings with regard to the system of assessment (3.1.1). Secondly, it answers the question of whether students achieve the intended learning outcomes (3.1.2).

3.1.1. Assessment system

The committee is impressed by the proactive role of the Board of Examiners in ensuring the quality of the assessment system and the individual assessments. The introduction of course descriptions including assessment plans, test matrices and response models certifies the validity of the exams. All assessment plans are checked by a member of the Board of Examiners and all bachelor exams and assignments are validated in advance by one or more colleagues. At least two examiners assess the students' results in cases of project assignments. In the master programme many exams are very specialised and are taken orally. In those cases, too, the examiner evaluates the student's performance on the basis of an examination plan with a response format. Oral exams are considered to be especially useful instruments to check the independence and depth of the student's work. Re-sits are carried out on the basis of the same assessment plan as the original exam.

Prior to the examination students can find the learning objectives, course information and assessment procedures in Osiris, the student information system of the university. They also have access to representative test exams, and old exams are often discussed in class. After the exam the explanation of the correct answers is also provided.

The Board of Examiners told the committee that it has not seen cases of fraud or plagiarism so far. Sometimes students are not very accurate in quotations and referencing, although they are taught how to do this in the second project in the first year. All papers and reports are checked by plagiarism software. The fact that project assignments are renewed each year also helps to prevent plagiarism and cheating.

The assessment of PLE projects consists of 50% group mark and 50% individual mark. A group mark is usually given for the end product, while individual marks are given for the presentation, defence and contribution to the report. In project F the balance is different: 25% group mark and 75% for the individual component. Students acknowledged in their meeting with the committee that they consider this to be a fair system. The tutors are able to assess the individual student's contribution and tutors address students who show 'free rider' behaviour.

The master thesis is assessed by a master examination committee consisting of at least three members: the graduation professor, the daily supervisor and an independent examiner from another specialisation area. Marks are given for the thesis, presentation, oral defence, problem-solving approach and mastering of the theory behind the problem. The final mark is not necessarily the average of the five components. Especially the student's independence or self-reliance in the execution of the project weighs heavily in the final mark. The committee agrees with this procedure. It makes it possible to correct for cases when such intensive supervision was needed that the report cannot be considered to be the work of the student him-/herself only.

3.1.2. Achievement of intended learning outcomes

The committee checked fifteen bachelor reports (project F) and fifteen master theses to assess if the intended learning outcomes are achieved.

When the committee discussed the F-reports in its preparatory meeting the main point of criticism was the lack of scientific articles in the reference lists. The range in quality from just passing level to very good was also remarkable. During the site visit the staff members explained that the use of literature in the reports is indeed not one of the assessment criteria in project F, but that this is one of the objectives in project ITO. The large quality differences are due to the fact that the reports are submitted without a preliminary check by the tutor and that there is no time for revisions: the deadline is upheld strictly. Apart from these issues the committee agreed with the marks given by the lecturers.

To determine if the bachelor learning objectives have been achieved, the best criterion is their success rate in the master programme. On this score the outcome is positive: the drop out from the master programme is very limited.

The quality of the master theses was satisfactory to good. The papers had clear problem formulations, showed logical reasoning and were generally well-written. The committee's marks were at the same level as the original grades. The progression in complexity, analytical skills and scientific writing from bachelor theses to master theses was quite large. As the teaching staff explained, intensive supervision by a PhD student might contribute to this in some cases. The theses reflect the academic level of the graduation projects.

A recent alumni survey shows that all graduates have found a job within six months after graduation. Their jobs are within the field of mechanical engineering to a moderate extent for 20%, to a great extent for 40% and to a very great extent for the remaining 40%. 86% feel they are adequately prepared for their jobs. Companies are very eager to attract the graduates and some have even mentioned that they are willing to pay the 'langstudeerdersboete' for students so they can finish their degree. The committee recommends to strengthen and structure the feedback received from companies on the quality of the graduates, as it seems to be rather informal at present.

These positive outcomes were supported by the alumni whom the committee met during the site visit. As particularly strong points they mentioned the approach and working methods they had learned, the ability to handle uncertainties and keep the overview when working on a problem. They found this to be a unique asset of their education. The theoretical basis was sufficiently broad, they indicated that additional knowledge can be picked up while working. When asked to mention points of improvement they emphasised that the mind-set they learned through PLE is more important than specific contents or courses.

3.2. Considerations

The department of Mechanical Engineering at the University of Twente has found a way to assess the individual student's knowledge and skills but also do justice to the group work in the PLE project groups. The learning objectives of the different curriculum elements are checked by assessments that are valid, reliable and transparent. The Board of Examiners monitors and checks the individual exams and is obviously in control.

The range of marks for the bachelor theses (project F) is large. The committee agreed with the marks given, both the high and the low grades. The range is so large because the reports were submitted without revision rounds on the basis of a tutor's comments or feedback. Therefore, the grades reflect the performance of the students perhaps even better than more polished theses where staff's input is part of the final product.

In the master programme the latter is solved by the grading system for the master theses: in addition to marks for the thesis, presentation, oral defence and mastering of the theory behind the problem, a separate mark is given to the student's independence. The theses were marked fairly and were generally of a high level.

The alumni were very satisfied with the education and training they had received, especially with the mind-set and skills they learned from the PLE-approach. They are much sought after by companies. The committee concludes that the graduates are indeed the young men and women who can be proud of their degree and who can play a leading role in their field of expertise, as intended by the department.

3.3. Conclusion

Bachelor's programme Mechanical Engineering: the committee assesses Standard 3 as satisfactory.
Master's programme Mechanical Engineering: the committee assesses Standard 3 as good.

General conclusion

The committee judges the bachelor and master programmes in Mechanical Engineering to be solid and stimulating academic programmes. The design of the programme structure, the way it is taught by qualified and committed staff members, and the conditions created for quality control all contribute to a fitting teaching and learning environment. The assessment of the learning outcomes in tests, assignments and, above all, the bachelor and master thesis meets the required quality standards. Both the quality of the theses and the experiences of the alumni show that the intended learning outcomes are achieved.

The committee assesses the *bachelor's programme Mechanical Engineering* as satisfactory.
The committee assesses the *master's programme Mechanical Engineering* as good.

Appendices

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

Joris De Schutter (chair) received the M.Sc. degree in mechanical engineering from the Katholieke Universiteit Leuven, Belgium, in 1980, the M.Sc. degree from the Massachusetts Institute of Technology, in 1981, and the Ph.D. degree in mechanical engineering, also from KU Leuven, in 1986. Following work as a control systems engineer in industry, in 1986, he became a lecturer in the Department of Mechanical Engineering, KU Leuven, where he has been a full professor since 1995. He teaches courses in kinematics and dynamics of machinery, control, robotics and optimisation. His research interests include sensor-based robot control and programming, optimal motion control of mechatronic systems, and modeling and simulation of human motion. In 2000-2001 he spent a sabbatical year in industry (environmental technology). From 2001 to 2003 he was president of K VIV, the Flemish association of university-graduated engineers.

Gijs Calis received his master's degree in Mechanical Engineering (Production Automation) from Eindhoven University of Technology in 1974. He held various management positions within the Stork group of companies as of 1974. His latest position was Corporate Director Risk Management, Stork B.V.; Corporate Head Office (2002 – 2010).
He retired in April 2010. His current other positions include being the chairman of the Division of Mechanical Engineers of the Royal Institute of Engineers in The Netherlands; vice-chairman and arbitrator of the Council of Arbitration for the Metal Trade and Industry; and chairman of the Policy Committee 'Machinebouw' of NEN, the standardisation institute of the Netherlands. Formerly he was a member of the Advisory Board of the Graduate School of Engineering Mechanics in the Netherlands (1996 -2011) and a member of the Advisory Committee to the Faculty of Mechanical Engineering of Delft University of Technology (1996 - 2000) and the UHD committee of this Faculty (2000 – 2005).

Sanne Janssen received her BSc degree in Mechanical Engineering from the Eindhoven University of Technology in August 2012. She has been a member of the educational committee since 2010. In 2010-2011 she has also been the commissioner of education of the study association Simon Stevin. At present she is a master student of mechanical engineering at the same university in the Dynamics and Control department.

Hans ter Meulen was awarded a MSc in Physics from the Katholieke Universiteit Nijmegen (currently Radboud University). He specialised in experimental molecular physics at the same university, where he obtained a PhD degree in 1976 on the origins of the maser radiation from interstellar hydroxyl radicals. Hereafter he started a research group focused on molecular spectroscopy and molecular dynamics using tunable narrowband laser techniques. In 1980 he became associate professor at Nijmegen University and started with applied research in the field of both reactive and non-reactive flows. He collaborated with research groups at the universities of Delft, Eindhoven and Twente in the fields of fluid dynamics and mechanical engineering. In 1997 Hans ter Meulen became full professor in Applied Physics at Nijmegen University. Beside research he has been involved intensively in the science education programmes. He chaired the education committee for Physics for many years. From 1995 onwards he has coordinated the programme of Science, a new broad study programme at Nijmegen. From 2005 to 2008 he was the director of the education institute for Physics and Astronomy and from 2008 to 2011 he was vice-dean for education at the Faculty of Science. He was retired in 2012.

Marc Vantorre obtained his degree of naval architect (MSc) in 1981 and PhD titles in 1986 and 1990, all at Ghent University. Presently he holds the position of senior full professor at Ghent University (Faculty of Engineering and Architecture), where he is head of the Maritime

Technology Division. He is responsible for the courses in maritime hydrostatics and hydrodynamics for students Master of Electromechanical Engineering (main subject Maritime Engineering). He also teaches courses Ship Technology and Water & Shipping on behalf of the interuniversity (UGent - UA) programmes Master of Maritime Science and Advanced Master Technology for Integrated Water Management, respectively. He is member of the Programme Committees of the mentioned master programmes. His research activities concern ship behaviour in shallow and restricted waters, including maneuvering and vertical motions induced by waves and squat, as well as wave energy conversion. The research on the first topic is mainly performed in close co-operation with Flanders Hydraulics Research (Antwerp, Flemish Government). He is and has been member of several international working groups (PIANC, ITTC).

Appendix 2: Domain-specific framework of reference

1. ABET

Mechanical Engineering is one of the disciplines defined by ABET. The previous self-evaluation report used the ABET criteria for its domain-specific frame of reference (DSFR). The three collaborating programmes in Mechanical Engineering at TU/e, TUD and UT have decided to add the OECD (A tuning-AHELO conceptual framework of expected/desired learning outcomes in engineering) and ASME (An Environmental Scan for ASME and the Global Summit on the Future of Mechanical Engineering) definition documents as an extension to this DSFR. Sequentially, we will discuss the proposed Learning outcomes for an Engineering programme, the proposed Learning outcomes for a Mechanical Engineering programme and the criteria for a Master's programme.

Engineering programme

Engineering has classically been defined as the profession that deals with the application of technical, scientific, and mathematical knowledge in order to use natural laws and physical resources to help design and implement materials, structures, machines, devices, systems and processes that safely accomplish a desired objective. As such, engineering is the interface between scientific and mathematical knowledge and human society. The primary activity of engineers is to conceive, design, implement and operate innovative solutions – apparatus, processes, and systems – to improve the quality of life, address social needs or problems, and improve the competitiveness and commercial success of society.
Engineering is quite different from science. Scientists try to understand nature. Engineers try to make things that do not exist in nature. Engineering Technology is of great economic importance. Although many achievements are not eye-catching and do not receive much public notice, many of the activities are essential for the proper functioning of the modern society. The engineer designs devices, components, subsystems, and systems. To create a successful design, in the sense that it leads directly or indirectly to an improvement of the quality of life, the engineer must work within constraints provided by technical, economic, business, political, social and ethical issues.
No profession unleashes the spirit of innovation like engineering. From research to real-world applications, engineers constantly discover how to improve our lives by creating bold new solutions that connect science to life in unexpected, forward-thinking ways.

Proposed learning outcomes for an Engineering programme

The OECD has launched a feasibility study, Assessment of Higher Education Learning Outcomes (AHELO), which is a ground-breaking initiative that will assess learning outcomes on an international scale by creating measures that would be valid for all cultures and languages.
A comparative summary of some of the most influential learning outcome frameworks in the engineering field is set out in Appendix 1. That there is a common understanding throughout the world of what an engineer is supposed to know and be able to do is most striking and probably differentiates engineering from many other disciplines. In a comparative review of the Tuning-AHELO, EUR-ACE Framework Standards for the Accreditation of Engineering Programmes and the ABET criteria for accrediting engineering programmes, the following learning outcomes for Engineering programmes were distinguished:

a) Generic Skills: The ability to…
- …function effectively as an individual and as a member of a team;
- …communicate effectively with the engineering community and with society at large;
- …recognise the need for and engage in independent life-long learning;

- …demonstrate awareness of the wider multidisciplinary context of engineering.
b) Basis and Engineering Sciences: The ability to…
- …demonstrate knowledge and understanding of the scientific and mathematical principles underlying their branch of engineering
- …demonstrate a systematic understanding of the key aspects and concepts of their branch of engineering
- …demonstrate comprehensive knowledge of their branch of engineering including emerging issues.

c) Engineering Analysis: The ability to…
- …apply their knowledge and understanding to identify, formulate and solve engineering problems using established methods
- …apply knowledge and understanding to analyse engineering products, processes and methods
- …select and apply relevant analytic and modeling methods
- …conduct literature searches, use databases and other sources of information
- …design and conduct appropriate experiments, interpret the data and draw conclusions.

d) Engineering Design: The ability to…
- …apply their knowledge and understanding to develop designs to meet defined and specified requirements
- …demonstrate an understanding of design methodologies, and be able to use them

e) Engineering Practice: The ability to…
- …select and use appropriate equipment, tools and methods
- …combine theory and practice to solve engineering problems
- …demonstrate understanding of applicable techniques and methods, and their limitations
- …demonstrate understanding of the non-technical implications of engineering practice
- …demonstrate workshop and laboratory skills
- …demonstrate understanding of health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions within a societal and environmental context, and commitment to professional ethics, responsibilities and norms of engineering practice
- …demonstrate knowledge of project management and business practices, such as risk and change management, and awareness of their limitations.

Criteria for a Mechanical Engineering programme
Mechanical Engineering is a discipline of Engineering that applies the principles of physics and materials science for analysis, design, manufacturing, and maintenance of mechanical systems. It is the branch of engineering that involves the production and usage of heat and mechanical power for the design, production, and operation of machines and tools. It is one of the oldest and broadest engineering disciplines.
The engineering field requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, and structural analysis. Mechanical engineers use these core principles along with tools like computer-aided engineering and product lifecycle management to design and analyse manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircraft, watercraft, robotics, medical devices and more.
The field has continually evolved to incorporate advancements in technology, and mechanical engineers today are pursuing developments in such fields as composites, mechatronics, and nanotechnology. Mechanical engineering overlaps with aerospace engineering, building

services engineering, civil engineering, electrical engineering, petroleum engineering, and chemical engineering to varying amounts.

The fundamental subjects of mechanical engineering include:

Statics and dynamics	Mathematics – in particular, calculus, differential equations, and linear algebra
Strength of materials and solid mechanics	Engineering design
Instrumentation and measurement	Product design
Thermodynamics, heat transfer, energy conversion, and HVAC	Control theory and mechatronics
Fluid mechanics and fluid dynamics	Material engineering
Mechanism design (including kinematics and dynamics)	Design engineering, computer-aided design (CAD), and computer-aided manufacturing (CAM).
Manufacturing engineering, technology, or processes	

Mechanical engineers are also expected to understand and be able to apply basic concepts from chemistry, physics, chemical engineering, civil engineering, and electrical engineering. Most mechanical engineering programs include multiple semesters of calculus, as well as advanced mathematical concepts including differential equations, partial differential equations, linear algebra, abstract algebra, and differential geometry, among others.
Next, we will discuss the trend for the future of mechanical engineering and the learning outcomes for a mechanical engineering programme according to OECD.

Trends for the future of mechanical engineering according to ASME
The Institute for Alternatives Futures describes in an environmental scan for ASME and the Global Summit on the Future of Engineering mentions nine trends that will change the character of mechanical engineering in the coming decades. These nine trends play an important role in the development of our curriculum:
1. Developing Sustainably
2. Engineering Large & Small Scale Systems
3. Competitive Edge of Knowledge
4. Collaborative Advantage
5. NanoBio Future
6. Regulating Global Innovation
7. Diverse Face of Engineering
8. Designing at Home
9. Engineering for the Other 90 Percent

Criteria for a MSc level programme
The criteria of the ABET are intended to assure quality and to foster the systematic pursuit of improvement in the quality of engineering education that satisfies the needs of constituencies in a dynamic and competitive environment.
All Master's level programmes seeking accreditation from the Engineering Accreditation Commission of ABET must develop, publish, and periodically review, educational objectives and student outcomes. The criteria for master's level programmes are fulfilment of the baccalaureate level general criteria, fulfilment of programme criteria appropriate to the masters level specialisation area, and one academic year of study beyond the baccalaureate

level. The programme must demonstrate that graduates have an ability to apply master's level knowledge in a specialised area of engineering related to the programme area.
According to the ABET, an Engineering curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyse, design, and realise physical systems, components or processes; and prepare students to work professionally in both thermal and mechanical systems areas.
Nevertheless, generally accepted programme elements are Mechanical Automation, Control Engineering, Mathematics, Thermodynamics, Fluid & Solid Mechanics, Design Methods, Production Methods and Material Sciences. Between these accepted programme elements, there are differences in priorities between the universities. In general can be concluded that the programme must demonstrate that faculty members responsible for the upper-level professional programme are maintaining currency in their specialty area.

2. OECD

The Tuning-AHELO project on learning outcomes is the result of a comparative review of the EUR-ACE Framework Standards for the Accreditation of Engineering Programmes and the ABET criteria for accrediting engineering programmes. It is consistent with other frameworks/sets of learning outcomes, relevant for defining the Tuning-AHELO set of learning outcomes for first cycle engineering programmes in general. The corresponding ABET criteria are included between round brackets after the title of each identified group of learning outcomes.

First cycle programme learning outcomes in engineering developed in the framework of the Tuning-AHELO project:

Generic Skills (d, g, h, i)

Graduates should possess generic skills needed to practice engineering. Among these are: the capacity to analyse and synthesise, apply knowledge to practice, adapt to new situations, ensure quality, manage information, and generate new ideas (creativity). More particularly, graduates are expected to have achieved the following learning outcomes:
• the ability to function effectively as an individual and as a member of a team;
• the ability to communicate effectively with the engineering community and with society at large;
• the ability to recognise the need for and engage in independent life-long learning;
• the ability to demonstrate awareness of the wider multidisciplinary context of engineering.

Basic and Engineering Sciences (a)

In general, the underpinning knowledge and understanding of science, mathematics and engineering fundamentals are essential to satisfy other programme outcomes. Graduates should be able to demonstrate their knowledge and understanding of their engineering specialisation, and also the wider context of engineering. More particularly, graduates are expected to have achieved the following learning outcomes:
• the ability to demonstrate knowledge and understanding of the scientific and mathematical principles underlying their branch of engineering;
• the ability to demonstrate a systematic understanding of the key aspects and concepts of their branch of engineering;
• the ability to demonstrate comprehensive knowledge of their branch of engineering including emerging issues.

Engineering Analysis (b, e)
Graduates should be able to solve engineering problems consistent with the level of knowledge and understanding expected at the end of a first cycle study programme, and may involve experience from outside their field of specialisation. Analysis can include the identification, specification and clarification of the problem, determination of possible solutions, selection of the most appropriate solution method, and effective implementation. First cycle graduates should be able to use various methods, including mathematical analysis, computational modelling, or practical experiments, and should be able to recognise societal, health and safety, environmental and commercial constraints. Furthermore, graduates should be able to use appropriate research or other detailed investigative methods of technical issues consistent with the level of knowledge and understanding expected at the end of a first cycle study programme.
Investigation may involve literature research, design and execution of experiments, interpretation of data, and computer simulation. It may require that databases, codes of practice and safety regulations are consulted. More particularly, graduates are expected to have achieved the following learning outcomes:
• the ability to apply their knowledge and understanding to identify, formulate and solve engineering problems using established methods;
• the ability to apply knowledge and understanding to analyse engineering products, processes and methods;
• the ability to select and apply relevant analytic and modelling methods;
• the ability to conduct literature searches, use databases and other sources of information;
• the ability to design and conduct appropriate experiments, interpret the data and draw conclusions.

Engineering Design (c)
Graduates should be able to create engineering designs consistent with the level of knowledge and understanding expected at the end of a first cycle study programme, working in co-operation with engineers and non-engineers. The design may be of processes, methods or artefacts. The specifications should be wider than technical aspects, including awareness of societal, health and safety, environmental and commercial considerations. More particularly, graduates are expected to have achieved the following learning outcomes:
• the ability to apply their knowledge and understanding to develop designs to meet defined and specified requirements;
• the ability to demonstrate an understanding of design methodologies, and be able to use them.

Engineering Practice (f, j, k)
Graduates should be able to apply their knowledge and understanding to developing practical skills for solving problems, conducting investigations, and designing engineering devices and processes. These skills may include the knowledge, use and limitations of materials, computer modelling, engineering processes, equipment, workshop practice, and technical literature and information sources. They should also recognise the wider, non-technical aspects, such as ethical, environmental, commercial and industrial, implications of engineering practice, ethical, environmental, commercial and industrial. More particularly, graduates are expected to have achieved the following learning outcomes:
• the ability to select and use appropriate equipment, tools and methods;
• the ability to combine theory and practice to solve engineering problems;
• the ability to demonstrate understanding of applicable techniques and methods, and their limitations;

• the ability to demonstrate understanding of the non-technical implications of engineering practice;
• the ability to demonstrate workshop and laboratory skills;
• the ability to demonstrate understanding of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions within a societal and environmental context, and commitment to professional ethics, responsibilities and norms of engineering practice;
• the ability to demonstrate knowledge of project management and business practices, such as risk and change management, and awareness of their limitations

3. ASME

ASME (American Society of Mechanical Engineers) prepared a document in 2008, looking ahead at the challenges expected in 2028.

The nine drivers of change described in the report grapple with many of the grand challenges faced by society over the next twenty years. They reflect the needs, wants and desires of people around the globe. They also explore what mechanical engineering will need to do well in order to do this good work in the world. For each driver, IAF (Institute for Alternative Futures) offers a forecast of what might happen and explains how these changes could affect mechanical engineering.

Here are the nine drivers and forecasts briefly summarised.

1. Developing Sustainably: Rapidly developing economies are adding to global environmental pressures and competition for energy, water, and other high-demand resources. Mechanical engineering will be challenged to develop new technologies and techniques that support economic growth and promote sustainability.

2. Engineering Large & Small Scale Systems: Engineers in 2028 will work at the extremes of very large and very small systems that require greater knowledge and coordination of multidisciplinary and multi-scale engineering across greater distances and timeframes. A new field of systems engineering will incorporate much of the knowledge and practices of mechanical engineering.

3. Competitive Edge of Knowledge: In 2028, the ability of individuals and organisations to learn, innovate, adopt and adapt faster will drive advanced economies. Mechanical engineering education will be restructured to resolve the demands for many individuals with greater technical knowledge and more professionals who also have depth in management, creativity and problem-solving.

4. Collaborative Advantage: The dominant players in all industries in 2028 will be those organisations that are successful at working collaboratively. The 21st century will be defined by the integration of competitive markets with new methods of collaboration.

5. NanoBio Future: Nanotechnology and biotechnology will dominate technological development in the next 20 years. In 2028, nanotechnology and biotechnology will be incorporated into all aspects of technology that affect our lives on a daily basis. They will provide the building blocks that future engineers will use to solve pressing problems in diverse fields including medicine, energy, water management, aeronautics, agriculture and environmental management.

6. Regulating Global Innovation: Innovation, within the framework of a global economy, will remain a complex affair in 2028. Fundamental restructuring of the regulation and protection of intellectual property on a global basis is unlikely. As more complex technologies require greater collaboration and sharing of patents, incremental changes will occur to produce equitable and beneficial results for the innovators and those that adopt and commercialise innovations.

7. Diverse Face of Engineering: Demand for new technologies will sustain global demand for adequately skilled and innovative mechanical engineers in 2028. Prospective employers will seek and promote people with unique and varied backgrounds to maximise their potential for success in diverse cultures and situations.

8. Designing at Home: By 2028, advances in computer aided design, materials, robotics, nanotechnology and biotechnology will democratise the process of designing and creating new devices. Engineers will be able to design solutions to local problems. Individual engineers will have more latitude to design and build their devices using indigenous materials and labor – creating a renaissance for engineering entrepreneurs. The engineering workforce will change as more engineers work at home as part of larger decentralised engineering companies or as independent entrepreneurs.

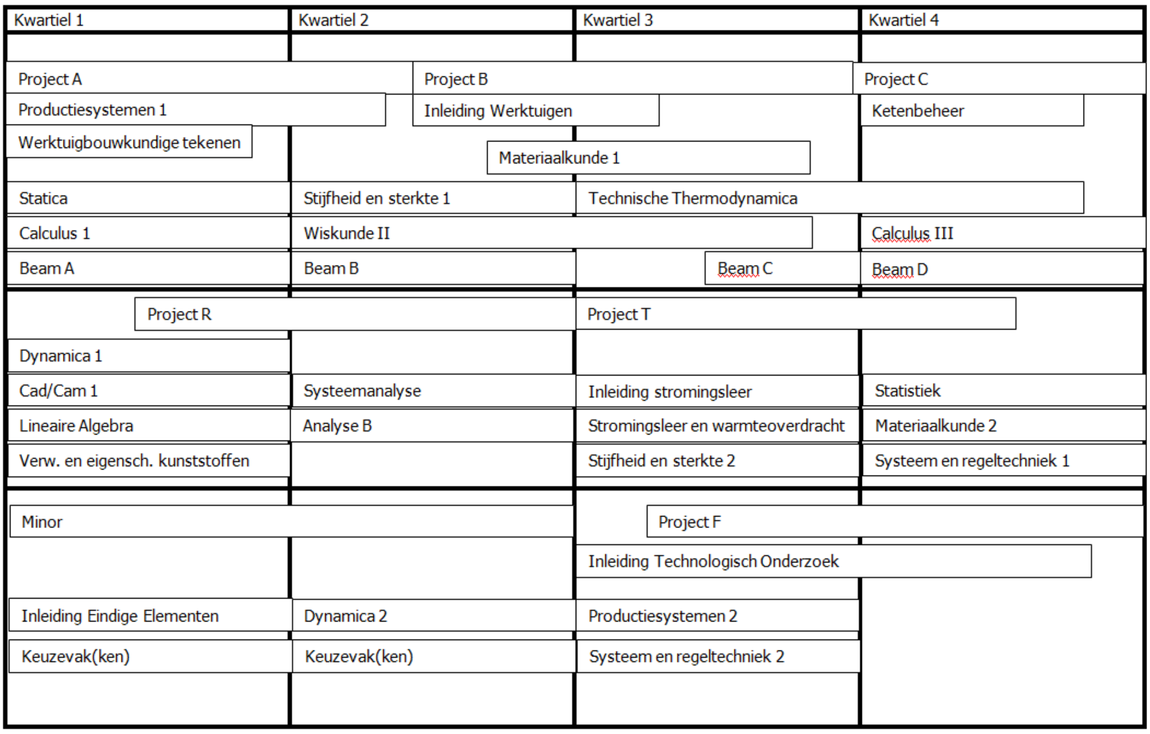
9. Engineering for the Other 90 Percent: By 2028, globalisation and new business models will increasingly drive the development of mechanical engineering projects that serve the poorest 90 percent of humanity – the four billion people who live on less than $2 a day.

Appendix 3: Intended learning outcomes

Bachelor's graduate	**Master's graduate**
Has mechanical engineering competences at academic level:	
a. Broad and profound technical scientific knowledge of mechanical engineering disciplines *(Mechanics of Materials, Fluid Dynamics, Energy Technology, Control Engineering and Dynamical Systems, Design & Production),* and the skills to use this knowledge effectively	a+. Advanced level of knowledge within at least one sub discipline and the ability to apply this knowledge in design and research in this area
b. Thorough knowledge of methods, paradigms and tools to analyse and interpret data	b+. Ability to design and conduct experiments, to develop models and simulations
c. Ability to contribute to the solution of technological problems by a systematic approach involving analysis, formulating sub-problems and evaluating the implementation	c+. Ability to identify, formulate and solve engineering problems by designing and development of innovative solutions, including evaluating the feasibility
d. Ability to integrate theory and practice from a range of sub-disciplines	
e. Ability to use the techniques, skills and modern engineering tools, whenever relevant for engineering practice	
f. Ability *to design* a system, component or process to meet desired needs, within defined boundary conditions	
***Has psychological, social and personals competences*:**	
g. Ability to communicate effectively with professionals about their own work and its relevance and possible impact in varying contexts	
h. Ability to work in (multidisciplinary) teams, taking initiatives, identifying any lack of expertise and filling those gaps	h+. Ability to work independently on a design or research assignment
i. Ability and attitude to evaluate technological, societal and ethical impact of his work and to take professional responsibility for his own decisions	i+. Insight in the complex working of modern industrial organisations
j. Ability to decide about continuation of his formal education in a related Master's programme	j+. Ability to decide about the first step in his professional career
k. Attitude and ability to maintain and improve academic and professional competence (life-long learning)	

Appendix 4: Overview of the curricula

Overview of the bachelor's programme



Overview of the master's programme

First year	Quartile 1	Quartile 2	Quartile 3	Quartile 4	Total	Margins allowed
Compulsory courses within the competency profile (research, design, management)	10	5	5		20	
Selection from other competency profiles		5			5	
Core courses per sub-discipline	5	5	5	5	20	15-20
Specialist courses for each graduation theme			5		5	0-10
Free choice				10	10	10-15
Second year						
Company or research internship	15	5			20	15-20
Graduation project		10	15	15	40	40-45
Total (minimum)	30	30	30	30	120	120

Appendix 5: Quantitative data regarding the programmes

Data on intake, transfers and graduates

Graduates in cohort	BSc Intake					
	VWO	HBO (after propaedeutics	HBO (after premaster)	International	Other	Total (%male/ %female)
2005-2006	69	0	5	2	1	77 (95%/5%)
2006-2007	131	0	0	4	2	137 (95%/5%)
2007-2008	106	3	0	3	3	115 (94%/6%)
2008-2009	111	0	1	5	2	119 (95%/5%)
2009-2010	108	1	0	11	3	123 (94%/6%)
2010-2011	79	2	15	3	5	104 (94%/6%)

Annual student intake of students in the master's programme with a BSc degree

Graduates in cohort	MSc Intake					
	BSc UT	Other Dutch university	HBO	Other higher education		Total (%male/ %female)
2005-2006	62	1	11	1		77 (95%/5%)
2006-2007	80	1	10	2		137 (95%/5%)
2007-2008	86	3	4	2		115 (94%/6%)
2008-2009	11	1	18	2		119 (95%/5%)
2009-2010	71	1	9	4		123 (94%/6%)
2010-2011	75	0	2	5		104 (94%/6%)

Bachelor's efficiency (re-enrolment); degree obtained after 3, 4, 5 and 6 years (cumulative %)

Performance of bachelor's students					
Cohort	Number	% after 3 yrs	% after 4 yrs	% after 5 yrs	% after 6 yrs
2005-2006	64	14%	45%	64%	72%
2006-2007	120	17%	38%	65%	
2007-2008	101	14%	37%		
2008-2009	102	16%			
2009-2010	101				
2010-2011	78				

Average length of studies in months since enrolment in the master's programme

Graduates in cohort	BSc UT		Other Dutch university		HBO		Other higher education	
	Number	Months	Number	Months	Number	Months	Number	Months
2005-2006	2	23						
2006-2007	24	25					1	25
2007-2008	41	27					2	28
2008-2009	55	30	1	33	2	35	2	25
2009-2010	63	29	1	28	4	40		
2010-2011	68	29	1	35	2	42	2	26

Teacher-student ratio achieved

On the reference date 1 March 2012, a total of 674 students were registered in the bachelor's programme (526 students) and master's programme (148 students). The total number of staff fte in education is 27.2. This means that the staff-student ratio is approximately (674 / 27.2 =) 25:1.

Category	**Fte in education**
Full professors	2.8
Associate professors	4.3
Assistant professors	7.6
Lecturers	2
Student assistants	0.9
Mentors	0.1
Tutors (PhD students)	4.8
Graduation supervisors (PhD students, academic staff)	4.5
Other academic staff	0.2
Total	***27.2***

Average amount of face-to-face instruction per stage of the study programme

Learning and teaching methods and hours spent in bachelor's and master's programme

Learning activity	Bachelor			Master	
	B1	B2	B3	M1	M2
Lectures	15% 255 hours	21% 355 hours	13% 215 hours	29% 48- hours	
Tutorials	12% 200 hours	11% 195 hours	1% 25 hours		
Exercises/assignments /labs	5% 85 hours	3% 40 hours	2% 35 hours	2% 35 hours	
Projects (group)	40% 670 hours	24% 410 hours	20% 330 hours		
Individual study	25% 420 hours	38% 630 hours	19% 310 hours	67% 1130 hours	
Minor and elective courses			44% 740 hours		
Examinations	3% 50 hours	3% 50 hours	1% 25 hours	2% 35 hours	
Practical training (internship)					33% 560 hours
Graduation project (thesis)					67% 1120 hours
Total	100% (1680 hours	100% (1680 hours	100% (1680 hours	100% (1680 hours	100% (1680 hours)

Appendix 6: Programme of the site visit

Vrijdag 14 september 2012	
8.00	**Ontvangst commissie**
8.30-9.30	**Management** Prof.dr. F. (Rikus) Eising, decaan Prof.dr.ir. A. (André) de Boer, opleidingsdirecteur Ir. M. (Mark) Rijkeboer, voormalig bachelorcoördinator Dr. G.G.M. (Genie) Stoffels, bachelorcoördinator Prof.dr.ir. F.J.A.M. (Fred) van Houten, MT-lid Dr.ir. C.M. (Marjolein) Dohmen-Janssen, MT-lid Dr.ir. D. (Dorien) van de Belt, Internationalisering en lid Faculteitsraad Drs. E.M. (Lisa) Gommer, co-auteur zelfstudierapport
9.30-10.15	**Studenten** **Bachelor programma:** R.M. (Roeland) Weigand (hbo) P. (Petra) Kuipers (2e jaars) T.H. (Nick) Hoksbergen(2e jaars) L.D.K. (Khoi) Vu (3e jaars) **Master programma:** H. (Hugo) Nauta S.S. (Sandra) Poelsma M.C. (Miranda) Versteeg **Studievereniging Isaac Newton:** J. (Joni) Terpstra (voorzitter)
10.15-11.00	**Docenten** Dr.ir. R.G.K.M. (Ronald) Aarts, Control Dr.ir. A.H. (Ton) van den Boogaard, Mechanica Dr.ir. T.C. (Ton) Bor, Materialen Dr.ir. R. (Rob) Hagmeijer, Stromingsleer Ir. I.F. (Ilanit) Lutters-Weustink, Productie Prof.dr.ir. T.H. (Theo) van der Meer, Thermodynamica Dr.ir. M.B. (Matthijn) de Rooij, Project B Prof.dr.ir. D.J. (Dik) Schipper, ITO Dr.ir. W.W. (Wessel) Wits, Ontwerpen Dr.ir. G. (Gerrit) Zwier, Wiskunde
11.00-11.45	**Opleidingscommissie** Prof.dr.ir. H.J.M.F.(Bart) Koopman, voorzitter Dr.ir. T.H.J. (Tom) Vaneker, docent Dr.ir. N.P. (Niels) Kruyt, docent A. (Beralt) Meppelink, student W.(Wouter) de Vries, student S.O. (Sven) van der Heide, evaluatiecommissie

11.45-12.05	**Bezoek faciliteiten in 2 groepen**
12.05-12.45	**Lunch**
12.45-13.30	**Examencommissie en studieadviseur** Prof.dr.ir. H.W.M. (Harry) Hoeijmakers, voorzitter Dr. G.G.M. (Genie) Stoffels, secretaris Dr.ir. G.R.B.E. (Gert Willem) Römer Prof.dr.ir. R. (Remko) Akkerman Drs. E.M. (Lisa) Gommer Dr. J.L.M. (Jolanthe) Schretlen, studieadviseur
13.30-14.00	**Alumni** Ir. T. (Tessa) Janssen, MSM/Huisman Ir. B. (Bart) de Jong, TM/Huisman Ir. K. (Katja) Witvers, TM-PM, Pentair Ir. L. (Lambert) Russcher, TM, Reden Ir. W. (Wouter) Klunder, DE, VIRO Ir. R. (Rick) Hoitzing, MA, VDL Ir. J.J.G.)Johan) Rikkert, TE, Bosch-Nefit Ir. M. (Maarten) Haagsma, PM, Timmerije
14.00-14.30	**Voorbereiding eindgesprek en open spreekuur**
14.30-15.30	**Eindgesprek met management** Prof.dr. F. (Rikus) Eising, decaan Prof.dr.ir. A. (André) de Boer, opleidingsdirecteur Ir. M. (Mark) Rijkeboer, voormalig bachelorcoördinator Prof.dr.ir. F.J.A.M. (Fred) van Houten, MT-lid Dr.ir. C.M. (Marjolein) Dohmen-Janssen, MT-lid Dr.ir. D. (Dorien) van de Belt, Internationalisering en lid Faculteitsraad Drs. E.M. (Lisa) Gommer, co-auteur zelfstudierapport
15.30-17.30	**Opstellen bevindingen**
17.30-18.00	**Mondelinge rapportage en afsluiting**

Appendix 7: Theses and documents studied by the committee

Prior to the site visit, the committee studied the theses of the students with the following student numbers:

Bachelor:

0143324	0169374	0206148
0166472	0098493	0146145
0199877	0180912	0168319
0168718	0140937	0171387
0137618	0145165	0149616

Master:

0068322	0079944	0047244
0041106	0071102	0040940
0076112	0070483	0042048
0048259	0068659	0151114
0215066	0113980	

During the site visit, the committee studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

Course materials for courses and projects:
- Course outlines (including learning goals assessment method and assessment matrices)
- Assignments
- Answers and assignment papers by students
- Evaluation forms

Quantitative data on student intake and output

Educational committee:
- Minutes of 2011-2012 meetings
- Annual educational reports
- Curriculum evaluations

Board of Examiners:
- Minutes of 2011-2012 meetings
- Letters and communications to staff

Information on
- internationalisation
- academic education
- re-design bachelor programme 2013-2014

Appendix 8: Declarations of independence

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Joris De Schutter

PRIVÉ ADRES: Tr. Van Ryswycklaan 1
B-2850 Boom
Belgie

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

Werktuigbouwkunde

AANGEVRAAGD DOOR DE INSTELLING:

TU Delft, TU Eindhoven
Universiteit Twente

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

1

nvao
nederlands - vlaamse accreditatieorganisatie

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

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

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

PLAATS: Boom DATUM: 2 september 2012

HANDTEKENING:

2

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: G. Calis

PRIVÉ ADRES: Plasweg 50
3768 AN Soest

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

Werktuigbouwkunde (en Maritieme Techniek)
aan TUD, TUE en UT

AANGEVRAAGD DOOR DE INSTELLING:

[illegible]

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

1

nvao
nederlands - vlaamse accreditatieorganisatie

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

PLAATS: Rotterdam DATUM: 4 sept. 2012

HANDTEKENING:

2

nvao nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: J.J. ter Meulen

PRIVÉ ADRES: Van Peltlaan 271
6533 ZH Nijmegen

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

Werktuigbouwkunde

AANGEVRAAGD DOOR DE INSTELLING:

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

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

PLAATS: Nijmegen DATUM: 4-9-2012

HANDTEKENING:

2

nvao nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Marc Vantorre

PRIVÉ ADRES:

Drakenhoflaan 61
B 2100 Antwerpen

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

Werktuigbouwkunde

AANGEVRAAGD DOOR DE INSTELLING:

TU Delft
Uni. Twente

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

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

PLAATS: Rotterdam DATUM: 4/9/2012

HANDTEKENING:

2

nvao nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Sanne E. M. Janssen

PRIVÉ ADRES: Karel de Grotelaan 192
5653 HD Eindhoven.

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

Werktuigbouwkunde Twente

AANGEVRAAGD DOOR DE INSTELLING:

QANU

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

1

nvao nederlands - vlaamse accreditatieorganisatie

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

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

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

PLAATS: Rotterdam

DATUM: 4 - 9 - 2012

HANDTEKENING:

Jansse

2

nvao nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Marianne van der Weiden

PRIVÉ ADRES: Homeruslaan 62
3581 MJ Utrecht

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

Werktuigbouwkunde

AANGEVRAAGD DOOR DE INSTELLING:

TUD, UT, TUE

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

1

nvao nederlands - vlaamse accreditatieorganisatie

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

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

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

PLAATS: Utrecht

DATUM: 4-9-2012

HANDTEKENING:

2