Coordinated with	head of ESA of IE&IS, program director of IE&IS, Dieuwke de Haan	
Budgetary consequences	x	
Personal consequences	x	
Legal consequences	x	
Communication	This document will be discussed in several fora.	
Former relevant documents/decisions and advices		
Discussed earlier in		**Remarks:**
☒ EC IE ☒ EC IS	☒ For determination	
☒ FB	☒ For discussing/judgment	
☐ OC ☐ OR ☐ Cap. chairs	☐ For information	

Assessment policy

School of Industrial Engineering and School of Innovation Sciences

11/11/2020
Examinations Committee IE / Examinations Committee IS
Tamara de Bock in consultation with Marjan Vrijnsen en Tom van Woensel

TU/e

Contents

Introduction

The education activities of the department of IE&IS are organized over two schools: the School of Industrial Engineering and the School of Innovation Sciences.

The School of Industrial Engineering comprises three educational programs. The table below gives a list of the school's educational programs and the responsible Exam Committee (EC).

CROHO educational programs	Bachelor College	Graduate Program	Exam Committee
BSc Industrial Engineering (BtB)	Major Industrial Engineering (IE)		EC IE
MSc Operations Management & Logistics (OML)		Graduate Program Industrial Engineering (IE)	EC IE
Special Master's track Manufacturing Systems Engineering within Operations Management & Logistics (MSE)			EC IE
MSc Innovation Management (IM)			EC IE

The School of Innovation Sciences has four educational programs. The table below gives a list of the School's educational programs and the responsible Examination Committees.

CROHO educational programs	Bachelor College	Graduate Program	Examinations Committee
BSc Innovation Sciences (IS)	Major Sustainable Innovation (SI)		EC IS
	Major Psychology & Technology (PT)		EC IS
MSc Human Technology Interaction (HTI)		Graduate Program Innovation Sciences (IS)	EC IS
MSc Innovation Sciences (IS)			EC IS

This policy paper is based on the assessment policy format as indicated in the TU/e Assessment policy[1], including the update from 2019[2]. In this assessment policy, we present our vision on education and examinations (Section 1). Section 2 covers quality assurance of examinations, and Section 3 discusses quality assurance of the final educational level of students.

[1] Halsema, L., Swagten, H., Werkgroep project implementatie toetsbeleid (2014), Toetskader TU/e. Eindhoven: Technische Universiteit Eindhoven.
[2] De Haan, D, Watering, G. van de, Meeuwen, L. van Toetskader TU/e 2019, Eindhoven.

1. Vision on the organization of education and examinations at IE&IS

The Department of IE&IS presents its vision on education in the document 'Educational Concept for the Department of IE&IS'. This document is updated on several occasions. In addition, the department follows the guidelines of the Bachelor College and Graduate School.

The examinations policy is based on documents (by the IE&IS educational management and/or by the Exam Committee) about quality assurance in relation to examinations. This assessment policy document is written by the IE&IS educational management and submitted for review to the IE and the IS Curriculum Committee. It is confirmed by the Exam Committees IE and IS, and Departmental Board of IE&IS.

1.1 Educational vision of the Department of IE&IS

Learning outcomes
Learning outcomes (or exit qualifications) play a central role in the design of the educational programs of both schools. Learning outcomes specify the knowledge, skills and attitude that a student should have acquired on completion of the program. The learning outcomes of the programs are defined based on the demands that are made on an academic engineer. These demands are based mainly on international benchmarks, the interrelationships between education and research, and contacts with industry. At the start of the design of the major courses and master's programs, there was a consultation round with the various parties involved to define clear and broadly supported learning outcomes. Discussions with organizations in industry, alumni and (international) researchers led to a first set of learning outcomes. In case of changes in the environment or internal changes, the learning outcomes are updated in consultation with the parties involved.

The learning outcomes of the IE programs are assessed against the 3TU Criteria for Academic Bachelor's and Master's Curricula, as shown in the table below.

Table 1: ACQA competence areas and learning outcomes of the BSc IE and MSc OML and IM

ACQA Competence area	BSc IE	MSc OML and IM
scientific disciplines	The graduate bases his/her choices in analysis and design on academic knowledge from several disciplines. The graduate is able to apply his/her multidisciplinary knowledge and insight under supervision to structure and analyze complex, business problems, with the aim to systematically improve business processes in industrial and service organizations.	The graduate is an engineer who has thorough mastery of the state-of-the art scientific knowledge and insight on the design, behavior, and performance of operational processes in industrial and service organizations, or of innovation processes. The graduate is capable of independently identifying and supplementing any lack of knowledge.
doing research	The graduate is able to carry out an analysis in a structured and reproducible manner; using a careful and well-founded selection of theoretical models and research methods.	The graduate has research skills to independently conduct studies that meet academic standards.
designing	The graduate is able to determine how the	The graduate is capable of modeling and

	performance of business processes changes as a function of changes in input. He/she can with supervision produce recommendations for (re)design and/or improvement of business processes.	(re)designing a complex business process, based on the results of a study, including specifications for the required information and the organizational context.
scientific approach	The graduate is able to behave systematically, he/she possesses the skills to develop and use theories, models and coherent interpretations.	The graduate possesses the necessary learning skills to enable him/her to enter subsequent programs requiring substantial independence, such as PhD programs or postgraduate professional programs or courses.
basic intellectual skills	The graduate is able to reflect, think (with supervision) and has a critical attitude.	The graduate is able to reflect, think and has a critical attitude.
co-operating and communicating	The graduate is able to communicate (in writing and orally) clearly, unambiguously and in a professional manner in different contexts. He/she can operate independently and in interdisciplinary teams.	The graduate has social skills to independently conduct studies that meet academic standards; Can operate independently and in teams, at an academic level; is able to operate effectively and efficiently in a multidisciplinary context; Is able to communicate clearly and unambiguously both in industry and in academia, with non-specialists and specialists in the domain.
temporal and social context	The graduate is able to analyze ethical aspects and social and environmental consequences of scientific thinking and behavior.	The graduate is aware of the relative importance of knowledge of scientific disciplines, and the societal impact of scientific knowledge (and vice versa);

The learning outcomes of the IS programs are assessed against the 3TU Criteria for Academic Bachelor's and Master's Curricula, as shown in the tables below.

ACQA Competence area	**BSc IS major PT**	**BSc IS major SI**
scientific disciplines	1. Knowledge of and insight into specific technological systems and their components in one of the following technology domains: Information and Communication Technologies, Robotics, and Built Environment. 2. Knowledge of the core concepts, theoretical frameworks and methodologies of psychology and insights into their application to understand the relationships between technology and users. 3. Knowledge of and basic skill in the techniques of observation, data collection and analysis techniques commonly used in the human-technology domain, and an awareness of the scope and	1. Knowledge of and insight into specific technological systems and their components in one of the following technology domains: Sustainable Energy and Urban Plannding and Mobility. 2. Knowledge of and insight into the core concepts, theoretical frameworks and methodologies of innovation science for sustainability, thereby building upon disciplines such as economics and sociology. 3. Multidisciplinary knowledge integrating innovation sciences knowledge with technological knowledge to address sustainability challenges. 4. Knowledge of and basic skills in the

	limitations of these methods 4. Knowledge of and skills in the basics of the engineering profession such as mathematics, statistics and programming.	relevant techniques of observation, data collection and analysis for sustainable innovation. 5. Knowledge of and skills in the basics of the engineering profession such as mathematics, statistics and programming.
doing research	1. Ability to reformulate an ill-structured research problem in terms of the core concepts and theories of psychology; in particular those pertaining to human-technology interactions. 2. Ability to develop and execute a research plan (with supervision). 3. Ability (with supervision) to contribute to the development of scientific knowledge in the area of the psychology of human-technology interactions. 4. Ability (with supervision) to recognize and analyze problems typical for human-technology interaction from a technological and psychological perspective 5. Ability to appraise (under supervision) relevant scientific evidence on its usefulness in addressing a given research problem 6. Understanding of the ethics of psychological / user research and has both the ability and attitude to adhere to these rules.	1. Ability to formulate a sustainability research problem in terms of the core concepts and theories of innovation sciences 2. Ability to develop a research plan (with supervision). 3. Ability (with supervision) to contribute to the development of scientific knowledge in one of the areas of the innovation sciences for sustainability. 4. Ability (with supervision) to identifying and analyzing problems typical for the innovation sciences, by integrating technological and social sciences perspectives. 5. Ability to appraise (under supervision) relevant scientific evidence on its usefulness in addressing a given research problem.
designing	1. Ability to reformulate an ill-structured design problem in terms of the core concepts and theories of psychology; in particular those pertaining to human-technology interactions. 2. Ability to develop and execute (under supervision) a sound plan for formulating design requirements. 3. Ability to integrate existing knowledge on technological requirements for human-technology interactions in the (re-)design of (requirements for)	1. Ability to translate the outcomes of sustainable innovation research into design, policy or strategy recommendations for innovation in existing and new socio-technical systems (under supervision). 2. Ability to identify both the social and the technical implications of innovation sciences in the design recommendations for sustainability problems

	products or systems. 4. Ability (with supervision) to merge knowledge, methods and concepts of the technological and psychological domains. 5. Ability to make decisions with respect to design requirements where they pertain to the interaction between the user and the system or product, and to provide justifications for these decisions.	
scientific approach	1. Ability to document the result of psychological or user requirement research for future use within the organization. 2. Ability to use a systematic approach characterized by the consistent application of existing theories, concepts and models of psychology and technology. 3. Ability to look beyond the borders of a specific discipline, to be sensitive to the relative contributions of various disciplines. 4. Basic understanding of the practices and principles of science.	1. Basic understanding of the practices and principles of science. 2. Ability to look beyond the borders of a specific discipline, to be sensitive to the relative contributions of various disciplines. 3. Ability to use a systematic approach characterized by the consistent application of existing theories, concepts and models in innovation sciences.
basic intellectual skills	1. A reflective attitude, with an ability to critically reflect (with supervision) on own thinking, decision making, and professional behavior. 2. A critical mindset and the ability to ask constructive questions regarding the basic problems in the field. 3. Ability to form a reasoned opinion with regard to scientific arguments in the domain 4. Ability to think in abstract terms, including the ability to use and modify formal models of basic phenomena and processes in the domain.	1. A reflective attitude, with an ability to critically reflect (with supervision) on own thinking, decision making, and professional behavior. 2. A critical mindset and the ability to ask constructive questions regarding the basic problems in the field. 3. Ability to read and write scientific texts. 4. Ability to think in abstract terms, including the ability to use and modify (formal) models of basic phenomena and processes in the domain.
co-operating and communicating	1. 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 academic peers, engineers in one's domain, and users.	1. 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 academic peers and engineers in one's domain.

	2. Awareness of differences in work practices between scientific disciplines 3. Ability to contribute to multi- or interdisciplinary teams of engineers and academic peers. 4. Ability to understand, listen, read, talk and write in English.	2. Ability to work in (multidisciplinary) teams. 3. Ability to listen, read, talk and write in English.
temporal and social context	1. 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. 2. Understanding of the different roles of engineers and related professionals in society.	1. 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. 2. Understanding of the different roles of engineers and related professionals in society, in particular in relation to sustainability challenges.

ACQA Competence area	**MSc HTI**	**MSc IS**
scientific disciplines	1. Knowledge of and insight into technological systems and their components in a specialized area of their background engineering domain. 2. Thorough knowledge and understanding of concepts, theoretical frameworks and methodologies of the psychology and human-technology interaction domains. 3. Thorough knowledge of and advanced skills in the techniques of observation, data collection and analysis techniques in the human-technology domain, and an ability to critically reflect on the scope and limitations of these methods.	1. Advanced knowledge of and insight into technological systems and their components in a specific technology domain. 2. Thorough understanding of concepts, theoretical frameworks and methodologies of innovation sciences extending to the forefront of knowledge 3. 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. 4. 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 of the scope and limitations of these methods.
doing research	1. Ability to formulate research	1. Ability to formulate research

	problems in terms of concepts and theories of psychology and human-technology interactions 2. Ability to independently develop and execute a research plan. 3. Ability to contribute independently to the development of scientific knowledge in the area of the human-technology interactions. 4. Ability to identify and analyze problems typical for human-technology interaction by integrating technological and psychological perspectives. 5. Ability to appraise relevant scientific evidence on its usefulness in addressing research problems. 6. Understanding of the ethics of psychological / user research and has both the ability and attitude to adhere to these rules.	problems in terms of concepts and theories of innovation sciences. 2. Ability to independently develop and execute a research plan. 3. Ability to contribute independently to the development of scientific knowledge in one of the areas of the innovation sciences. 4. Ability to identify and analyze problems typical for the innovation sciences, by integrating technological and social sciences perspectives. 5. Ability to appraise relevant scientific evidence on its usefulness in addressing research problems.
designing	1. Ability to formulate design problems in terms of concepts and theories of psychology and human-technology interaction. 2. Ability to develop and execute a sound plan for formulating design requirements. 3. Ability to integrate existing knowledge, or identify gaps therein, on technological requirements for human-technology interactions in the (re-)design of (requirements for) products or systems. 4. Ability to integrate the technological and psychological domains, merging knowledge, methods and concepts. 5. Ability to make decisions with respect to design requirements where they pertain to the interaction between the user and the system or product, and to justify these decisions in a systematic manner.	1. 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. 2. Ability to independently identify both the social and the technical implications of innovation sciences in design recommendations.
scientific approach	1. Ability to document the result of psychological or user requirement research for the development of knowledge within the field and	1. Ability to apply and critically examine existing theories, concepts and models in the innovation sciences domain.

	beyond. 2. Ability to apply meticulously, and examine critically existing theories, concepts and models in the human-technology interaction domain. 3. 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. 4. Understanding of the practices and principles of science, and knowledge of current debates about this.	2. 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. 3. 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	1. A reflective attitude, with an ability to critically and independently reflect on own thinking, decision making, and professional behavior. 2. A critical mindset and the ability to ask constructive questions regarding complex problems in the field. 3. Ability to take a standpoint with regard to scientific arguments in the field, and to critically assess its value. 4. Ability to think in abstract terms, including the ability to develop formal models of phenomena and processes in the domain.	1. A reflective attitude, with an ability to critically and independently reflect on own thinking, decision making, and professional behavior. 2. A critical mindset and the ability to ask constructive questions regarding complex problems in the field. 3. Ability to read and write scientific texts. 4. Ability to think in abstract terms, including the ability to develop (formal) models of phenomena and processes in the domain.
co-operating and communicating	1. 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 2. Ability to recognize and deal with differences in work practices between scientific disciplines and academics from other cultural backgrounds. 3. Ability to take a leading role in multi- or interdisciplinary teams of engineers and academics. 4. Ability to listen, read, talk and write in English on a professional level	1. 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 2. Ability to recognize and deal with differences in work practices between scientific disciplines, and academics from other cultural backgrounds. 3. Ability to take a leading role in multi- or interdisciplinary teams of engineers and academics. 4. Ability to listen, read, talk and write in English on a professional level.

temporal and social context	1. 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 professional work. 1. 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.	1. 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. 2. 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.

Translation of learning outcomes to learning goals and teaching forms

Students develop exit qualifications throughout their BSc/MSc programs. This means that all courses contribute to gaining these learning outcomes. For this reason, the content and goals of all courses are formulated in course descriptions. The learning goals of the courses describe what students must know and the skills they must gain after completing a course. Examinations are aimed at the learning goals which have been defined for the course.

To align the learning goals of the courses and the learning outcomes of the program, learning lines are defined in the BSc curriculum. These learning lines ensure that:

a. there is minimal overlap within a learning line during the program;
b. the qualifications are continuously developed;
c. the intended level is achieved at the end of the program.

The way in which the defined learning outcomes are reached is indicated step-by-step in a learning line.

It is important that there is agreement within the program on the content of the learning lines. The learning lines are defined in teams of lecturers (either from a single discipline or multidisciplinary) based on the learning outcomes. Several basic principles for the allocation of the learning goals among the different years of the BSc program are followed in defining the learning lines:

First year/level 1: typical teaching forms are lectures, instruction supervised self-study and assignments with feedback/tutorials.

- Goal: orientation, selection, but also providing basic knowledge and building an academic attitude;
- Structure: the focus initially is on relatively simple tasks, with more attention for the overall competence areas (generic);
- Level: a group of students is not yet able to work completely independently. They are often not yet able to independently plan and manage their study programs. This means that in this phase attention mainly must be given to creating the basis for the further development of competences in later years (beginner's level).

In the second and third year/levels 2 and 3: typical teaching forms are lectures, assignments with feedback/tutorials, internships and individual research (thesis).

- Goal: deepening knowledge, applying knowledge and developing skills and academic attitude;

- Structure: the tasks become more complex. The various aspects of competences are dealt with (specific);
- Level: more attention can gradually be given to working independently, which means the content of the program can become more student-focused (advanced level).[3]

It is important that all academic competences (knowledge, skills and attitude) are covered without repetition throughout the program, in other words that they are in any case dealt with at beginners and advanced level. Courses consist of a mix of teaching forms.
In the MSc programs, no formal learning lines are organized in advance, because students choose one or more tracks and create their own learning path. The assignment of a mentor in an early stage in the MSc programs guarantees the coherence of the individual program, the optimal preparation for the MSc thesis and the attainment of the learning outcomes.

The program for both the bachelor college and the graduate school within the Department of IE&IS is based on the determined learning goals. All courses and professional skills contribute to one or more of these learning goals. The detailed information regarding the learning goals for each program is given in Appendix 1.

Alignment of learning goals and examination forms
In the BSc programs, we distinguish three types of learning goals of a course:

1. Gaining new knowledge;
2. Applying knowledge:
    a. doing exercises with knowledge (focused on automating);
    b. applying knowledge in a context;
3. Developing non-discipline-related competences (skills and attitude).

This knowledge, skills and attitude can be learned through a variety of teaching methods. The table below gives an idealized picture of types of learning goals and the corresponding examination forms in the BSc programs. In many cases the acquisition of knowledge will precede the exercises and application of that knowledge.

Type of learning goals	**Type of examinations**
Acquisition of knowledge	Written examinations
Acquisition of and exercises with knowledge	Written examinations and assignments
Acquisition and application of knowledge, development of non-discipline-related competences	Assignments, thesis and portfolio

In the School of IE& IS , several testing platforms are used, namely Canvas, AnsDelft and Cirrus. In the future, digital examination will be more and more common. Some pilots have started with special functionalities within Cirrus, like programming and authentic testing.
At the School of IE and IS, the cutting-score is determined conform the EER (article 5.7 EER BC, article 5.7 EER GS).

Evaluating alignment
Evaluation of the alignment of learning goals, educational forms and examination form is carried out on a 'before and after' basis. Before the course:

[3] In the master's phase students work towards Expert level.

- The Curriculum Committee (Dutch abbreviation OC) discusses the match between the learning goals, educational forms and the examination method every time a course is developed or changed substantially;
- The Exam Committee (EC) annually examines the courses using the details provided in the Education and Examination Regulations (OER). The examination committee Industrial Engineering and the examination committee Innovation Sciences together have a assessment committee, to examine the quality of examinations at the request of the examination committees or the teacher
- The Exam Committee (EC) checks the quality of the BSc and MSc thesis on a regular basis. The Exam Committee Industrial Engineering has a separate committee to do this. The Exam Committee Innovation Sciences checks the quality itself; The OC and EC advise the Director of Education on the educational program, the courses, and education and examination forms.

After the course, complaints from students received through the Exam Committee, Curriculum Committee or the educational management (written complaints or course evaluations), may be reasons to discuss the alignment of the learning goals and the examinations with lecturers.

1.2 Vision on the examinations Department of IE&IS

Professional lecturers
The Department of IE&IS respects and trusts in the professionalism of lecturers and strives to create optimal conditions within which scientists can excel in their education and research. Professional lecturers have the responsibility to take initiatives and to develop working methods that contribute to the implementation of the examinations policy. This means that:

1. Lecturers are dedicated to transparent, valid and reliable construction, holding and assessing examinations;
2. The Department provides teachers with enough time for developing, holding and assessing examinations;
3. And gives teachers the opportunity to train themselves in testing and assessment.

The TU/e requires that its teachers have a University Teaching Qualification (Dutch: Basis Kwalificatie Onderwijs). One of the competences in the UTQ is 'Testing and Assessment', which involves:

The lecturer can:
1. design a test plan, including assessment criteria and;
2. using this, develop tests to check whether the students have met the learning objectives sufficiently well;
3. assess the learning process in groups of and individual students;
4. use student test results to assess whether learning objectives have been achieved;
5. analyze test results and draw conclusions on the quality of learning, teaching and testing.

About 58% of the lecturers of the School of IE, and 56% of the lecturers of the School of IS has UTQ certificates (based on the 2019 data for IE, and 2018 data for IS).
Teachers can be assisted by student assistants in their educational tasks. However, in the Department of IE&IS, bachelor and master students that are appointed as student assistants are not allowed to assist in grading. In several documents the regulations for teaching and teacher assistants are described.[4]

[4] Documents "1731998 Regulations for Teaching and Teacher Assistants_24Sept2018", 173199_Advies Teacher en teaching assistants reglement en professionaliseringsplan_24sept2018"and "1731998_OB_FBs inzake TA regelgeving en professionaliseringsplan_17sept2018"

Basics of the IE&IS assessment policy

Lecturers make choices about the way in which they carry out examinations within the boundaries set by the educational policy and the guidelines of TU/e and the department. At the TU/e, we are aware of the influence of examinations on the study behavior of students, and we focus on the use of examinations as a 'tool of learning' and as a 'tool for learning'.[5] Examinations as test of knowledge ('tool of learning'): the result of learning is to gather factual knowledge or skills, which may be correct or incorrect. Examinations as learning ('tool for learning'): examinations are a tool to facilitate learning and to support students in developing their own understanding of a subject.

Examinations influence the way in which students learn. The basic principles as stated below are followed in the Department of IE&IS:

- Examinations make it clear to students which knowledge is regarded as important;
- Examinations provide an understanding of the learning process; they give feedback on what students do and do not understand and/or what they can and cannot do, and on whether they have studied well and sufficiently. This means that examinations do not just mark the reaching of the final stage of education (summative examination) but can also provide feedback on how much progress a student has made in the learning process (formative examination). Feedback helps students to understand their own learning process, which will allow them to better direct their studying work;
- Online tools for feedback and examinations can be used. For example, by means of 'learning analytics' it is possible to track students' online study activities, and to respond specifically to them;
- Direct feedback may be given by a lecturer, but also by fellow students ('peer review').

The department IE&IS has a long tradition of quality improvement in relation to examinations. Already in 1999 the department started an 'examinations' project aimed at increasing the knowledge and skills of lecturers in designing and analyzing examination questions. However, this did not result in a coherent examinations policy. A list of questions was prepared in 2010, in preparation for laying down the examinations policy of the department. The conclusion of the educational management was that several elements of the examinations policy were not yet defined within the department. Based on this analysis, the IE&IS educational management in consultation with the Exam Committees took the initiative to lay down an examinations policy for the department. The following steps were taken:

- Memorandum on examinations policy (2008);
- Proposal for the implementation of an OGO (Design-Based Learning) assessment system (2009);
- Quality assurance procedure for BSc and MSc theses for IE and IS (2010);
- Exam Bureau (2010);
- Assessment of the Quality Procedure (April 2012);
- Strengthening of the IE&IS Exam Committees (October 2012);
- Rules and guidelines for the TIW (Innovation Sciences) Exam Committee (December 2012).
- Foundation thesis committee (toetscommissie) (September 2017)
- Hiring a teacher support officer (September 2017)

These documents are the starting point for describing the assessment policy of the department.

[5] See: Meijers, A. & P. den Brok (2013), 'Engineers for the future: An essay on education at TU/e in 2030'. Eindhoven: University of Technology.

1.3 Responsibilities of the Exam Committee and management

Both Exam Committees are independent bodies in the Department of IE&IS. Its most important task in relation to examination quality is the embedding of the quality system as described in Fig. 1 and proactive involvement in the processes and procedures as described above.

The ways in which the proactive role of the Exam Committee is put into effect in the Department of IE&IS include:

- Meetings twice a year between the chair of the Exam Committee and the Departmental Board;
- Meetings four times a year between the chair of the Exam Committee, the chair of the Curriculum Committee and the Director of Education;
- Monitoring of the examination process within the School, for example by supervising the peer review procedure. This is mandated by the Exam Committees IS and IE to the assessment committee

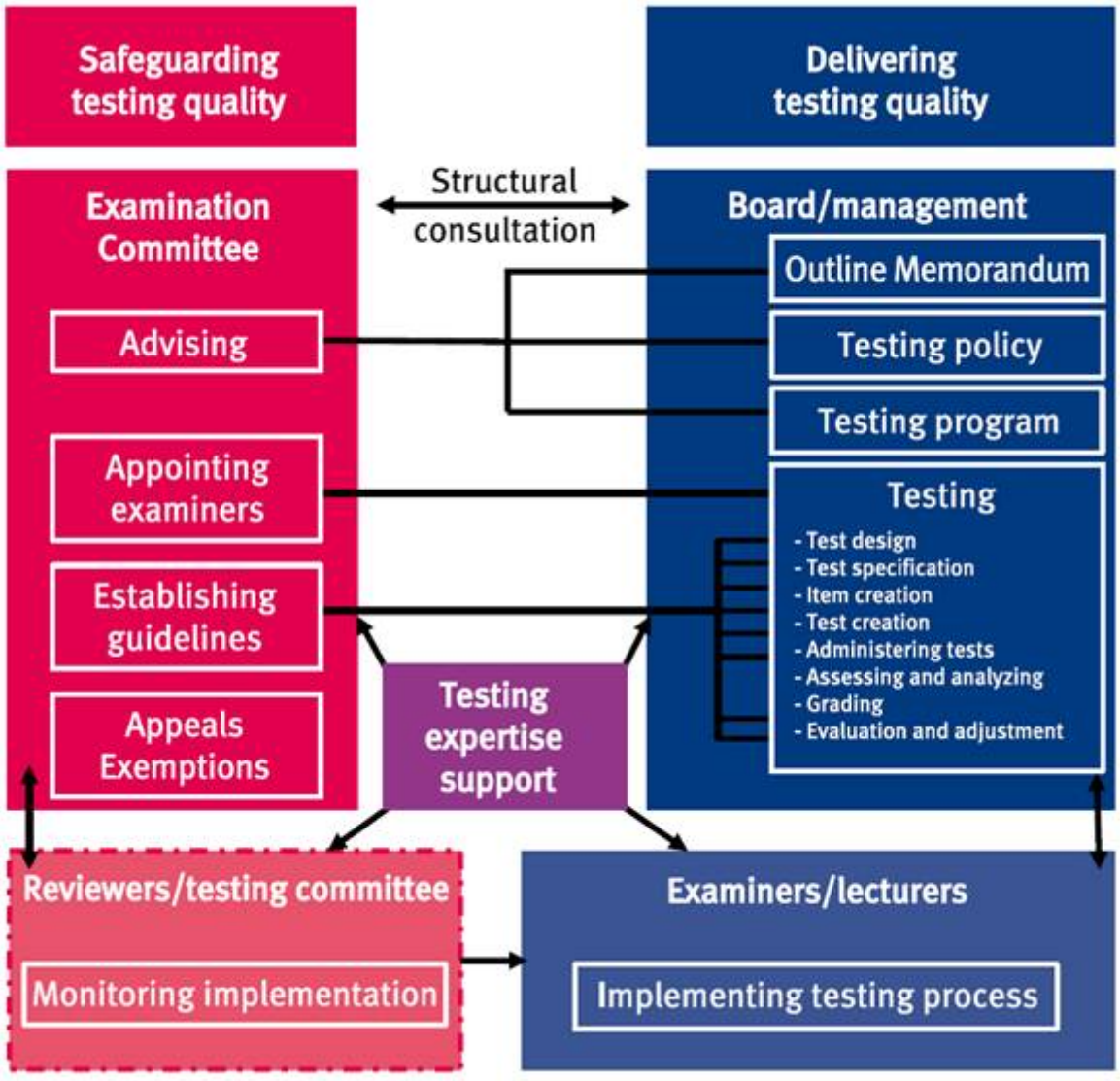

***Figure 1**. Division of responsibilities between Exam Committee and management (see: Van Zijl & Jaspers (2012), Joosten-ten Brinke & Van der Linen-Straatman (2012)).*

The Exam Committee has a legal right to investigate the quality of examinations, the results of examinations and the success percentages etc. by means of course evaluations, questionnaires, gathering complaints etc. A further description of the tasks and role of the Exam Committee can be found in the Examination Regulations of the School of IE (see: https://educationguide.tue.nl/programs/bachelor-college/majors/industrial-engineering/regulations/ =) and of the school IS (see: https://studiegids.tue.nl/opleidingen/graduate-school/masters-programs/human-technology-interaction/regulations/.
In addition, the Exam Committee appoints examiners, who in general are lecturers responsible for giving the education to which the examination relates (see appendix 2 for the profile of the examiners of the Department of IE&IS). The examiners assess whether students successfully completed the examinations or practical assignments. The corresponding certificate is issued on behalf of the Exam Committee. The Exam Committee itself has final responsibility.[6]

The Exam Committee must be familiar with the content of the educational programs and the regulations (TU/e and WHW [Higher Education and Scientific Research Act]), and this information must be easily accessible for all stakeholders (Curriculum Committee, students, lecturers, student counselors, Student Councils and Director of Education). The aim is for all the members of the Exam Committee to cover, both thematically and methodologically, the different aspects of the content of the educational programs. This means all members must stay sufficiently in touch with the organization of TU/e and the School to be able to deal with the matters that arise in the right context.
Composition of the Exam Committee (in accordance with the 'Examination Committee Guide TU/e, 2014):

1. The Departmental Board appoints the Exam Committee;
2. The Exam Committee has the following composition:
    a. a chair: preferably a full professor;
    b. a vice-chair, to be appointed from among the members;
    c. three members;
    d. external member, from another school
    e. an official secretary.
3. The members and the chair must be staff members who make a substantial contribution to one or more of the educational programs provided by the department;
4. The appointment is for 2 years. Reappointment is possible for the external member the re-appointment can only be once (total 4 years);
5. The Exam Committee may consist of subcommittees, such as a committee for everyday tasks, a committee for quality assurance of MSc and BSc theses and a thesis Assessment committee.

The Department of IE&IS developed profiles for the chair, vice-chair, secretary, members and advisors (See Appendix 3). Besides the expertise of the EC members in the different disciplines of IE, the EC members possess also basic knowledge expertise in law (WHW), quality assurance and testing (UTQ). As of September, 1th 2015, the appointment of an external member to the EC is compulsory.

The chair and secretary of the Exam Committee of both the School of IE and the school IS take part in university-wide consultative bodies: the Advisory Committee for Bachelor's Examinations (AEB), the Advisory Committee for Master's Examinations (AEM) and the secretaries of the Exam Committees discussion group. If necessary, the committee seeks advice from the student counselor, the Director of Education or others. The Exam Committee may follow a training course provided at TU/e level. In addition, TU/e has appointed an examinations expert to advise the Exam Committees.

[6] Both the IE Exam Committee and the IS Exam Committee developed a profile of the examiners for the various educational programs on the basis of the 'TU/e examiner profile'.

The Exam Committee accounts for (and reflect on) its activities during the year in an annual report. This report will be discussed by the chair of the Exam Committee with the Departmental Board (including the the IE&IS Director of Education).

2. Quality assurance of examinations

The basic principle for quality assurance of examinations is that the quality system must focus on continuous improvement. Figure 1 shows the quality assurance cycle in relation to examinations in the Department of IE&IS.

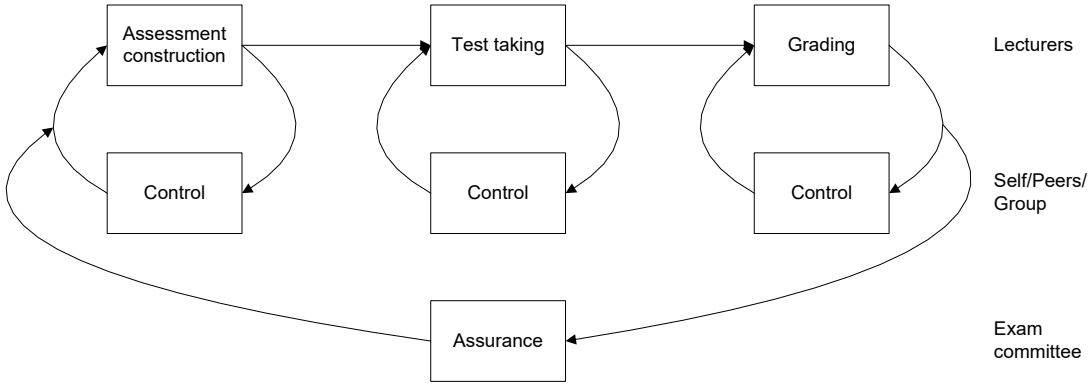

Figure 2: Schematic representation of the examination quality assurance cycle

The examination quality assurance system consists of three elements: examination construction, holding of the examinations (test taking) and grading. Each examination must meet the criteria of transparency, validity and reliability.

- ***Transparent***: it is clearly communicated to students before the examination how and on which aspects they are being examined;
- ***Valid***: the examination covers the learning goals. Validity relates to the content (in line with the learning goals), level (difficulty) and representative quality;
- ***Reliable***: the examination makes a significant distinction in the extent to which the students have achieved the learning goals. This also relates to the quality of the examination (distinguishing ability, minimal chance of random answers, unambiguous), the conditions under which the examination is held (standardization and objectivity) and the way in which the results are assessed (objective, non-random, and precise).

Lecturers have primary responsibility for these three aspects. Quality control of these aspects is carried out in the first instance within the group in which the lecturer works. For each aspect, the School takes specific measures for the quality assurance of the examinations.

The Exam Committee has a specific role in the quality assurance of examinations because of its legal responsibility for the quality assurance of all examinations in Higher Education. It monitors the final level of the educational program and the quality of examinations within a program. The Exam Committee may investigate the processes and procedures used by the School to monitor and improve the quality of examinations. The Exam Committee is also authorized to appoint examiners.

2.1 Examination plan

Each year an examination plan for each **study program** is included as an appendix to the Education and Examination Regulations. This describes how courses are concluded. The examination plan deals with all examinations in a course (both summative and formative, final and interim, conditional and selective etc.). Box 1 shows an overview of the course details as described in the Educational and Examination Regulations:

- The semester and quarter in which a course is given;
- The course code and if applicable the course code(s) of the interim examination(s);
- The name of the course;
- The number of study points in EC;
- The examination forms: Written, Assignment, Report, Presentation, Oral, Notebook examination, practical exercise, test;
- The quartile in which the examinations are held.

At **course level**, a study guide describes how the examinations are held. Box 2 gives an overview of the aspects described in a study guide in Osiris and/or Canvas (Osiris is leading):

1. Structure of the examination
- Form of interim and examinations
2. Material covered by the examination
3. Handing-in procedure
4. Dates of feedback and/or inspection
- Scheduling of feedback times and way in which feedback is given (e.g. question hour, tutorial, meetings with supervisor etc.)
- Scheduling and method of inspection (for written exams)
5. Determination of the final grade
- Way in which the final grade is determined: e.g. weighting of sections, minimum requirements, peer review
- Who determines the final grade?
6. For assignments:
- Assessment criteria
- Peer assessment
7. Optional for multiple-choice examinations:
- Dividing the examination questions over the material covered by the examination

The dates of the examination and resit are published in My Timetable.

It is therefore clear in advance what is being examined (linked to the learning goals of the course), how and when the examination will be held, if applicable what the consequences will be of passing or failing the examination, how different examinations count towards the final grade of the course, how the examination will be assessed (and by whom) etc. This information is visible in the studyguide months before the semester starts. The exact dates of publication are set in the Program and Examination regulations. This description ensures transparency; it forces lecturers to think in advance about how they will structure the examinations or their course and enables the Exam Committee to carry out its monitoring tasks better.

The number and nature of the (interim) examinations are described in the course descriptions (see https://tue.osiris-student.nl/#/onderwijscatalogus/extern/start). The course descriptions are submitted for review to the Curriculum Committee. A total overview of all examinations is given in the Education and Examination Regulations, on which the Curriculum Committee and the Examination Committee advise, which is approved by the Departmental Council, and which is confirmed by the Departmental Board. This gives the Exam Committee the opportunity to fulfill its monitoring role in relation to (interim) examinations in advance. The planning for the examinations is published a couple of weeks before the start of the semester. The exact dates of the publication are set in the Program and Examination Regulations.

2.2 Procedures for composing, holding or assessing examinations

The examination procedures are described in the Examination Regulations of the courses. These can be found on the Education guide of the IE programs (https://studiegids.tue.nl/opleidingen/bachelor-college/majors/technische-bedrijfskunde/reglementen/?L=) and on the Education guide of the IS programs (https://studiegids.tue.nl/opleidingen/bachelor-college/majors/psychology-technology/reglementen/) . The Examination Regulations are drawn up by the Exam Committee and include, both guidelines for the Exam Committee, and guidelines for examiners to compose, hold, assess and analyze examinations.

Other guidelines for examinations were drawn up on the introduction of the BSA (Binding Recommendation for Continuation of Studies) in 2010 and updated on the introduction of the Bachelor College in 2012. A list of the guidelines for written examinations is given below:

Procedure for composing examinations
In the Department of IE&IS, the procedure as described below is followed for composing written examinations:

1. The examination is composed in advance by the lecturer;
2. The learning goals of the course are used as the starting point for composing the examination. The lecturer must be able to show the relationship between the goals and the examination questions, for example as a result of complaints of students in course evaluations, or at the request of the Exam Committee;
3. The examination contains a list of the points that can be obtained per sub question and an answer model;
4. The examination has been reviewed, discussed and approved by at least two lecturers.[7] In handing-in the examination questions, the lecturer includes a memo signed by a colleague stating which colleague has reviewed the examination. The presence of the answer model is also checked. The Exam Committee monitors the observation of this guideline;
5. Based on the check, the responsible lecturer adjusts the questions or the answer model;
6. When the course is running, the lecturers notify the students about the examinations. Students are given the opportunity to practice using similar assignments (e.g. with past examinations);
7. The finalized examination is handed-in to the secretariat of the Groups by the responsible lecturer not later than a week before the examination.

The examination schedule showing the dates and times of the examinations in the coming semester is announced at least a month before the start of the semester. Rescheduling an examination or changing its location is only allowed with the prior approval of the Exam Committee.

Examination questions must be **valid**. Table 1 shows the tools that can be used to assess the content validity of examination questions (Do the items of the scale cover the important characteristics of

[7] See Examination Regulations 2019 Article 2.1.1 : “an assessment plan is in place for each study component that meets the requirements of the Departmental Assessment Policy, and whether the plan has been published for students,
- multiple lecturers were involved in the construction of each test and response model,
- tests are checked, before they are administered, by reviewers in terms of validity, reliability and transparency,
- tests are graded according to a procedure in which differences between assessors are kept to a minimum”

the concept being measured?).[8] The table also shows the policy of the School in relation to these tools.

Table 1: Tools and policy for measuring the content validity of examination questions.

Tool	By whom	Policy of IE&IS
Before: making an assessment plan. The matrix shows how many questions the examination contains for a specific subject and level (e.g. factual knowledge or application). This matrix reflects the learning outcomes of the course or part of a course to be examined.	Lecturer	This tool is being increasingly used, particularly by lecturers who have taken a course 'written examinations' as part of their BKO (Basic Teaching Qualification). This course is mandatory from 2013 for the BKO participants of the Department of IE&IS. The Exam Committee monitors this procedure and strongly endorses it.
Before: peer review of examination content, form and answer model (if open questions are used). An example of a checklist for the assessment of open and closed questions.	Peer review	This tool is mandatory for all examinations . The Exam Committee monitors this procedure.
After: checking the difficulty of examination questions and the examination (p-value), attractiveness of the incorrect answers (a-value), the contribution of each question to the reliability (Rit, Rat, Rir and D-index).	Examination expert	Some lecturers carry out an analysis of this kind for multiple-choice examinations. For the use of this tool an appointment can be made with the teacher support officer within the department IE&IS.

Procedures for holding examinations

The procedures for holding examinations in the Department of IE&IS are as follows:

*Procedure for **handing-in examination questions and answers***

The questions for written examinations, including the cover page and the answer model, are handed-in before the start of the examination week to the secretariat of the Group. The answer model may be changed after the answers of students have been seen.

The central examinations bureau provides a suitable examination room for the number of participating students and the nature of the examination. The student administration notifies the Group secretariat of the number of students who are registered for the examination. The central examinations bureau notifies the teacher in which room the examination will be held.

The central examinations bureau ensures that there are enough examination papers in the examination room. The secretariat sends the exam to be printed to the central print service. The central print service ensures the distribution to the correct examination room.
After the examination, the examination papers are collected by the proctor and handed-in to the material expert.
In the Examination Regulations, instructions are provided to lecturers, proctors and students, concerning e.g.:

- Presence of lecturer/material expert during the examination:
- Instruction of proctors:
- Accessibility of the lecturer/material expert during re-sits:
- Collection of the completed examinations.

Transparency is an important principle in relation to the quality of examinations. For examinations, transparency relates to the procedures and processes. These must be clearly visible to the students,

[8] See: Howitt, D. & D. Cramer (2011), Introduction to Research Methods in Psychology. Harlow etc.: Pearson Education.

and students must be informed about them or must be able to find out about them. Table 2 gives a list of the tools that can be used to measure the quality of how examinations are held, and the policy relating to these tools.

Table 2: Tools and policy relating to measurement of transparency of examinations.

Tool	By whom	Policy of IE&IS
Before: Mandatory examination instructions.	Lecturer	Every written examination has a cover page which states the examination instructions for students and proctors.
Before: Making it clear in the study guide how the grades are determined.	Lecturer	Mandatory (see section 1.2). The Exam Committee monitors this procedure.
Before: Providing practice examinations.	Lecturer	In the Bachelor College, lecturers do not teach in week 8 of each quartile, but instead give tutorials and practice examinations.
After: Course evaluations, curriculum evaluations, Student Councils.	Quality assurance staff, study associations, individual students	Remarks about any unclear points are passed on to the educational management through the Student Councils. The Exam Committee receives complaints from students and deals with these itself or through the educational management.
After: Reports from proctors. After each examination period the educational management and the Exam Committee receive a report of any irregularities arising during examinations.	Real Estate Management	If necessary, the lecturer or student concerned is contacted by the Exam Committee or educational management.

Procedures for assessment of examinations

The ***procedures for the assessment of examinations*** in the Department of IE&IS are as follows:

1. The examinations of a part of the examination candidates are checked using the answer model. After this first round, the answer model is adjusted if necessary;
2. If several lecturers are involved in the grading process, they will preferably each check their own questions instead of dividing the examinations among themselves;
3. The responsible lecturer will ensure that the procedures in relation to grading are observed;
1. .

Procedure for ***handing-in of grades***

The result of all written examinations must be handed-in to the student administration not later than 15 working days after the examination, except for the grading of the examinations of quartile 4 and the Interim period. These must be handed-in not later than 5 working days after the end of the examination period (and before 1 September). The latest date for handing-in the results is shown on the list of examination candidates (see also under point 3). This also applies to the results of assignments etc.

The results of interim examinations are determined within 5 working days, and in any case not later than 5 days before the examination.

The responsible teacher can download the list of examination candidates for his/her own course and upload it again after filling in the grades. If the responsible teacher wants to, the education

administration will send lists of examination candidates (hard-copy and digital) in the groups concerned to the lecturer. The results may be shown on these lists.

*Procedure for **automated processing of multiple-choice (MC) examinations***
MC examinations may be processed by the Group secretariats by using software of the Department Mathematics and Computer Science. More information: Hans Cuypers (f.g.m.t.cuypers@TUE.nl). Also the use of ANS Delft is possible to process MC exams. Canvas can be used for tests/quizzes, but must only be used for low stake tests (10%) because of safety reasons.

Procedure for digital examinations
When teachers want students to make the examination on a laptop in the normal examination rooms on the TU/e campus, the teacher can use the STEP protocol to make the laptop of the student suitable for examinations.

For students who are not present at the TU/e campus at the examination time, the Exam Committee cab consider digitally proctoring options. This kind of proctoring is already used in proctoring the enrollment tests in 2018 and 2019, for Industrial Engineering.

The department has a procedure for examination ***assessments that are received too late***:
- each examination has a cover page clearly showing the latest date for handing-in the results. In addition, a list is sent to the secretariat showing all information about the examinations, such as date, time and number of examination candidates, as well as the latest date for handing-in the results. In addition, the latest date for handing-in the results is preprinted on each page. When using the system for downloading the examination candidates, the teacher is warned by the system about the deadline for handing in the results.
- One day after the announcement of the results (or on the following Monday if this date is a Friday), the lecturer or the course administration receive an e-mail asking when the results can be expected, or the teacher gets a warning by the system. The Exam Committee can give permission for a longer assessment period at the request of the lecturer.
- At the end of the examination period, the complete list is sent to the Exam Committee. This shows the Exam Committee the scale of the problem and enables it to take the appropriate action using the authorizations which it holds.

In grading examinations, the question of **reliability** is of primary importance. Reliability is linked to the extent to which the examination provides consistent results regardless of the goal. The measured correctness or the reliability of an examination can be regarded in two ways, according to the classical test theory:
1. the extent to which there is agreement between the assessors (= inter-assessor reliability);
2. the extent to which the scores are consistent after a repeated measurement by the same assessor (= test-retest reliability).

Table 3 shows the tools and the policy at Department of IE&IS relating to the measurement of the reliability of examinations.

Table 3: Tools and policy relating to measurement of reliability of examinations.

Tool	By whom	Policy of IE & IS
Answer model	Peers	For open questions an answer model must be present that has been approved in advance by peers and that is used to grade examinations. The Exam Committee monitors this procedure.
Consultation between assessors	Lecturer and team	If there are multiple assessors there must be consultation on the assessment of the examinations. Questions should preferably be shared between the assessors, and not the complete examinations. The Exam Committee monitors this procedure.
Analysis of examinations. With open questions using the coefficient alpha method (e.g. Cronbach's alpha). Analysis of MC exams.	Examination expert	The examination expert at TU/e can be asked to analyze examinations, for example at the request of the Exam Committee.

2.3 Measurement of results: tools to measure the quality of examinations

The lecturer is responsible for the quality of examinations. To measure the quality of examinations, course evaluations are used in the first instance. Article 2.1, of the Examination Regulations states that the Exam Committee monitors the quality of examinations based on the information obtained from the students and through the educational quality assurance staff (who assess the quality of the educational units and discuss this with the lecturer). The information is obtained, among other sources, from the questionnaires used for the course evaluations.

Examples of statements about examinations in the course evaluations are:

- The assessment/final test of this course was appropriate (e.g. methods used, relevance and clarity of the questions/assignments);
- The final test accurately represented the subject matter.
- This interim test (e.g. clarity of questions/assignment, level, etc.) provided clear feedback on my progress in this course.
- The feedback I received was sufficient and useful.
- The assessment as a whole was appropriate (e.g. methods used, relevance and clarity of the assignments).
- The assessment criteria were clear.
- The interim test provided sufficient feedback to improve my work by the end of the project.
- This assessment component (interim/final test) was clear, relevant and representative.

If the results of the course evaluations indicate that an examination and/or the assessment procedure are not of the required quality, the Exam Committee refers the responsible lecturer to the Teacher Support Officer.
The lecturer has tools available to measure the quality of the three phases of the examination quality cycle (Figure 1, §1.3). The Exam Committee also uses these tools to investigate and assure the quality of examinations, both in advance and afterwards.

Other rules relating to the analysis and evaluation of examinations are:

1. Students can view their work after the assessment, so they can learn from it and can check the assessment. The responsible lecturer will make clear in advance (in the study guide) how, where and when students can review their examinations. After the examination has been assessed, students will receive an e-mail with the date on which the examinations are available for viewing;

2. All examinations, including questions and answer models, must be kept for at least 2 years by the secretariat of the group the lecturer belongs to, in accordance with article 4.11, para. 3 of the Education and Examination Regulations (BSc courses). BSc and MSc theses are kept for at least 7 years (in accordance with article 5.11 of the Education and Examination Regulations). The guidelines for the administrative processing and archiving are given in the Examination Regulations. Written examinations and assignments are kept for 2 years;
3. In accordance with the Education and Examination Regulations for the Bachelor College, the results of interim examinations are only valid in the academic year in which they are taken. The Exam Committee may decide that:
    - interim examinations remain valid for a longer period, for example in case of a test, an experiment, fieldwork or an excursion;
    - PRV examinations remain valid in case the PRV is a training only, and not integrated in a course (for example the PRV information skills).

2.4 Anti-plagiarism policy

As well as the quality assurance both in advance and afterwards of theses, the department followed since 2006 an anti-plagiarism policy. This anti-plagiarism policy is aimed at making students (and lecturers) aware of the scientific standards relating to plagiarism and detecting it in scientific work and papers. As of 2015, the TU/e policy regarding anti-plagiarism is implemented. The anti-plagiarism policy is part of the Regulations of the Examination Committee. The examination committee is thinking of ways how to help teachers to prevent free riding by students within group assignments. Teachers can add a text in the study guide how they will prevent free riding in case of group work for example.

2.5 Communication

Students and lecturers find information on the education rules and regulations, as well as on the rules and regulations concerning examination on the digital education site: http://educationguide.tue.nl. This page also provides detailed information about the BSc and MSc thesis projects and related material including forms for each major and master programs,

Information on making complaints is found on: https://studiegids.tue.nl/organisatie/regelingen-en-gedragscodes/klachten-en-geschillen/

For lecturers, the Teaching support @ Quality Insurance of ESA provides more information on examination, testing, fraud, use of Urkund/Ansdelft/Cirrus, etc. and the concerning TU/e policy. At Departmental level, the ‘portefeuillehouder onderwijs’ of each group and the Director of Education provide information about examination to (new) lecturers. The Student Administration informs lecturers about operational issues regarding examinations.

3. Assurance of the final level of students

Article 7 of the Higher Education and Scientific Research Act (WHW) lays down regulations for registration in higher education. Under the regulations of the Inspectorate of Education, the most important requirements for student examinations and assessments, and the prerequisites for assurance of the final level, are given below[9]:

- The Education and Examination Regulations. These describe the content and the rules for assessments and examinations for each course or group of courses, and form the basic document for students, lecturers, Exam Committees, examiners and managers, and lay down the applicable procedures and the rights and duties of both the students and the educational institute, as laid down in article 7.13 of the Higher Education and Scientific Research Act (WHW);
- The Exam Committee. The Exam Committee has to safeguard the quality of the examinations and final examinations in terms of content, method and level. The Exam Committee has the task of ensuring that graduates have achieved the final qualifications as described in the Education and Examination Regulations (articles 5.1.);
- The examiners. Examiners assess students, and by doing so make an important contribution to assuring and promoting the level of students ;
- Observation of internal regulations and procedures.

The way in which the School of IE and IS monitors and assures the final level of students is described below.

3.1 Level of BSc and MSc theses

Several tools are used to maintain the quality of BSc and MSc theses:

1. A thesis manual which is updated annually by the deputy Director of Education and is posted on the digital TU/e education guide (http://educationguide.tue.nl). This manual describes the steps to be taken in the BSc and MSc graduation process and the regulations relating to supervision, assessment etc.;
2. Graduation of BSc and MSc students is part of the BSc and MSc curriculum evaluation. This evaluation enables students to express their views on different aspects of BSc and MSc graduation, their supervision and the assessment of their theses.
3. The BSc Thesis committee consists of two members (a supervisor and an assessor)These members are selected conform the criteria with regards to the authorizations to evaluate examinations, as determined by the Exam Committee.
4. The second member of the BSc Thesis committee acts as an assessor. The assessor can be from any group. The role of the assessor is to guarantee the end terms of the Bachelor End Project. The project of the student has to fit within these terms. This is only possible when the second assessor is involved in judging the research proposal. The second assessor has a role in the beginning and at the end of the project. The second assessor is not required to be present at the final presentation. Both mentor and assessor provide a grade on the written thesis in writing, after which the grade for the written thesis is determined after discussion. The final grade for the BSc project is determined by the mentor.

[9] Inspectie van het onderwijs (2011), Alternatieve afstudeertrajecten en de bewaking van het eindniveau in het hoger onderwijs. Utrecht.

5. The MSc Thesis committee consists of three members (a mentor, a second supervisor and an assessor). The members are selected conform the criteria with regards to the authorizations to evaluate examinations, as determined by the Exam Committee.
6. The second member of the MSc Thesis committee is a second supervisor who can be from any group.
7. A student writes a research proposal for the MSc thesis, which is assessed by the mentor and second supervisor. For the school IS, the research proposal also must be approved by the examination committee. For the school IE, this is mandated to the mentor and second supervisor.
8. The third member of the MSc Thesis committee acts as an assessor. The third assessor represents here a more disciplinary focus than the first and second supervisor and is qualified to judge the engineering aspects of the thesis. The role and expected input of the third assessor consists of reading the final report, attending the thesis defense session and participating in the final deliberations regarding the grade.
9. The use of assessment forms for BSc and MSc theses is mandatory in the Department of IE&IS. The Exam Committee plays an important role in determining and monitoring these assessment criteria.
10. The course administration carries out the archiving of BSc and MSc theses, including the assessment forms. If the forms are not correctly filled-in, the assessors are asked to complete this process.

3.2 Quality assurance of BSc and MSc theses

Regulations for quality assurance of BSc and MSc theses are determined and approved by the Exam Committee and the Departmental Board.

The regulations (see Appendix 4 and 5) are updated over time, and include provisions on:
- Assessment of research proposals for the school IS (*ex ante*); rejected research proposals must be adjusted before they are resubmitted to the Exam Committee;
- Appointment of the assessors for the an Thesis committee by the Exam Committee. The assessment committee for the BSc thesis consists of 2 assessors, for the MSc thesis of 3 assessors;
- Assessment forms: checking that these are correctly filled-in is carried out by the student administration, incompletely filled-in forms are sent back to the assessors;
- Assessment of the quality of the theses by (a committee of) the Exam Committee: the Exam Committee takes steps if the assessment by the committee significantly differs from that of the assessors.

3.3 Involvement of stakeholders

The best indicator of the quality of graduates from our educational programs is the time needed to find employment. In general, all students find jobs within three months, the majority in a much shorter time than that. The Department of IE&IS monitors the relevance of the educational programs to the employment market by means of regular alumni surveys and the alumni monitor.

The department set up an Advisory Board to advice on matters relating to education. This board consists partly of alumni of the educational programs. It plays an active role in considering the level and the content of the educational programs. It also maintains regular contact with alumni and alumni associations from the School, in which the alignment of the educational programs with the employment market is an important topic of discussion.

4. Innovation

The bachelor program Industrial Engineering is revised starting from September 1st 2019. There are a number of reasons for this revision. Students were feeling less challenged in the program. This was visible through the analysis of the evaluations in terms of student effort versus grades. A similar analysis will be done for the other programs (efforts, versus grades, versus challenge). Next to this, the use of Python as a key programming language throughout the program facilitates more cases and assignments involving programming.The trend within the TU/e is to have more digital examinations. This can be done by doing the exams on a laptop, but also via scanning the written examinations such that the grading can be done digitally. The TU/e is also planning to digitalize the process of putting the grade in the educational systems. There are also plans to introduce challenged-based learning. The examination committees Industrial Engineering and Innovation Sciences are aware of these projects and stay informed about the latest developments within these projects. The examination committees actively question the project owners for information, with the purpose of keeping informed. This enables to take actions when necessary, according responsibilities of the examination committee.

In every action,the examination committee reflects upon their way of working. For example, the examination committees , even though it doesn't belong to the task of the Examination Committee, are willing to inform their colleagues within the capacity groups better about the tasks of the exam committee, and about the rules and regulations which affect the staff members. All actions that are (to be) taken to improve the way of working are addressed in the year report of the examination committee. This can be used in preparation in case of a visitation. The evaluation of a visitation committee will of course be used to improve even more.

Appendix 1: Learning Outcomes Programs School of IE

BSc IE

DSFR Generic Competences	BSc IE Learning Outcomes												
	Domain-specific									General Scientific			
	D1: Scientific disciplines	**D2**: Doing research	**D3:** Designing	In conducting research in the context of these three activities, a graduate of the BSc Industrial Engineering bases his/her choices on academic knowledge of:						**G4:** Scientific approach	**G5:** Basic intellectual skills	**G6:** Co-operating and communicating	**G7:** Temporal and social context
				Mathematics, Modeling and Design	Information Systems	Operations Management	Work and Organizational Psychology	Innovation Management	Business Economics				
Sufficient understanding of science, technology and technological innovation	X				X	X		X					
Keen analytic mindset combined with a drive to synthesize towards a solution	X	X	X										
Competent in translating complex issues in workable models and design and execute appropriate research programmes	X		X	X	X	X		X					
Adequate mathematics skills for modelling and executing research activities		X		X									
Able to conduct standard experiments, tests and measurements, and to analyse and interpret and apply the results in order to improve products, processes and systems	X	X											
Able to (re)design products, processes and systems in an IE&SE context			X		X	X		X					
Adequate understanding and competences in a number of technical, economic and social	X						X		X				

disciplines to underpin research programmes													
An adequate understanding of the drivers of socio-, economic and political organizations in society													X
Able to assess the impact of IE&SE products, processes and systems in a business, societal and global context		X								X			X
Able to organize and drive for efficiency and effectiveness	X		X									X	
Resourcefulness and creative problem solving			X							X			
Excellent communication, listening, and negotiation skills							X				X		

IE MSc IM

DSFR Generic Competences	IE MSc IM Learning Outcomes						
	Domain-specific			General scientific			
	D1: Scientific disciplines	**D2**: Doing research	**D3:** Designing	**G4:** Scientific approach	**G5:** Basic intellectual skills	**G6:** Co-operating and communicating	**G7:** Temporal and social context
Sufficient understanding of science, technology and technological innovation	X						
Keen analytic mindset combined with a drive to synthesize towards a solution		X	X				
Competent in translating complex issues in workable models and design and execute appropriate research programmes		X	X				
Adequate mathematics skills for modelling and executing research activities	X	X					
Able to conduct standard experiments, tests and measurements, and to analyse and interpret and apply the results in order to improve products, processes and systems		X					
Able to (re)design products, processes and systems in an IE&SE context			X				
Adequate understanding and competences in a number of technical, economic and social disciplines to underpin research programmes	X						
An adequate understanding of the drivers of socio-, economic and political organizations in society							X
Able to assess the impact of IE&SE products, processes and systems in a business, societal and global context				X			X
Able to organize and drive for efficiency and effectiveness	X		X		X	X	

Resourcefulness and creative problem solving			x	x			
Excellent communication, listening, and negotiation skills					x		
Ability to adapt to many environments, interact with a diverse group of individuals and understand the roles of various stakeholders in the processes				x	x		
Experience in working in an interdisciplinary and international environment					x	x	
Able to identify the arising ethical dilemma and to reflect on this dilemmas							x
Total	**4**	**4**	**5**	**3**	**4**	**2**	**3**

IE MSc OML

DSFR Generic Competencies	IE MSc OML Learning Outcomes											
	Domain-specific			General scientific								
	D1: Scientific disciplines	**D2**: Doing research	**D3:** Designing	**G4***	**G5***	**G6***	**G7***	**G8***	**G9***	**G10***	**G11***	**G12***
Sufficient understanding of science, technology and technological innovation	X			X	X					X		
Keen analytic mindset combined with a drive to synthesize towards a solution		X	X	X	X	X	X	X			X	X
Competent in translating complex issues in workable models and design and execute appropriate research programmes		X	X	X								
Adequate mathematics skills for modelling and executing research activities	X	X	X	X								
Able to conduct standard experiments, tests and measurements, and to analyse and interpret and apply the results in order to improve products, processes and systems	X	X	X	X								
Able to (re)design products, processes and systems in an IE&SE context	X		X		X	X						
Adequate understanding and competences in a number of technical, economic and social disciplines to underpin research programmes	X	X		X				X				
An adequate understanding of the drivers of socio-, economic and political organizations in society										X		
Able to assess the impact of IE&SE products, processes and systems in a business, societal and global context			X		X		X	X	X	X		
Able to organize and drive for efficiency and effectiveness	X		X		X	X		X	X		X	X
Resourcefulness and creative problem solving	X	X	X	X	X	X		X			X	X

Excellent communication, listening, and negotiation skills					x	x		x	x			
Ability to adapt to many environ-ments, interact with a diverse group of individuals and understand the roles of various stakeholders in the processes					x	x		x	x	x		
Experience in working in an interdisciplinary and international environment				x	x	x		x				
Able to identify the arising ethical dilemma and to reflect on this dilemmas					x		x	x		x		
Total	**7**	**6**	**8**	**8**	**10**	**7**	**3**	**9**	**4**	**5**	**3**	**3**

* G4: Applying knowledge in research; G5: Applying knowledge in industry; G6: Operating independently and in teams; G7: Reflecting and behaving systematically; G8: Operating effectively and efficiently in multidisciplinary context; G9: Communicating; G10: Awareness of temporal and social context; G11: Entering subsequent programs requiring substantial indepence; G12: Identifying and supplementing lack of knowledge

BSc SI

BSc program Innovation Sciences - Major Psychology & Technology and Major Sustainable Innovation	Program objectives Bachelor program Innovation Sciences DSFR						
	1. Scientific Disciplines	2. Executing research, scientific approach	3. Informing design, strategy and policy	4. Learning skills	5. Co-operation & communication	6. Social context
1. Competent in scientific Disciplines	X					
2. Competent in doing research		X				
3. Competent in designing			X			
4. A scientific approach		X				
5. Basic intellectual skills				X		
6. Competent in co-operating and communicating					X	
7. Takes account of the temporal, technological and social context						X

BSc PT

BSc Psychology & Technology							
	1. Competent in scientific Disciplines	2. Competent in doing research	3. Competent in designing	4. A scientific approach	5. Basic intellectual skills	6. Competent in co-operating and communicating	7. Temporal, technological and social context
Basic courses							
2WBB0 Calculus variant 2	X			X	X		
3NxB0 Physics	X			X	X		
2IAB0 Data Analytics for Engineers	X	X	X	X	X		
0SAB0 USE				X	X	X	X
4WBB0 Design			X	X	X	X	
Cognition and Social Interaction							
0HV30 Social Psychology & Consumer Behavior	X	X				X	X
0HV60 Thinking and Deciding	X	X	X	X	X	X	
0HV80 HTI in Social context	X		X	X	X	X	X
Brain Perception Action							
0HV40 Brain Body Behavior	X	X	X	X	X	X	
0HV20 Perception & Motor Control	X	X		X	X	X	
0HV100 Human Factors	X	X	X	X	X	X	X
Research Methods							
0HV00 RM1: Designing Research	X	X		X	X	X	
0HV50 RM2: Dealing with data	X	X		X	X	X	
0HV110 RM3: Advanced RM and Research ethics	X	X		X	X	X	X
Technical courses							
0HV120 Programming for P&T	X		X				
Technical major courses (20 ec)	X			X		X	
Technical electives (min 15 ec)	X			X		X	
Integration courses							
0HV10 Introduction P&T	X	X		X	X	X	
0HV70 OGO Qualitative Research	X	X	X	X	X	X	
0HV90 OGO Quantitative Research	X	X	X	X	X	X	
0BEPP0 BSc Final Project	X	X	X	X	X	X	X

MSc HTI

MSc program Human-Technology Interaction	Program objectives Master program Innovation Sciences DSFR						
		1. Scientific Disciplines	2. Executing research, scientific approach	3. Informing design, strategy and policy	4. Learning skills	5. Co-operation & communication	6. Social context
	1. Scientific disciplines	X					
	2. Competent in doing research		X				
	3. Competent in designing			X			
	4. A scientific approach		X				
	5. Basic intellectual skills				X		
	6. Competent in co-operating and communicating					X	
	7. Takes account of the temporal, technological and social context						X

MSc IS

MSc program Innovation Sciences	Program objectives Master program Innovation Sciences DSFR						
		1. Scientific Disciplines	2. Executing research, scientific approach	3. Informing design, strategy and policy	4. Learning skills	5. Co-operation & communication	6. Social context
	1. Scientific disciplines	X					
	2. Competent in doing research		X				
	3. Competent in designing			X			
	4. A scientific approach		X				
	5. Basic intellectual skills				X		
	6. Competent in co-operating and communicating					X	
	7. Takes account of the temporal, technological and social context						X

APPENDIX 2a: profile of the examiners of the School of IE

Bachelor End Project

A person with the status of Postdoc, Assistant-, Associate-, Full Professors or Lecturer can only act as examiner of Bachelor end projects if they have sufficient experience with supervising Bachelor End Projects in the School of IE at TU/e, i.e.:

Staff members hired on or after 01-09-2018:

- ☐ either passed the course 'supervising Bachelor End Projects' or have obtained their BKO; *and*
- ☐ have supervised at least two Bachelor End Projects in the School of IE at TU/e in the past two years under the responsibility of a qualified examiner.

Staff members hired before 01-09-2018:

- ☐ have supervised at least two Bachelor End Projects in the School of IE at TU/e in the past five years as a qualified examiner; *or*
- ☐ have supervised at least two Bachelor End Projects in the School of IE at TU/e in the past two years under the responsibility of a qualified examiner.

Master thesis projects

A person with the status of Postdoc, Assistant-, Associate-, Full Professor or Lecturer can only act as examiner of Master thesis projects if they have sufficient experience with supervising Master Projects in the School IE at TU/e, i.e.:

Staff members hired on or after 01-09-2018:

- ☐ either passed the course 'supervising Master Theses' or have obtained their BKO or; *and*
- ☐ has supervised at least two Master Theses in the School of IE at TU/e in the past two years under the responsibility of a qualified examiner.

Staff members hired before 01-09-2018:

- ☐ has supervised at least two Master Theses in the School of IE at TU/e in the past five years as a qualified examiner; *or*
- ☐ has supervised at least two Master Theses in the School of IE at TU/e in the past two years under the responsibility of a qualified examiner.

For persons who do not meet these criteria, a motivated request can be made to the Exam Committee by a Capacity Group Chair, to let them act as examiners. The Exam Committee will evaluate the request primarily based on the requirements that the person must have a PhD degree and meet an equivalent of the experience criteria outlined above. Master thesis assessment committees may contain max only 1 assessor that is not a qualified examiner.

APPENDIX 2b: profile of the examiners of the School of IS

The purpose of this document is to determine the rules whether teachers of the Bachelor programs Psychology & Technology (BPT) and Sustainable Innovation (BSI) and de Master programs Human-Technology Interaction (HTI) and Innovation Sciences (IS) can have examination authority. This is important to secure the quality of these educational programs.

Examination authority in the Bachelor programs Psychology & Technology (BPT) and Sustainable Innovation (BSI)

The following employees teaching in the Bachelor programs are **in principle** examiner: assistant professors, associate professors, and full professors.
For the following functions extra demands for nomination are required to determine the qualification to supervise a Bachelor End project

PhD:

Can exclusively be appointed as a second assessor for the Bachelor End project when he/she has done the BEP course of TEACH with a positive result and has completed two internships at a BEP project.

Postdocs and researchers:

Can be appointed as first or second assessor at a Bachelor End project when he/she has started his/her BKO trajectory and has completed an internship at a BEP project, or when he/she has done the (preferable) BEP or Master course of TEACH with a positive result and has completed two internships at a BEP project.

Other functions:

For other functions a request can be handed in. He/she at least has to have done the (preferable) BEP or Master course of TEACH with a positive result and has completed two internships at a BEP project.

Qualification of Exams in the Master programs HTI and IS

The following employees teaching in the master programs are **in principle** examiner: assistant professors, associate professors, and full professors.
For the following functions extra demands for nomination are required to determine the qualification to supervise a Master thesis project

PhD:

Can exclusively be appointed as a second assessor for the master thesis project when he/she has done the (preferable) BEP or master course of TEACH with a positive result and has completed two internships at a master thesis project.

Postdocs and researchers:

Can be appointed as first or second assessor (never third assessor) at a master thesis project when he/she has started his/her BKO trajectory and has completed an internship at a master thesis project, or when he/she has done the (preferable) BEP or master course of TEACH with a positive result and has completed two internships at a master thesis project. A postdoc can be examiner for courses when he/she is brought forward by the mentor and is approved by the Examination Committee IS.

Other functions:

For other functions a request can be handed in. He/she at least has to have done the (preferable) BEP or master course of TEACH with a positive result and has completed two internships at a master thesis project.

Definition internship: he/she shadowed an authorized examiner with a TU/e BEP-project.

Appendix 3: Profile of chair, vice-chair and members of the Exam Committee (May 2013)

Chair

- Final responsibility for carrying out the tasks of the Exam Committee and the policies as defined by the committee as a whole
- Representing the Exam Committee (mandate to the chair if decisions need to be taken rapidly with accountability)
- Chairing meetings
- Signing diplomas
- Specific activities/action points of the Exam Committee
- Final responsibility for annual reports and the annual plan of the Exam Committee
- Deciding vote on resolutions if there is no majority
- Member of the Central Exam Committee Bachelor College (AEB) and of the Central Exam Committee Graduate School (AEM)

- Personal characteristics:
    - Acts effectively
    - Able to take decisions
    - Tactical
    - Takes the initiative
    - Good communication and social skills

Vice-chair

- Supports and when necessary deputizes for the chair
- Together with the secretary ensures that specific educational data is available when needed
- Deals with individual requests and elective packages
- Personal characteristics:
    - Tactical
    - Structured
    - Persuasive
    - Good communication and social skills

Full Exam Committee

- Participation in hearings (fraud, appeal): the chair and at least 1 member of the Exam Committee must participate. In case of appeals to the Executive Board: hearings with the student and lecturer to investigate possible friendly settlements and, if no agreement is reached, the subsequent hearing before the Executive Board.
- Determining the guidance in case of requests (policy-making)
- Jointly defining the quality system in relation to examination content and organization
- Promoting his/her own expertise in relation to membership of the Exam Committee
- Personal characteristics:
    - Examination expert; at least one member of the Exam Committee
    - Educational expert
    - Sensitive to the working environment
    - Knowledge of relevant legislation and regulations
    - Advisory skills

Secretary

- Scheduling consultation meetings and hearings; coordinating the agenda with the chair
- Making available information so that the Exam Committee can take soundly based decisions

- Making available data for the annual report
- Writing minutes of the meetings
- Attending consultation meetings with the secretary of the Central Exam Committee
- Dealing with decisions of the Exam Committee
- Handling correspondence
- Providing administrative support and advice; not authorized to take decisions
- All 'standard' tasks of the Exam Committee may be delegated to the course administration (study packages, dispensations, examination results etc.), and therefore do not need to be dealt with specifically by the secretary; there must be a structured method within the Exam Committee for making available data which the Exam Committee needs as standard (what/when) from the course administration. This will allow a standard set of data to be built up

- Personal characteristics:
    - Structured
    - Accurate
    - Knowledge of relevant legislation and regulations
    - Concise
    - Consistent
    - Careful and thorough

Advisory members

- Study advisors:
    - Structural advisory tasks (not relating to decisions or policy-making) on individual requests

- Examination expert:
    - sits together with the teacher to assess the examination, when asked by the examination committee or by the teacher.

Appendix 4: Quality assurance of BSc theses

Regulations for quality assurance of BSc theses

1. A research proposal for a BSc thesis must have a predefined format. Each proposal is assessed by a staff member who is authorized to take examinations.
2. The Exam Committee appoints a second assessor for all Final BSc projects.
3. Both the first and second assessors are authorized to take examinations.
4. The tasks and responsibilities in the BSc Thesis Thesis committee are:
    a. The first member of the BSc Thesis Assesment Committee is the supervising mentor who is denominated as the first assessor;
    b. The BSc mentor can be a PhD candidate, under the condition that he/she has sufficient seniority by having successfully followed the TEACH course 'supervising BSc students' and is coached by a qualified faculty member. In case the BSc mentor is a PhD candidate, the assessment form can only be signed by the qualified faculty member. He/she has to be present at the final presentation.
    c. The second member of the BSc Thesis committee acts as an assessor. The assessor can be from any research chair. The role of the assessor is to guarantee the end terms of the Bachelor End Project. The project of the student has to fit within these terms. This is only possible when the assessor is involved in judging the research proposol. So the assessor has a role as well in the beginning as in the end of the project.
    d. The role and expected input of the second BSc thesis assessor is that he/she receives the report and determines what grade he/she would give for the thesis (not the professional skills). He/she does not have to be present at the final presentation. Both mentor/1st assessor and 2nd assessor provide a grade on the written thesis in writing, after which the grade for the written thesis is determined after discussion. The final grade for the BSc project is determined by the mentor.

5. The Exam Committee may take further action if it considers it necessary to do so on the basis of the assessments of the first and second assessors.
6. The assessment of the BSc thesis is carried out on the basis of a completely filled-in assessment form. The first assessor hands-in this filled-in form to the course administration.
7. The grades for the BSc thesis are not official until the assessment form has been received by the course administration. The course administration keeps a list of the BSc theses that have been handed-in and the corresponding assessment forms.
8. BSc theses are in principle confidential, and are collected and kept by the course administration.

Appendix 5: Quality assurance of MSc theses

School of IE: Regulations for quality assurance of MSc theses in Operations Management & Logistics (OML), including MSE special track, and Innovation Management (IM)

1. Research proposals are written by students and assessed by the mentor (first assessor) and the second supervisor (second assessor). If they commit themselves to a project, both sign a start form.
2. The Examinations Committee of Innovation Sciences assesses the submitted graduation proposals for the School IS during the examination meeting, with the approval of the supervisors.
    a. A graduation proposal may be approved or rejected; the Examinations Committee will support the rejection of a graduation proposal with reasons.
    b. If a graduation proposal is rejected, a modified proposal must be submitted for assessment to the Examinations Committee.
3. For all graduation projects the Exam Committee appoints an Thesis committee.
4. The members of the thesis committee are to be selected in accordance with the criteria set by the Exam Committee for authorizing examiners.
5. The tasks and responsibilities in the MSc Thesis Thesis committee are:
    a. The first member of the MSc Thesis Thesis committee is the supervising mentor who is qualified by the Exam Committee and acts as the first assessor;
    b. The second member of the MSc Thesis Thesis committee can be from any research chair and acts as an assessor;
    c. The third member of the MSc Thesis Thesis committee acts as an assessor
    d. Each member of the thesis committee provides a grade for the written thesis in writing. The assessor determines what grade he/she would give for the thesis (not the process and other skills)
    e. The role and expected input of the third MSc thesis assessor consists of reading the final report, attending the thesis defense session and participating in the final deliberations regarding the grade.
6. The Exam Committee may take further action if it considers it necessary to do so on the basis of the assessments of the Thesis committee.
7. The assessment of the thesis is carried out on the basis of a completely filled-in assessment form. The first assessor hands-in this filled-in form to the course administration.
8. The grades for the thesis ate not official until the assessment form has been received by the course administration. The course administration keeps a list of the MSc theses that have been handed-in and the corresponding assessment forms.
9. MSc theses are public and are kept in the library. For this reason an MSc theses must be a complete and legible report. The MSc thesis assessment form includes a part in which the first assessor has to give agreement for the copies which are provided to the library.