

Assessment report
Limited Programme Assessment

Master Innovation Sciences

Eindhoven University of Technology

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1. Executive summary

In this executive summary, the panel presents the main considerations which have led to the assessment of the quality of the programme Master Innovation Sciences of Eindhoven University of Technology. The programme was assessed according to the NVAO Assessment Framework.

The panel observed programme management has taken up the recommendations made in the previous assessment in 2011. Programme management, among others, improved the scheduling of the curriculum to limit study delay, raised the number of lecturers having obtained the University Teaching Qualification and intensified the contacts with alumni.

The objectives of the programme are to study and understand innovations and innovation processes in socio-economic systems and the effects, challenges and opportunities of the introduction of new technologies in these systems. The panel supports these objectives and the subsequent focus in the programme on the disciplines of economics, transition studies and technology and also on advanced research methods for this domain. The panel observed the programme to be interdisciplinary in addressing the three disciplines mentioned and in integrating these. The efforts of management of the Vrije Universiteit, Utrecht University and Eindhoven University of Technology programmes to draft the domain-specific framework of reference are very much appreciated by the panel. Through this framework, the programme is definitely linked to international concepts, notions and trends in the innovation sciences domain.

The panel observed the programme intended learning outcomes to meet the programme objectives, exhibiting, among others, knowledge and understanding of the constituent disciplines economics, transition studies and technology in the context of innovations in socio-economic systems, advanced research and design skills and academic skills. Although the panel is positive about the disciplines economics and transition studies being both addressed, it is recommended to inform students clearly about the differences in perspective of each of these disciplines. The intended learning outcomes are structured and have been well-elaborated. The panel ascertained the intended learning outcomes to meet the requirements of a master level programme and to correspond to the domain-specific framework of reference for innovation sciences.

The Advisory Board is instrumental in keeping the programme aligned with trends in the professional field.

The panel shares the concern of programme management about the limited number of incoming students in the programme and recommends to take measures to increase the influx and to raise the student success rates. The proportion of female students complies with the technical studies average in the Netherlands.

The admission requirements and admission processes are appropriate. Programme management drafted rather strict admission criteria, tailored to the various student categories. The panel is positive about the pre-master and deficiency programme offered to incoming students.

The panel feels the curriculum to be well-structured, covering all of the intended learning outcomes and addressing subjects which are relevant for this programme. Students are appropriately taught disciplinary and interdisciplinary knowledge and understanding. Although research methodology is addressed satisfactorily, the panel advises to strengthen the application of the research methods and techniques. The panel is content with the ample opportunities offered to students to spend part of the curriculum abroad.

The teaching concept and the study methods fit the programme and promote self-directed learning by the students. The panel is positive about the assignments and projects within the courses, promoting the application of knowledge and skills. The study load, the number of contact hours and the student-to-staff ratio are adequate. The panel is very positive about the study guidance in the programme and feels students are especially well guided in their choice of electives and the composition of their curriculum. Programme management is advised to inform students more clearly about their career perspectives.

The panel is positive about the lecturers' research track records and about their educational track records. All of the lecturers have a PhD and are active researchers in their field. The proportion of 62 % of the lecturers having obtained and another 18 % of them being in the process of acquiring the University Teaching Qualification is quite satisfactory. The panel applauds the programme management intentions to pursue a 50 % proportion of female lecturers in the set of yearly appointments of new staff.

The assessment policy of the School of Innovation Sciences which applies to this programme as well, is appropriate, specifying relevant rules and regulations as well as control mechanisms for the examinations and assessments in the programme. The measures taken by programme management to foster the validity of the examinations and reliability of the assessments are satisfactory. The examinations and assessments and the processes in this respect are adequately monitored by the Board of Examiners.

The panel approves of the examination methods, programme management has selected. They are in line with the course contents to be assessed.

The processes of supervision and assessment for the *Graduation Projects* are regarded by the panel to be satisfactory. The assessment by three examiners, using forms with relevant assessment criteria leads to reliable assessments. The panel recommends to require all of the assessment criteria to be satisfactory and not to allow compensation. In addition, the panel advises programme management to introduce rubrics forms for the assessment of the *Graduation Project* to calibrate grades, like has been done in the Sustainable Innovation major of the Bachelor Innovation Sciences. These forms may further improve the reliability of the assessments.

The examinations of the courses studied by the panel are satisfactory in breadth and depth and reflect the learning goals of the courses. The panel assesses the *Graduation Projects* the panel reviewed to be at least satisfactory. The grades given for these projects are appropriate. The panel recommends to improve the alignment between the grades given for assessment criteria and the written comments on the criteria. In addition, the panel advises to strengthen the reflection on the research design or application, which includes applying appropriate research methods and techniques. The panel also suggests to achieve more alignment in the set-up of the projects, as these are now quite diverse.

The panel assesses the programme Master Innovation Sciences of Eindhoven University of Technology to be satisfactory and recommends NVAO to grant re-accreditation to this programme.

Rotterdam, 20 April 2017

Panel chair
Prof. dr. ir. P.C. de Weerd-Nederhof

Secretary
drs. W. Vercouteren RC

2. Assessment process

Certiked VBI received a request to conduct a limited programme assessment for the re-accreditation of the academic degree programme Master Innovation Sciences. This request was submitted by Eindhoven University of Technology.

The panel composition was as follows (please refer to Annex 6: Assessment panel composition for more detailed information).

- Prof. dr. ir. P.C. de Weerd-Nederhof, Professor Organizational Studies and Innovation and chair of NIKOS, University of Twente (panel chair);
- Prof. dr. A.M. Bergek, Professor Innovation Systems and Technology Policy, Chalmers University of Technology (panel member);
- Prof. dr. M.S. van Geenhuizen, Professor of Innovation and Innovation Policy in the Urban Economy, Delft University of Technology (panel member);
- Prof. dr. C.M. Jonker, Professor Interactive Intelligence, Delft University of Technology (panel member);
- E.E.M. Leo BSc, student Master Educational Sciences, University of Amsterdam (student member).

On behalf of Certiked, drs. W. Vercouteren RC was responsible for the process coordination and for drafting the panel's report. All panel members and the secretary signed a statement of independence and confidentiality.

Certiked requested the approval by NVAO of the proposed panel of experts to conduct this assessment. NVAO have given their approval.

The panel conducted this assessment on the basis of the NVAO Assessment Framework of 19 December 2014 (Staatscourant nr. 36791). The final products or theses studied by the panel were selected according to the NVAO Guidelines for the assessment of final projects during external assessments of 18 February 2015.

The following procedure was adopted. The panel members studied the documents presented beforehand by programme management, including a total of ten theses (please refer to Annex 4: Documents studied and Annex 5: Final products reviewed). In addition, ten theses were selected of the programme Master Human-Technology Interaction, which is offered by the same School within Eindhoven University of Technology.

Before the date of the site visit, the panel chair and the panel secretary met to discuss the assessment procedures. On 14 February 2017, the panel had a meeting to discuss the preliminary findings concerning the quality of the programme.

During the meeting on 14 February 2017, the findings of the panel members, including those concerning the theses, were discussed. On the basis of the input of the panel, the secretary summarised the questions, which served as a starting point for the discussions with the programme representatives during the site visit.

On 14 February and 15 February 2017, the panel conducted the site visit at the Eindhoven University of Technology campus. The site visit proceeded in accordance with the schedule drawn up beforehand (please refer to Annex 3: Site visit schedule). Prior to the site visit, programme management communicated the open office hours to the students in the programme and the staff of the programme. No one called on the panel.

A draft version of this report was finalised by the secretary, having taken into account the information presented as well as the findings and considerations of the panel. The panel members studied the draft report and made a number of changes. Thereupon, the secretary drew up the final report. This report was presented to programme management to be corrected for factual inaccuracies. After having been corrected for these factual inaccuracies, the report was sent to the institution's Board to accompany their request for re-accreditation.

3. Overview of the programme

3.1 Basic information about the programme

Administrative information about the programme:

Name programme in CROHO: Master Innovation Sciences
 Orientation, level programme: Academic Master
 Grade: MSc
 Number of credits: 120 EC (two-year programme)
 Specialisations: Global Sustainability, Innovation Strategy and Policy
 Location: Eindhoven
 Mode of study: Full-time (language of instruction is English)
 Registration in CROHO: 66265

Administrative information about the institution:

Name of institution: Eindhoven University of Technology
 Status of institution: Government-funded university
 Institution's quality assurance: Approved

Quantitative data about the programme

Proportion of students who completed the programme in three years (n+1)

Cohort	2010	2011	2012
Proportion of students	83 %	67 %	59 %

Lecturers' qualifications

Qualification	MSc	PhD	UTQ*
Percentage of lecturers	100 %	100 %	62 %

*UTQ means having obtained Dutch University Teaching Qualification. Additionally, about 18 % of staff is in the process of acquiring the UTQ-certificate.

The student-to-staff ratio in the programme changed from 14.5 (2013) to 20.4 (2015).

The number of contact hours per week is about 10.3 hours per week for the mandatory courses and the specialisation electives. Electives and international courses have not been included. In the Graduation Project, 20 contact hours are available to the students.

3.2 Main facts about the institution

The Master programme Innovation Sciences is a programme of the School of Innovation Sciences of the Department of Industrial Engineering & Innovation Sciences of Eindhoven University of Technology.

According to their website, the mission statement of Eindhoven University of Technology is to be a leading, international, in engineering science and technology specialised research University. The University wants to offer excellent teaching and research and thereby contribute to the advancement of technical sciences and research in the Eindhoven region and in the world as a whole. The education, research and knowledge valorisation activities of the University are meant to contribute to the solution of major societal issues in the areas of energy, health and smart mobility, to foster the development of technological innovation in cooperation with industry and to strengthen the progress in engineering sciences through excellence in key research areas and through innovation in education.

More than 10,000 students study at Eindhoven University of Technology, nearly 6,000 of them being bachelor students and over 4,000 of them being master students. There are more than 1,000 PhD-students.

Eindhoven University of Technology comprises nine departments, being the Departments of Biomedical Engineering, Built Environment, Electrical Engineering, Industrial Design, Industrial Engineering & Innovation Sciences, Chemical Engineering & Chemistry, Applied Physics, Mechanical Engineering and Mathematics and Computer Science. These departments offer 11 bachelor programmes and 22 master programmes.

4. Overview of assessments

Standard	Assessment
Standard 1. Intended learning outcomes	Satisfactory
Standard 2: Teaching-learning environment	Satisfactory
Standard 3: Assessment	Satisfactory
Standard 4: Achieved learning outcomes	Satisfactory
Programme	Satisfactory

5. Findings, considerations and assessments programme

5.1 Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to contents, level and orientation; they meet international requirements.

Findings

The programme is research-oriented master programme, with the objectives to study, understand and improve the complex field of innovation, especially concerning innovations and innovation processes at the macro-level or in socio-economic systems. The programme is directed towards the study of the effects, challenges and opportunities of the introduction of new technologies. This field of study requires knowledge and understanding of social sciences, technology and advanced research methods. The programme, therefore, addresses two distinct disciplines, being on the one hand the social sciences, especially economics and transition studies and on the other hand technology. In addition, students are educated in research methods and techniques for this domain. In particular, students are trained in new technologies, economics of innovation, science and technology studies, sociology of innovation, history of technology and philosophy. Students are offered the choice between two distinct specialisations, *Global Sustainability and Innovation* or *Innovation Strategy and Policy*.

Students are trained to enter the labour market. In particular, they are educated to become engineers who are specialised in innovation sciences.

As has been indicated, the programme is offered by the School of Innovation Sciences of the Department of Industrial Engineering & Innovation Sciences. This programme is specially meant to study, analyse, manage and improve innovations and innovation processes at the level of socio-technical systems, addressing innovations from technological, economic and transitional perspectives. The goal of the Master Human-Technology Interaction Sciences of the School is to study, understand and improve innovations and the related processes at the interface of humans and technology, which may be said to involve the product-level of innovations. Firm-level innovations and innovation processes are covered in the Master Innovation Management of the School of Industrial Engineering within the Department.

In 2016, the domain-specific framework of reference for the innovation sciences domain was drafted by programme management of this programme in collaboration with the innovation sciences programmes of Vrije Universiteit Amsterdam and of Utrecht University. In this domain-specific framework of reference, the international domain of innovation sciences is delineated and research, education and study subjects in this domain are addressed.

Programme management drafted the intended learning outcomes of the programme. These intended learning outcomes (please refer to Annex 1 for an overview) address knowledge and understanding of the disciplines technology, economics and transition studies in the context of innovation sciences, advanced research skills, advanced design skills, academic skills, communication and cooperation skills and societal awareness.

Programme management demonstrated the correspondence between the intended learning outcomes of the programme and the Criteria for Academic Bachelor and Master Curricula (the so-called Meijers-criteria) of the Universities of Technology in the Netherlands. Therefore, it may be deduced that the intended learning outcomes match the Meijers-criteria for the master level. In addition, programme management showed the learning outcomes to be within the boundaries set by the domain-specific framework of reference and, therefore, to be part of the innovation sciences domain.

The Advisory Board of the Department of Industrial Engineering & Innovation Sciences, the members of which are representatives of the professional field, gives advice to programme management on a regular basis on the intended learning outcomes and the curriculum of the programme. They do so from the perspective of the professional practice.

Considerations

The panel supports the objectives of the programme to study and understand innovations and innovation processes in socio-economic systems and to study the effects, challenges and opportunities of the introduction of new technologies in these systems. In addition, the panel agrees to the focus in the programme on the disciplines economics, transition studies and technology and on advanced research methods to analyse innovations and innovation processes in this field. The programme is definitely interdisciplinary in addressing the three disciplines mentioned and in integrating these.

The panel observed the programme being geared towards preparing students to enter the labour market as engineers, specialised in the field of innovation sciences.

The panel very much appreciates the efforts of management of the Vrije Universiteit, Utrecht University and Eindhoven University of Technology programmes to draft the domain-specific framework of reference. Through this framework, the programme is definitely linked to international concepts, notions and trends in the innovation sciences domain.

The panel studied the intended learning outcomes of the programme and observed these to meet the programme objectives, exhibiting, among others, knowledge and understanding of the constituent disciplines technology, economics and transition studies, advanced research skills and design skills, academic skills and societal awareness.

The panel regards the intended learning outcomes to be structured and to be well-elaborated. The panel ascertained the intended learning outcomes to meet the Meijers-criteria and to correspond to the domain-specific framework of reference for innovation sciences.

In the panel's view, the Advisory Board of the Department is instrumental in keeping the programme aligned with trends in the professional field.

Assessment of this standard

These considerations have led the assessment panel to assess standard 1, *Intended learning outcomes* to be satisfactory.

5.2 Standard 2: Teaching-learning environment

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

Findings

As has been mentioned, this is a programme of the School of Innovation Sciences of the Department of Industrial Engineering & Innovation Sciences. The Department Board is chaired by the dean and is responsible for the policy and quality of all research and educational activities in the Department. The director of education has the day-to-day responsibility for all of the educational programmes of the School of Innovation Sciences, these being the Bachelor Innovation Sciences, the Masters Innovation Sciences and Human-Technology Interaction and the PhD programme Innovation Sciences, and advises the Department Board on these programmes. The director of education, the vice director of education and the programme chairs of the Bachelor Innovation Sciences, major Psychology & Technology and the Master Human-Technology Interaction on the one hand and of the Bachelor Innovation Sciences, major Sustainable Innovation and the Master Innovation Sciences on the other hand, together form the Educational Board. The Educational Institute of the School comprises a number of supporting departments, such as Student Counselling, Quality Assurance and International Office. The Educational Board is advised on the quality of the programmes mentioned by one Programme Committee, being composed of both students and lecturers of the programmes. The Advisory Board advises the Department Board on the alignment of the Departmental activities with the professional field requirements, including the educational programmes. The Board of Examiners of the School has the responsibility to monitor the quality of the examinations and assessments of the programmes.

The number of students enrolling in the programme remained rather stable over the past five years. The influx of students was 23 students in 2011, while the influx was 22 students in 2015. The vast majority of the students completed their bachelor programme at Eindhoven University of Technology. About 10 % to 15 % of the incoming students come from abroad. A limited number of students have as their previous education the polytechnic bachelor diploma (in Dutch: *hbo*). For this programme, no definite figures on the diversity in the student population are readily available. It is fair to expect the figure to correspond to that for the corresponding major in the Bachelor Innovation Sciences programme and to be about 20 %.

The entry requirements vary for different categories of applicants. Students having completed the Bachelor programme Innovation Sciences of Eindhoven University of Technology or one of a list of specific bachelor programmes of other Dutch universities are admitted directly. Students with a bachelor degree of Eindhoven University of Technology may enter the programme, if they took a number of specific packages in the elective space of their bachelor programme. Students having completed the polytechnic bachelor programme in one of the technical disciplines may be admitted to the standard pre-master programme, if they have passed both a mathematics and an English test. Students with university bachelor diplomas are allowed in on the conditions of sufficient technical knowledge and completing a tailor-made deficiency programme. Foreign students will have to demonstrate sufficient technical knowledge and will need to complete the standard pre-master programme or the tailor-made deficiency programme.

Programme management presented tables in which the relations between the intended learning outcomes and the courses have been specified. From these tables, it may be deduced that all of the intended learning outcomes are addressed in one or more courses.

The curriculum spans two years (120 EC) and is organised according to the Graduation School structure of Eindhoven University of Technology (please refer to Annex 2 for an overview). This curriculum, therefore, is composed of five mandatory or core courses (25 EC), specialisation electives (30 EC), electives (20 EC) and the *International Semester* (at least 15 EC). Students complete the curriculum with their *Graduation Project* (30 EC). In the specialisation electives part of the curriculum, students select either the *Global Sustainability* specialisation or the *Innovation Strategy and Policy* specialisation. The specialisations are composed of two core courses, two electives and two engineering courses. The courses specifically address subjects of the specialisation fields. Talented students may select the *Free Track*, for example in pursuing a dual degree. All students are to draft their professional skills development plan, which they have to discuss with their mentor.

In addition to the regular curriculum, talented students may enrol in the university-wide Master's Honours Academy, which implies 20 EC extra courses to improve their personal leadership skills. Students are very strongly encouraged to go abroad, the *International Semester* being a mandatory part of the curriculum. Students are presented a list of foreign universities to choose from.

The teaching concept of the programme is geared towards enabling students to acquire knowledge, understanding and skills at the master academic level in a largely self-directed way. Self-reliance of students in the learning processes is strongly promoted. Study methods adopted in the curriculum are lectures, tutorials, instruction sessions, assignments, projects and self-study. Assignments and projects are part of most of the courses. In these assignments and projects, students work individually or in small groups on, among others, systems design. The number of contact hours amounts to more than 10 hours per week for the mandatory courses and the specialisation electives. The student-to-staff ratio figure is about 20 to 1.

As to the study guidance, study advisors assist students in case of study problems or study delay. They also monitor the study progress. Additionally, students are guided by their mentor, this being a staff member. The mentor advises students on their choice of electives and on the *International Semester*. The mentor approves the electives selected by the students, before the list is submitted to the Board of Examiners for formal approval. This applies to all students. Foreign students are assigned a study buddy, a student of this programme, to assist them in their studies and with other matters.

The students success rates for the most recent cohorts are on average 19 % after two years and on average close to 70 % after three years. The student success rates are becoming less favourable, having gone from 83 % after three years for the 2010-cohort to 59 % for the 2012-cohort.

About 48 lecturers are involved in the programme. These lecturers are all active researchers in their fields of expertise, being employed by the School of Innovation Sciences and being a member of either the research group *Human-Technology Interaction*, the research group *Philosophy & Ethics* or the research group *Technology, Innovation & Society* within the School. All lecturers in the programme hold a PhD. About 62 % of them is in possession of the University Teaching Qualification-certificate, whereas another 18 % of the lecturers is in the process of acquiring this certificate. These figures all testify to the lecturers' capabilities in education. From the figures for the years 2014 and 2015 it may be derived, that about 29 % of the lecturing staff are female lecturers. This figure is exemplary compared to the average percentages of female staff at universities of technology in the Netherlands, being more in line with the average proportion of general universities. Programme management informed the panel to pursue a 50 % proportion of female lecturers in the set of yearly appointments of new staff.

Considerations

The panel shares the concern of programme management about the limited number of incoming students in the programme and recommends programme management to take measures to increase the influx. The panel would suggest to take the diminishing student success rates into consideration as well. The proportion of female students is in line with the average for technical studies in the Netherlands.

The panel approves of the admission requirements and the admission processes. Programme management drafted rather strict admission criteria, tailored to the various student categories. The panel is positive about the pre-master and deficiency programme offered to incoming students.

The panel feels the curriculum to be well-structured, covering all of the intended learning outcomes and addressing subjects which are relevant for this programme. Programme management informed the panel having sufficient latitude within the Graduate School structure to tailor the curriculum to the programme requirements. In the panel's opinion, students are appropriately taught disciplinary and interdisciplinary knowledge and understanding. Although research methodology is addressed satisfactorily, the panel advises to strengthen the application of these research methods and techniques. The panel is content with the ample opportunities offered to students to spend part of the curriculum abroad.

The teaching concept and the study methods of the programme are appropriate. In the panels' view, these promote self-directed learning by the students. The panel is positive about the assignments and projects within the courses, promoting the application of knowledge and skills.

The panel considers the study load of the programme, the number of contact hours and the student-to-staff ratio to be adequate.

The panel is very positive about the study guidance in the programme and feels students are especially well guided in their choice of electives and the composition of their curriculum. The panel advises to inform students more clearly about their career perspectives.

The panel is positive about the lecturers' research track records and about their educational track records. All of the lecturers have a PhD and are active researchers in their field. The proportion of 62 % of the lecturers having obtained their University Teaching Qualification and another 18 % of the lecturers being in the process of acquiring this certificate is quite satisfactory. The panel applauds the programme management intentions to pursue a 50 % proportion of female lecturers in the set of yearly appointments of new staff.

Assessment of this standard

These considerations have led the assessment panel to assess standard 2, *Teaching-learning environment* to be satisfactory.

5.3 Standard 3: Assessment

The programme has an adequate assessment system in place.

Findings

The examination policy of the School of Innovation Sciences applies to all of the programmes of the School. The examination policy has been laid out in the *Examination Policy School of Innovation Sciences* document, in which the strategy on examinations and assessments has been described and the rules, regulations and control mechanisms have been stipulated. The examination policy of the School is consistent with the *Examination Framework* of Eindhoven University of Technology.

The examination methods selected are in line with the course learning goals types. Knowledge acquisition is examined by means of written examinations. Knowledge application, for instance in the form of exercises, is examined through assignments. Professional or academic skills acquisition are examined in the form of assignments or portfolios. In most of the courses, interim examinations are scheduled, these being part of the grading of the courses. In all of the courses, multiple examinations are to be taken by the students and the final grade of the courses is a composite grade, this being the weighed outcome of the grades of the course components.

To promote the examinations' validity, these are prepared by one of the lecturers and presented to another lecturer for review. In addition, lecturers submit test matrices, relating the examination items to the course learning goals. To foster the reliability of the assessments, answer models are used for the assessments of examinations.

At the end of the programme, students are to complete the *Graduation Project*. For the project, a manual has been drafted. The *Graduation Project* is an individual project with a study load of 30 EC. Students are guided by two supervisors, at least one of which is a lecturer in the programme and the other is a lecturer from this programme or another programme of this University. As projects may be done within companies, students may also be guided by the external supervisor from the company. At the end of the project, the written report is to be submitted and the project is to be defended before the examiners. The projects are graded, on the basis of the oral defence and the written report. The projects are assessed by three examiners, being the supervisor and two independent assessors, one or both of whom coming from other departments of this University. The external supervisor may give advice on the assessment of the project. For their assessments, the examiners use a scoring model with a set of assessment criteria, derived from the Meijers-criteria. The final grade is made up of the written report (70 % of grade) and a number of additional skills demonstrated in the process (30 %).

As has been explained in the discussion of standard 2, the School-wide Board of Examiners monitors the examinations and assessments of this and other School of Innovation programmes. The responsibilities of the Board include appointing examiners and monitoring their performance, inspecting the course examinations quality, when courses are in the initial phase, analysing grade distribution outcomes of examinations, when they deviate significantly from the normal distribution and checking the quality in samples of *Graduation Projects*. The Board is very strict on cases of fraud.

Considerations

The assessment policy of the School of Innovation Sciences which applies to this programme as well, is appropriate. The panel is of the opinion this policy specifies relevant rules and regulations as well as control mechanisms for the examinations and assessments in the programme.

The panel approves of the examination methods, programme management has selected. They are in line with the course contents to be assessed. Having the courses assessed by multiple examinations allows to assess students' performances on different dimensions, relevant for the courses.

Programme management has taken a number of measures to foster the validity of the examinations and reliability of the assessments. The panel regards these measures to be satisfactory.

The panel regards the processes of supervision and assessment for the *Graduation Projects* to be satisfactory. The assessment by three examiners, using forms with relevant assessment criteria leads to reliable assessments. The panel recommends to require all of the assessment criteria to be satisfactory and not to allow compensation. In addition, the panel advises programme management to introduce rubrics forms for the assessment of the *Graduation Project* to calibrate grades, like has been done in the Sustainable Innovation major of the Bachelor Innovation Sciences. These forms may further improve the reliability of the assessments.

The panel approves of the position and activities of the Board of Examiners to ensure the quality and level of the examinations and assessments. The Board has the responsibilities and works according to the rules, as intended by Dutch applicable law. The examination and assessments and the processes in this respect are adequately monitored.

Assessment of this standard

The considerations have led the assessment panel to assess standard 3, *Assessment* to be satisfactory.

5.4 Standard 4: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Findings

The panel studied the examinations of a number of courses in the programme.

In the *Graduation Projects* with a 30 EC study load, all the intended learning outcomes of the programme are addressed and the students are to demonstrate in these projects to master these learning outcomes. The panel studied a total of ten *Graduation Projects*.

Graduates of the programme are prepared to enter the labour market. Programme management maintains regular contacts with the alumni. The results of a number of surveys among alumni show them to be in high demand. Nearly all of the graduates find suitable positions within three months after graduation. Most of them are satisfied with their current position. The score among alumni of this programme is satisfactory to good (3.7 out of 5).

Considerations

Having studied the examinations of a number of courses, which programme management presented, the panel concludes these examinations to be satisfactory in breadth and depth and to reflect the learning goals of the courses.

The panel assesses all the *Graduation Projects* the panel reviewed to be at least satisfactory. The grades given for the projects are appropriate. The panel recommends, however, to improve the alignment between the grades given for assessment criteria and the written comments regarding the criteria. In addition, the panel advises to strengthen the reflection on the research design or application in the projects, which includes applying appropriate research methods and techniques. The panel also recommends to achieve more alignment in the set-up of the *Graduation Projects*, as these are now quite diverse.

The panel is positive about the positions the graduates of the programme have been able to find. In addition, they did so in a relatively short period of time.

Assessment of this standard

The considerations have led the assessment panel to assess standard 4, *Achieved learning outcomes* to be satisfactory.

6. Recommendations

In this report, a number of recommendations regarding the programme quality have been listed. For the sake of clarity, these are brought together below. The recommendations are the following.

- Although the panel is positive about the disciplines economics and transition studies being both addressed, it is recommended to inform students very clearly about the differences in perspective of each of these disciplines.
- To take measures to try and increase the influx of students in the programme, as this number is remaining relatively low, and take the diminishing student success rates into consideration as well.
- To strengthen the application of research methods and techniques in the curriculum.
- To inform students more clearly about their career perspectives.
- To require all of the assessment criteria in the *Graduation Project* to be satisfactory and not to allow compensation.
- To introduce rubrics forms for the assessment of the *Graduation Project* to calibrate grades, like has been done in the Sustainable Innovation major of the Bachelor Innovation Sciences, as these may further improve the reliability of the assessments.
- To improve the alignment between the grades given for assessment criteria of the *Graduation Projects* and the written comments regarding the criteria.
- To strengthen the reflection on the research design or application, which includes applying appropriate research methods and techniques, in the *Graduation Projects*.
- To achieve more alignment in the set-up of the *Graduation Projects*, as these are now quite diverse.

Annex 1: Intended learning outcomes

The intended learning outcomes of the Master Innovation Sciences are as follows.

Competent in scientific disciplines

- Advanced knowledge of and insight into technological systems and their components in a specific technology domain.
- Thorough understanding of concepts, theoretical frameworks, and methodologies of innovation sciences extending to the forefront of knowledge.
- Thorough multidisciplinary knowledge integrating innovation sciences knowledge with technological knowledge in relevant domains, and the ability to critically reflect on the scope and limitations of this knowledge.
- Thorough knowledge of and advanced skills in the techniques of observation, data collection and analysis techniques in the innovation sciences domain, and an ability to critically reflect on the scope and limitations of these methods.

Competent in doing research

- Ability to formulate research problems in terms of concepts and theories of innovation sciences.
- Ability to independently develop and execute a research plan.
- Ability to contribute independently to the development of scientific knowledge on one of the areas of the innovation sciences.
- Ability to identify and analyse problems typical for the innovation sciences, by integrating technological and social sciences perspectives.
- Ability to appraise relevant scientific evidence on its usefulness in addressing research problems.

Competent in designing

- Ability to independently translate the outcomes of innovation sciences research into design, policy, or strategy recommendations for innovation in existing and new socio-technical systems.
- Ability to independently identify both the social and the technical implications of innovation sciences in design recommendations.

A scientific approach

- Ability to apply and critically examine existing theories, concepts and models in the innovation sciences domain.
- Ability to look beyond the borders of a specific discipline, to be sensitive to the relative contributions of various disciplines and to understand the knowledge demands of a specific discipline.
- Ability to use a systematic approach characterized by the consistent application of existing theories, concepts, and models in innovation sciences, and knowledge of current debates about this.

Basic intellectual skills

- A reflective attitude, with an ability to critically and independently reflect on own thinking, decision making, and professional behaviour.
- A critical mindset and the ability to ask constructive questions regarding complex problems in the field.
- Ability to read and write scientific texts.
- Ability to think in abstract terms, including the ability to develop (formal) models of phenomena and processes in the domain.

Competent in co-operating and communicating

- Capability of reporting and communicating the results of one's learning and decision making – including one's research outcomes – both verbally and in writing, with academics and engineers in various domain, users, and the general public.
- Ability to recognize and deal with differences in work practices between scientific disciplines, and academics from other cultural backgrounds.

- Ability to take a leading role in multi- or interdisciplinary teams of engineers and academics.
- Ability to listen, read, talk, and write in English on a professional level.

Takes account of the temporal, technological and social context

- Ability to reflect on the relation between the use of scientific knowledge and technology, the implicated social, normative, and ethical issues, and the way in which knowledge and technology development is influenced by its social and historical context, and the ability to integrate such relations and implications in their scientific work.
- Understanding of the different roles of engineers and related professionals in society, and the ability to determine one's own place as a professional in society.

Annex 2: Curriculum

In the table, the curriculum of the Master Innovation Sciences is presented.

Courses*	Credits
Mandatory Courses (Evolutionary Foundations, Research Methodology, Governing Innovations, Responsible Innovation and Sustainability, Modern Societies)	25 EC
Specialisation Electives (to be selected from pre-determined lists of either Global Sustainability track <i>or</i> Innovation Strategy and Policy track <i>or</i> Free track) (10 EC should be in the technical domain)	30 EC
Electives	20 EC
International Semester (minimum of 15 EC)	15 EC
Graduation Project	30 EC
Total credits of programme	120 EC

*Specialisation Electives or Electives may be taken in the first as well as in the second year. International Semester and Graduation Project are part of the second year.

Annex 3: Site visit schedule

The site visit was conducted on the Eindhoven University of Technology campus on 14 and 15 February 2017.

Site visit schedule on 14 February 2017.

- 15.00 h. – 17.30 h. Arrival panel and documents study (closed session)
- 17.30 h. – 18.15 h. Dean and programme management
Dr. G.J.T. Bombaerts (coordinator User, Society and Enterprise courses), dr. ir. E. van der Geer (director of education), prof. dr. I.E.J. Heynderickx (dean), dr. M.H. Jansen-Vullers (vice director of education), prof. dr. A.M.C. Lemmens (dean Bachelor College), prof. dr. A.W.M. Meijers (vice dean School Innovation Sciences)
- 18.15 h. – 19.15 h. Board of Examiners
Dr. A. Chockalingam (external member Board of Examiners), dr. ir. A. Haans (vice chair Board of Examiners), dr. J.I. Höffken (member Board of Examiners), prof. dr. ir. Y.A.W. de Kort (chair Board of Examiners), ir. W.L.M. Kuijpers (study advisor)

Site visit schedule on 15 February 2017.

- 08.30 h. – 09.00 h. Arrival panel and documents study (closed session)
- 09.00 h. – 10.00 h. Programme management and core lecturers Bachelor Innovation Sciences, major Psychology & Technology and Master Human-Technology Interaction
Dr. ir. E. van der Geer (director of education), dr. ir. A. Haans (coordinator Bachelor Innovations Sciences, major Psychology & Technology), dr. J.R.C. Ham (coordinator Master Human-Technology Interaction), dr. M.H. Jansen-Vullers (vice director of education), dr. ir. M.C. Willemsen (programme chair Bachelor Innovation Sciences, major Psychology & Technology and Master Human-Technology Interaction)
- 10.15 h. – 11.15 h. Lecturers and theses' examiners Bachelor Innovation Sciences, major Psychology & Technology and Master Human-Technology Interaction
Dr. ir. E.E.M. van Berkum (lecturer department Mathematics and Computer Science), dr. ir. R. H. Cuijpers (lecturer, thesis examiner), prof. dr. ir. W.A. IJsselstein (lecturer, thesis examiner), dr. G. Rooks (lecturer, thesis examiner), dr. ir. K.H.C.J. Smolders (lecturer, thesis examiner), dr. ir. M.C. Willemsen (lecturer, thesis examiner)
- 11.15 h. – 12.00 h. Students and alumni Bachelor Innovation Sciences, major Psychology & Technology and Master Human-Technology Interaction
P. Phillipens (second year student Bachelor, specialisation ICT), A. van Rietschoten (third year student Bachelor, specialisation Living), B. van der Stigchel (third year student Bachelor, specialisation Robotics), E. Corbet BSc (first year student Master), E. de Jong BSc (second year student Master), R. Conijn MSc (alumnus), M. Boerhof MSc (alumnus)
- 12.00 h. – 13.00 h. Lunch panel (closed session), consultation hour 12.00 h. – 12.30 h.

- 13.00 h. – 13.45 h. Tour around programme facilities
Ing. M.C. Boschman, prof. dr. C.C.P. Snijders, J. van Rijn (chair Intermate study association)
- 13.45 h. – 14.15 h. Programme management and core lecturers Bachelor Innovation Sciences, major Sustainable Innovation and Master Innovation Sciences
Prof. dr. F. Alkemade (programme chair Bachelor Innovation Sciences, major Sustainable Innovation and Master Innovation Sciences), dr. C. Castaldi (coordinator Bachelor Innovation Sciences, major Sustainable Innovation and Master Innovation Sciences)
- 14.15 h. – 15.00 h. Lecturers and theses' examiners Bachelor Innovation Sciences, major Sustainable Innovation and Master Innovation Sciences
Dr. C. Castaldi (lecturer, thesis examiner), dr. ir. A. Kirkels (lecturer, coordinator Bachelor thesis), dr. ir. H. Romijn (lecturer, thesis examiner), prof. dr. ir. G.P.J. Verbong (lecturer, thesis examiner), N. Verkade MSc (lecturer, thesis examiner), prof. dr. ir. E.B.A. van der Vleuten (lecturer, thesis examiner), dr. A.J. Wiczorek (lecturer, thesis examiner)
- 15.15 h. – 15.45 h. Students and alumni, including Programme Committee members, Bachelor Innovation Sciences, major Sustainable Innovation and Master Innovation Sciences
V. Mosmuller (first year student Bachelor, specialisation Energy), J. te Selle (second year student Bachelor), D. Prins (third year student Bachelor, specialisation Energy, member programme committee), P. Loonen (fourth year student Bachelor, specialisation Energy, board member Intermate study association), L. Hoefnagels BSc (first year student Master), Th. Ofman (second year student Master), L. van Son MSc (alumnus), T. Manders MSc (alumnus)
- 15.45 h. – 17.30 h. Deliberations panel (closed session)
- 17.30 h. – 17.45 h. Main findings presented by panel chair to dean, programme management and others

Annex 4: Documents studied

The panel studied the following documents, presented by programme management prior to the site visit

- Self-Assessment Master's Programme Innovation Sciences, 2016
- Intended learning outcomes
- Domain-specific frame of reference Innovation Sciences
- Matrix intended learning outcomes versus Domain-specific frame of reference
- Curriculum overviews
- Intended learning outcomes versus courses
- List of teaching staff School Innovation Sciences

In addition, the panel was given access to extensive digital information about the programme

On the day of the site visit, programme management presented the following documents

- Recommendations assessment panel in 2011 and programme management actions taken
- Course material and literature of a number of selected courses of the programme
- Examinations of a number of selected courses of the programme
- Examination matrix (example)
- Programme Committee minutes, 2014, 2015, 2016
- Board of Examiners annual reports, 2014 – 2015, 2015 – 2016
- List of theses having led to publications

Annex 5: Final products reviewed

The theses of the following ten students have been selected and reviewed by the panel.

- 0679597
- 0642401
- 0767330
- 0927285
- 0781350
- 0675341
- 0674779
- 0650000
- 0725477
- 0594348

Annex 6: Assessment panel composition

The assessment panel had the following composition:

- Prof. dr. ir. P.C. de Weerd-Nederhof, Professor Organizational Studies and Innovation and chair of NIKOS, University of Twente (panel chair);
- Prof. dr. A.M. Bergek, Professor Innovation Systems and Technology Policy, Chalmers University of Technology (panel member);
- Prof. dr. M.S. van Geenhuizen, Professor of Innovation and Innovation Policy in the Urban Economy, Delft University of Technology (panel member);
- Prof. dr. C.M. Jonker, Professor Interactive Intelligence, Delft University of Technology (panel member);
- E.E.M. Leo BSc, student Master Educational Sciences, University of Amsterdam (student member).

Prof. dr. ir. P.C. de Weerd-Nederhof (panel chair)

Mrs. De Weerd is Full Professor Organizational Studies and Innovation and chair of NIKOS, the department of Entrepreneurship, Strategy, Innovation and Marketing of the Faculty Behavioural, Management and Social Sciences of University of Twente. She, also, is the programme director of the Bachelor and Master International Business Management programmes of this University. From 2009 to 2015, she was responsible for setting up the Twente Graduate School. Mrs. De Weerd is, among others, a member of the Board of the International Product Development Management Conference and was until recently a member of the board of KIVI, the Dutch association for engineers.

Prof. dr. A.M. Bergek (panel member)

Mrs. Bergek is Full Professor Innovation Systems and Technology Policy at the Department of Energy and Environment of Chalmers University of Technology in Göteborg, Sweden. Prior to her current appointment, she was an assistant professor and an associate professor at the Department of Management and Engineering of Linköping University in Sweden. She published many articles and (parts of) books in her field of expertise, and conducted numerous research projects in this area. Mrs. Bergek holds a number of advisory positions at the Swedish Energy Agency.

Prof. dr. M.S. van Geenhuizen (panel member)

Mrs. Van Geenhuizen is Full Professor of Innovation and Innovation Policy in the Urban Economy at the Faculty of Technology, Policy and Management of Delft University of Technology. She took her doctorate from Erasmus University Rotterdam. Prior to her current appointment, she was, among others, a senior researcher at the Bartlett School of Planning at University College London. Mrs. Van Geenhuizen conducted a substantial number of activities in the Netherlands and abroad with regard to innovation and entrepreneurship. Her current research is mainly on commercialisation and entrepreneurship in sustainable energy and medical/healthcare systems. She has been a lead editor of eight edited volumes on subjects, including innovation, sustainability and knowledge economy, and she has published over 90 articles in peer-reviewed journals.

Prof. dr. C.M. Jonker (panel member)

Mrs. Jonker is Full Professor Interactive Intelligence at the Faculty of Electrical Engineering, Mathematics and Computer Science of Delft University of Technology. She took her doctorate in Computer Science from Utrecht University. Prior to her current appointment, she was, among others, research assistant at Berne University and an assistant and associate professor at Vrije Universiteit Amsterdam and a full professor at Radboud University. Mrs. Jonker's primary research interests are the study and modelling of forms of natural intelligent reasoning and interaction.

E.E.M. Leo BSc (student member)

Ms. Leo is a student in the Master programme Educational Sciences of University of Amsterdam. Previously, she completed the Bachelor programme in Educational Sciences at this University. She was, among others, a member of the Educational Committee of her programme and vice-chair of the Student Council of the Faculty of Social and Behavioural Sciences of University of Amsterdam. Ms. Leo participates as a student member on a regular basis in NVAO-accreditation panels.