SYSTEMS ENGINEERING, POLICY ANALYSIS AND MANAGEMENT

FACULTY OF TECHNOLOGY, POLICY AND MANAGEMENT

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This report was finalised on 28 March 2017

REPORT ON THE MASTER'S PROGRAMME SYSTEMS ENGINEERING, POLICY ANALYSIS AND MANAGEMENT OF DELFT UNIVERSITY OF TECHNOLOGY

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point (19 December 2014).

ADMINISTRATIVE DATA REGARDING THE PROGRAMME

Master's programme Systems Engineering, Policy Analysis and Management

Name of the programme:	Systems Engineering, Policy Analysis and Management
CROHO number:	60358
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Location(s):	Delft
Mode(s) of study:	full time
Language of instruction:	English
Expiration of accreditation:	31-12-2017

The visit of the assessment panel Technische Bedrijfs- en Bestuurskunde to the Faculty of Technology, Policy and Management of Delft University of Technology took place on 12 and 13 December 2016.

ADMINISTRATIVE DATA REGARDING THE INSTITUTION

Name of the institution:	Delft University of Technology
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

COMPOSITION OF THE ASSESSMENT PANEL

The panel that assessed the master's programme Systems Engineering, Policy Analysis and Management consisted of:

- Prof.dr ir. Rob van der Heijden, Radboud University Nijmegen [chair];
- Prof.dr. Harrie Eijkelhof, Utrecht University;
- Prof.dr. Arthur Petersen, University College London, United Kingdom;
- Prof.dr. Marcel Veenswijk, VU University Amsterdam;
- Prof.dr. Hens Runhaar, Wageningen University and Research & Utrecht University
- Maarten van Ruitenbeek, BSc, University of Groningen [student member].

The panel was supported by dr. Barbara van Balen, who acted as secretary. Appendix 1 contains the curricula vitae of the panel members.

WORKING METHOD OF THE ASSESSMENT PANEL

Cluster
The master's programme Systems Engineering, Policy Analysis and Management at the Delft University of Technology (hereafter: TU Delft) was assessed as part of the Industrial Engineering and Management and Systems Engineering, Policy Analysis & Management cluster. This cluster encompasses eleven programmes at four universities: Delft University of Technology, University of Groningen, Twente University of Technology and Eindhoven University of Technology. TU Delft served as the first point of contact and secretary on behalf of all four universities. Dr. E. Schröder, project manager at QANU, assisted the cluster with organisational and practical matters.

The project manager approached independent panel members based on the programmes' recommendations, taking into account the specialised tracks at the four institutions. The NVAO approved the panel composition on 10 October 2016. The cluster panel consisted of the following members:

- Prof.dr.ir. Rob van der Heijden, Radboud University Nijmegen [chair];
- Prof.dr. Harrie Eijkelhof, Utrecht University;
- Prof dr. Erik Demeulemeester, KU Leuven, Belgium;
- Prof.dr. Jan Kratzer, Technische Universität Berlin, Germany;
- Prof.dr. Arthur Petersen, University College London, United Kingdom;
- Prof.dr. Marcel Veenswijk, VU University Amsterdam;
- Prof.dr Hens Runhaar, Wageningen University and Research & Utrecht University;
- Prof.dr. Emmo Meijer, Eindhoven University of Technology;
- Dr. Margriet Nip, Tata Steel;
- Dr. Hector Ramirez Estay, Université de Franche-Comté, France;
- Maarten van Ruitenbeek, BSc, University of Groningen [student member];
- Sofie Vreriks, BSc, University of Twente [student member].

Prof.dr ir. Rob van der Heijden acted as panel chair during all four site visits. Prof.dr. Harrie Eijkelhof, an education expert with a long-standing academic career in the teaching of science, also agreed to partake in all four assessments. Two QANU secretaries were appointed to assist the panel during site visits: QANU project manager dr. Els Schröder and dr. Barbara van Balen, independent NVAO-certified secretary. Calibration meetings took place on 15 December 2016 and 22 March 2017 between prof.dr.ir. Van der Heijden, prof.dr. Eijkelhof and both secretaries to attune the panels' findings to assure consistency of the assessments within the cluster.

Site visit TU Delft

Preparation
To prepare for the assessment, the management provided a critical reflection on each master's programme. In them, the management described the current state of affairs and provided useful information for the assessment of its programmes. The project manager checked the report for completeness of information before sending it to the panel members. In consultation with the chair, the secretary also selected 15 master's theses, covering the full range of marks given, a range of thesis subjects, and representing the various examiners and master's tracks.

Site visit
A site visit to the Faculty of Technology, Policy and Management at TU Delft took place on 12 and 13 December 2016 in the presence of all six panel members, assisted by an NVAO-certified secretary. Prior to the site visit, the panel asked the programme to select representative interview partners. It met during the site visit with the programme management, current students, staff, alumni, members of the examination board and members of the programme committee of the programme. For the timetable of the site visit, see Appendix 5.

The panel also examined relevant study material, assessment forms and additional material during the site visit. This material is listed in Appendix 6. The panel provided students and lecturers with an opportunity to meet informally during a consultation hour outside the set interviews. No requests were received for this option. The panel used the final part of the visit for an internal meeting to discuss its findings. The visit concluded with an oral presentation of the preliminary impressions and general observations by the chair of the panel. This presentation was open to all.

Report
Based on the panel's findings, a draft report was prepared by the secretary. All panel members commented upon the draft report, and their comments were incorporated accordingly. Subsequently, the programme checked it for factual irregularities. Comments by the programme were discussed by the secretary and chair and, where necessary, other panel members before the report was finalised.

Decision rules
In accordance with the NVAO's Assessment framework for limited programme assessments, the panel used the following definitions for the assessment of both the standards and the programme as a whole.

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

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

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

Good
The programme systematically surpasses the current generic quality standard.

Excellent
The programme systematically well surpasses the current generic quality standard and is regarded as an international example.

SUMMARY JUDGEMENT

Standard 1
The master's programme Systems Engineering, Policy Analysis and Management (SEPAM) offered by Delft University of Technology (TU Delft) educates students as designers and managers of large-scale and complex multi-actor systems within a technology domain. The SEPAM programme is meant to give students tools to design solutions for large, complex, contemporary, socio-technical problems that are acceptable to all stakeholders. The programme has a distinctive focus on design for large-scale systems and complex, multi-actor systems. The panel clearly recognised the added value of the combination of engineering, social sciences and management in the programme. The general learning outcomes have been elaborated in well-defined and detailed learning outcomes, which meet the Dutch qualifications framework and tie in with the international perspective of the requirements set by the professional field and the discipline.

The SEPAM programme recently changed from a transfer master's programme for graduates of the bachelor's programme Technische bestuurskunde into one of the three master's programmes offered by the Faculty of Technology, Policy and Management (TPM). This change required rethinking the profile of the programme in order to distinguish it more clearly from the other master's programmes. The panel endorses the Faculty's plan to change the programme's title into 'Complex Systems Engineering and Management'.

Standard 2
The SEPAM programme is aimed at teaching students to analyse complex, contemporary, socio-technical problems both quantitatively and qualitatively and design new solutions acceptable to all stakeholders. In the first year, the students learn the foundations of design from a systems engineering and multi-actor perspective. The second year focuses on specialisation within the field, and the preparation and writing of the master's thesis. Students can specialise in one of the four tracks offered: Built Environment & Spatial Development (B&S), Energy and Industry (Energy track), Information & Communication, Transport & Logistics.

The panel established that the content and structure of the master's programme Systems Engineering, Policy Analysis and Management enable the students to achieve the intended learning outcomes, while also offering ample opportunity for creating an individual profile based on electives and specialisation tracks. The panel advises broadening the focus of the social sciences courses and adding literature with other perspectives (and schools) to the core of the social sciences syllabi. The quality of the teaching staff is good. They are accessible and create a good learning environment for the students, supported by the good facilities of the Faculty building.

Almost 50% of the students spend at least one semester abroad as an exchange student. The programme has succeeded in building a stimulating international environment, by attracting foreign students as well as by encouraging Dutch students to take parts of their studies abroad. With the SEPAM programme, TU Delft offers an attractive master's option for both students from the Netherlands as wider afield.

Standard 3
The Faculty of Technology, Policy and Management (TPM) described its assessment policy in the Assessment Policy 2013-2014 document. The panel studied a selection of test dossiers and master's theses and the accompanying assessment forms. Furthermore, it held a meeting with the Board of Examiners during the site visit. It verified that the programme has an adequate assessment system. The assessments are valid, transparent and reliable. The Board of Examiners is performing its legally mandated tasks adequately.

Standard 4
The panel studied a selection of 15 master's theses to assess whether the graduates had achieved the master's graduation level. It concluded that the graduates had demonstrated that they had

achieved the level that can be expected from an academic master. It noticed, however, that the master's thesis topics of this programme were not clearly distinctive from the topics chosen by the EPA master's students.
Furthermore, the panel concluded that master's graduates are highly appreciated in the professional field and that they easily embark on promising professional and academic careers, in which their academic profile and skills are valued.

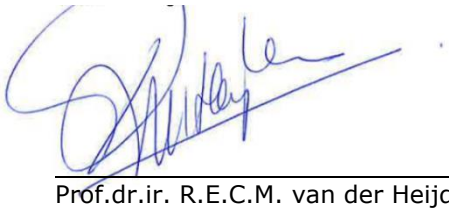
The panel assessed the standards from the *Assessment framework for limited programme assessments* in the following way:

Master's programme System Engineering, Policy Analysis and Management:

Standard 1: Intended learning outcomes	good
Standard 2: Teaching-learning environment	good
Standard 3: Assessment	satisfactory
Standard 4: Achieved learning outcomes	satisfactory
General conclusion	satisfactory

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

Date: 28 March 2017



Prof.dr.ir. R.E.C.M. van der Heijden

dr. B.M. van Balen

DESCRIPTION OF THE STANDARDS FROM THE ASSESSMENT FRAMEWORK FOR LIMITED PROGRAMME ASSESSMENTS

The master's programme Systems Engineering, Policy Analysis and Management (SEPAM) is offered by the Faculty of Technology, Policy and Management at Delft University of Technology (TU Delft). The SEPAM programme started formally in 2001 as the '*doorstroom*' (transfer) master's programme, when the original programme was separated into a bachelor's and master's programme following the Bologna agreements. Starting in 2016, SEPAM is also accessible for students with a monodisciplinary engineering degree or a degree in natural science.

The Faculty also offers one bachelor's programme *Technische bestuurskunde* and two other master's programmes: Engineering and Policy Analysis (EPA) and Management of Technology (MOT). The assessments of these programmes are described in separate reports.

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

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

Findings
SEPAM educates students as designers and managers of large-scale, complex, multi-actor systems within a technology domain. It teaches them to analyse complex, contemporary, socio-technical problems both quantitatively and qualitatively and design new solutions acceptable to all stakeholders. The SEPAM technology domains are the same as those in the bachelor's programme: Built Environment and Spatial Development, Energy and Industry, Information and Communication, and Transport and Logistics. The SEPAM programme is meant to give students the tools to design solutions for large, complex, contemporary, socio-technical problems, such as the implementation of electric transportation on a large scale.

The critical reflection stated that graduates have the ability to act autonomously in planning and implementing tasks at a professional level, design solutions, manage the change process, and think critically about the proposed solutions to real-world problems. They act as comprehensive engineers by approaching an assignment not simply as a technical challenge, but also by including numerous stakeholders' preferences and institutional and ethical considerations.

The following general intended learning outcomes are summarised in the critical reflection.
A SEPAM engineer:

1. knows how to intervene in real-world decision-making processes to establish a coherent combination of institutional arrangements and technical system design;
2. is able to identify the ethical dilemmas and to reflect on them;
3. is able to deal with complex issues both systematically and creatively, make sound judgments in the absence of complete data, and communicate his or her conclusions clearly to specialist and non-specialist audiences, both academic and professional;
4. is able to demonstrate self-direction and originality in tackling and solving problems, and acts autonomously in planning and implementing tasks at a professional or equivalent level;
5. is able to work well in interdisciplinary teams;
6. is able to present the results both in writing and orally, including in a scientific article.

These general learning outcomes have been elaborated in detailed intended learning outcomes (Appendix 3). The panel was impressed by the thorough translation of the mission and objectives of the programme into the intended learning outcomes. The intended learning outcomes are transparent and informative and indicate what can be expected from a master's level programme.

The panel ascertained that the intended learning outcomes meet the internationally accepted standards for academic master's programmes, the Dublin descriptors. The programme management specified in the critical reflection that the learning outcomes were formulated in accordance with the Meijers Criteria[1], which are used by degree programmes of universities of technology in the Netherlands to indicate the academic level to be achieved.

The students motivated their choice for the master's programme SEPAM by their preference for the design approach. The programme prepares them for a broad range of opportunities in the labour market. The alumni data demonstrate that SEPAM graduates very easily find jobs in their field of expertise. Alumni feel that the SEPAM programme has a balanced combination of engineering, social sciences and management. The panel sees added value in this combination and the multidisciplinary basis of the degree programme. These objectives are very well translated in the intended learning outcomes and in the courses on offer.

In the critical reflection, the SEPAM programme is compared to the Technology and Policy Programme of Massachusetts Institute of Technology (MIT), the Engineering and Public Policy Programme of Carnegie Mellon University (CMU), and the Management Science and Engineering Programme of Stanford University. These programmes also focus on complex systems engineering. Other programmes, e.g. University of Virginia, University of Waterloo and National University of Singapore, focus more on the optimisation of commercial processes. The SEPAM programme covers the Great Challenges of the 21st century posed by large-scale, interconnected, highly complex and dynamic, socio-technical systems as its points of departure. It is clear to the panel that the SEPAM programme can compare itself to the degree programmes of highly esteemed universities. The programme is focused on global developments and attracts international students because of its systems and design perspective. Although not completely unique, it is attractive for international students. During the site visit these students mentioned that the high international ranking of TU Delft also helped them choose this programme.

To the interviewed students, the difference in profile between the master's programmes EPA and SEPAM was clear enough to allow them to make a deliberate choice. To the panel, however, the difference was not obvious after studying master's theses from both programmes. Some master's theses from one programme could have been written by students from the other programme. In discussion with the management and the teachers, it became clear that the distinction between the two programmes could be articulated better. The necessity to distinguish became prominent only recently. In previous years, the programmes were aiming at different audiences, as SEPAM was originally the transfer master's programme for the bachelor Technische bestuurskunde graduates and EPA aimed at graduates from international monodisciplinary engineering and natural sciences bachelor's programmes.

For several years, SEPAM was a transfer master's programme with a unique policy profile - for the Netherlands - which is appreciated by the panel. With regard to the recent changes, the panel endorses the Faculty's plans to change the title of the programme into 'Complex Systems Engineering and Management'. It corresponds with the clear, distinctive profile that the Faculty has developed for the programme.

[1] The Meijers Criteria were specifically developed for degree programmes of the universities of technology to supplement the Dublin descriptors. Meijers, A.W.M., C.W.AM. van Overveld & J.C. Perrenet (2005), Academic Criteria for Bachelor and Master Curricula, TU Delft, TU/e & University of Twente.

The programme assessed by the panel has a balanced combination of engineering and social/political sciences. The objectives of the programme are very well translated in the intended learning outcomes and in the courses on offer.

Considerations
The panel considers it very positive that the master's programme SEPAM has a distinctive focus on large-scale systems and complex, multi-actor systems with an emphasis on design. It clearly recognised the added value of the combination of engineering, social sciences and management. It greatly appreciated that the general learning outcomes are elaborated in well-defined, detailed learning outcomes. It encourages the programme to develop a clear, distinctive profile in line with the proposed new title, 'Complex Systems Engineering and Management'.

SEPAM can compare itself to programmes offered by highly esteemed universities like MIT and is an attractive master's programme for students interested in complex systems, technology and design.

The panel concluded that the intended learning outcomes meet the Dutch qualifications framework and tie in with the international perspective of the requirements set by the professional field and the discipline. They fit the Domain-Specific Framework of Reference developed by the Dutch programmes for Industrial Engineering and Management.

Conclusion
The panel assesses Standard 1 as 'good'.

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

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

Findings
The SEPAM programme consists of 120 EC. Students learn to analyse complex, contemporary, socio-technical problems both quantitatively and qualitatively and design new solutions acceptable to all stakeholders. The programme explores the innovations in complex socio-technical environments and educates the students to think about more than technology alone. They learn to deal with matters such as existing regulations, subsidies and infrastructure systems, as well as ethical issues, different stakeholder interests, cultures and behaviour. The programme has an international character, which is appreciated by the panel.

The first year starts with an intensive one-week introduction to typical SEPAM problems. This introduction is followed by two large (8 EC each) courses aimed at teaching the design foundations from systems engineering and multi-actor perspectives. The first semester concludes with a course in which the two perspectives are integrated. In the second semester the foundations are built on in the Strategic Management of Large Engineering Projects course. The systems engineering and multi-actor aspects are used for the courses in the four technology domains. The ethical and legal aspects of design are discussed in two separate courses. The SEPAM design project at the end of the first year integrates the technology domain, systems engineering and multi-actor perspectives.

The second year focuses on specialisation within the field, and on the preparation and writing of the master's thesis. During the second year 9 EC can be filled with electives and specialisation

modules added for a total of 15 EC. The choice of the specialisation modules depends on the topic of the thesis research project. The only obligatory course in the third semester is the 6 EC master's thesis preparation course. This course can be followed online by students going abroad during their third semester. The panel appreciates that students have ample opportunity to diversify their studies in their second year based on their interests and thesis research project, creating an individual profile within the field. In its eyes, the curriculum design enables students to meet the intended learning outcomes.

Students can specialise in one of the four tracks offered: Built Environment & Spatial Development (B&S), Energy and Industry (Energy track), Information & Communication, Transport & Logistics. According to the panel 'Built Environment & Spatial Development', the field that was introduced last in the programme, is strongly focused on issues of spatial development. As a result, the technical complexity of this specialisation seems slightly underdeveloped compared to the other three specialisations. The panel suggests switching the focus in this domain to the major challenges in the built environment regarding sustainable building, including issues such as the planned energy transition, functional transformation of existing buildings, and reuse and recycling of materials. Nonetheless, the panel appreciates the diversity of tracks on offer and considers all suitable and relevant for the field.

Almost 50% of the students spend at least one semester abroad as an exchange student, which is considered a strong feature of the programme by the panel Many foreign students also take parts of their studies at Delft. Students report that they chose SEPAM because of the emphasis on 'hard' subjects and designing. Not many universities offer such master's programmes. The panel spoke with foreign SEPAM students who mentioned that they were attracted to the programme because of its unique combination of engineering, social sciences and management. They describe TU Delft as an open community for foreign students, a real international environment where they feel well supported with organising the practical affairs of studying in Delft.

The panel studied some course files of the master's programme and noted that the literature used in the social sciences courses seems slightly biased and mainly includes the basics of cultural studies. It discussed this issue with the teachers, who mentioned that additional critical literature is discussed in these courses, along with the books and articles the panel saw in the course dossiers. This answer met the panel's concerns regarding the level of the current courses at a more informal level. Nevertheless, the panel recommends formally reconsidering the content of these courses and adding more critical reflections upon and approaches to the social sciences to the core to avoid the risk that the content of these courses remains monoparadigmatic.

Since all staff members of the Faculty are involved in all degree programmes, it is not possible to give a student-staff ratio for one of the programmes. The critical reflection presents a student/staff ratio of 21.3 for the whole Faculty. Based on their observations during the site visit, the quantity of staff at SEPAM is, in general, sufficient to create a stimulating learning environment for students.

The panel noted that the staff is really involved with teaching and coaching and is accessible to the students. Their doors are open, and staff and students are frequently present in the Faculty building. All members of the teaching staff are UTQ (University Teaching Qualification) qualified or are busy taking the courses needed for the qualification. All members of the teaching staff hold a master's degree and are tenured, and almost all module managers have PhDs. Some 80% of the teachers fulfil the English language proficiency requirements. The quality of the teaching is regularly monitored. An essential component of this monitoring is to ask students their opinions after all courses. After each evaluation, the teachers reflect on the outcomes and propose improvement measures. The panel considers the staff qualified and well-prepared for their teaching responsibilities.

The panel toured the Faculty building and established that the study environment is very stimulating and aids to students meeting the intended learning outcomes. Students have ample

room and facilities to study, to cooperate in study groups and to meet each other and their teachers. They are actively involved in the programme. Each degree programme of the TPM Faculty has its own Board of Studies (BoS), on which both teachers and students participate. The BoS monitors the quality of the teaching and advises on matters relevant to the programme. Members of the faculty-wide study association participate on the Faculty board and the BoS and actively contribute to the process of evaluation and improvement of the programme. The study association also organises excursions to industry and lectures by representatives of the work field.

Considerations
The panel established that the content and structure of the master's programme SEPAM enable the students to achieve the intended learning outcomes. It assessed the content, the coherence, the teaching methods and the feasibility of the programme, as well as the quantity and quality of the teaching staff. The quality of the teaching staff is good. The teaching staff is accessible and creates a good learning environment for the students, supported by the good facilities of the Faculty building.

The panel verified that the curriculum design enables students to meet the intended learning outcomes, while also offering ample opportunity for creating an individual profile based on electives and specialisation tracks. The panel appreciates the diversity of tracks on offer in the SEPAM programme. There is some room for improvement regarding the newest track, focusing on the domain of Built Environment & Spatial Development. The panel recommends to focus in this track more explicitly on the technological challenges related to the creation of a more sustainable built environment to further raise its technological complexity. Furthermore, the panel advises to introduce additional material in the syllabus of the social sciences courses to represent the various takes and opinions within the available literature in order to strengthen the courses' critical approach.

With the SEPAM programme, TU Delft offers an attractive master's programme for students from the university itself as well as for foreign students. The programme has succeeded in building an international, stimulating environment, by attracting foreign students as well as by encouraging Dutch students to do part of their studies abroad. The panel verified that students of the programme take the offered opportunities and partake in international exchange, both in Delft and abroad, and that therefore SEPAM enjoys the advantages of being a truly international community.

Conclusion
The panel assesses Standard 2 as 'good'.

Standard 3: Assessment
The programme has an adequate assessment system in place.

Explanation:
The tests and assessments are valid, reliable and transparent to the students. The programme's examining board safeguards the quality of the interim and final tests administered.

Findings
The Faculty of Technology, Policy and Management (TPM) has described its assessment policy in the Assessment Policy 2013-2014 document. The document describes the current and the desired situation with regard to the roles and tasks of several bodies in the Faculty. The Faculty's assessment policy has evolved during the assessment period and now includes measures concerning the transparency, validity and reliability of assessment.

Transparency of assessment is achieved by course guides providing the necessary information about examinations, a Master Thesis Assessment Guide, and the availability of examples of earlier exams. The validity is achieved by peer-reviewed preparation of exams and the use of assessment

plans for each module. Reliability is achieved by having a graduation committee of three staff members assess the theses and by using plagiarism detection programmes.

The panel studied a selection of test dossiers and of master's theses and the accompanying assessment forms. It met with the Board of Examiners during the site visit. It established that the Faculty has an adequate assessment policy in place.

According to the panel, the Board of Examiners (BoE) is performing its legally mandated tasks adequately. During the site visit the BoE presented a clear vision of its role to the panel. The BoE chair explained that the BoE does not have the ambition to check every examiner and every teacher, but prefers to take an advisory position. The panel sees some risks in this position and recommends the BoE to pay attention to the prescribed independence of the BoE.

The students reported that the testing and assessment procedures are transparent; they know in advance how they will be tested and what the criteria are. The quality of tests and examinations is included in the regular student evaluation procedure. In general, the students were satisfied with the tests and the examinations.

Master's thesis research projects are always assessed by a committee of at least three academic staff members. The committee meets at least four times during the project: kick-off, mid-term, green light, and thesis defence. The process is administered using prescribed forms. The thesis examiners use a grading scheme (rubric) to ensure that the grades are balanced and the intended learning outcomes are achieved.

As of 2011, two thesis reviews are performed annually. One of the reviews is performed by the BoE. This review focusses on the reliability of the assessment of the theses. The second review is performed by the Director of Studies, at the request of the BoE, and concerns the extent the theses fit the intended learning outcomes. Furthermore, every two years an independent committee is appointed by the BoE to assess and benchmark the grading of masters' theses of the Faculty's three master's programmes.

Considerations
The panel established that the Faculty of Technology, Policy and Management of TU Delft has an adequate assessment system. The assessments are valid, transparent and reliable. The Board of Examiners is performing its legally mandated tasks adequately.

Conclusion
The panel assesses Standard 3 as 'satisfactory'.

Standard 4: Achieved learning outcomes
The programme demonstrates that the intended learning outcomes are achieved.

Explanation:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes.

Findings
The SEPAM master's thesis project comprises 30 EC. Students can find all the information, rules and regulations concerning the thesis work on the online Graduation Portal. All students must write a scientific paper as part of their master's thesis. The critical reflection reported that several of these theses have provided the basis for academic papers published in journals or presented at conferences and that several awards were granted.

The panel studied 15 master's theses to establish whether the graduates had achieved the intended learning outcomes of the programme and found that they had achieved the level that can be expected of a master graduate. The panel found the level of the master's theses to be good and agreed generally with the grading. It had one general remark concerning the length of the theses; several of the theses significantly exceeded 100 pages. It discussed this remark with the teachers and the Board of Examiners. This discussion did not lead to a consensus opinion, and the panel recommends limiting the size of the master's theses by setting a maximum length.

The studied theses demonstrated a good mastery of scientific theory. The panel was satisfied with the quality of the analyses and the presentation of the research results. In its view, the students posed relevant research questions, explained the theory adequately, and identified appropriate models, which they approached with an independent and critical academic attitude. The students clarified both positive and negative aspects of the research methods employed and delivered well-formulated, suitable and practical recommendations to companies and organisations in an orderly and clear manner. The subjects of several of the studied theses could also have been chosen by students of the EPA master's programme, according to the panel. This remark, however, refers to the earlier mentioned issue of distinction between the profiles of these programmes and has no consequences for the assessment of the quality of the theses. All theses demonstrated that the graduates had achieved the intended learning outcomes of the master's programme SEPAM.

The graduates of the SEPAM programme easily find jobs in their field and according to their expertise. Graduates find jobs in industry, in international (engineering) consulting firms or strategy departments, in multinationals and the banking sector, in government agencies and research organisations. According to the critical reflection, more than 90% of the graduates find a job within six months after graduation, and the average time to find a job is less than two months. Alumni are doing work they are trained for and are grateful for the good training they received in the programme. The programme has an active alumni network that is also accessible for graduates from the other master's programmes of the Faculty.

Considerations
The panel concludes that the graduates of the master's degree programme SEPAM have achieved the intended learning outcomes. The level of the master's theses concurs with that expected for an academic master's programme. Furthermore, the panel finds that the graduates are highly appreciated in their professional field and that they easily embark on promising professional and academic careers, in which their academic profile and skills are valued.

The panel recommends limiting the length of the master's theses.

Conclusion
The panel assesses Standard 4 as 'satisfactory'.

GENERAL CONCLUSION

The master's programme Systems Engineering, Policy Analysis and Management educates students as designers and managers of large-scale and complex, multi-actor systems within a technology domain. The panel assessed standard 1, Intended learning outcomes, as good. The intended learning outcomes have been specified in concrete terms of content, level and orientation; they meet international requirements. The panel greatly appreciated that the general learning outcomes are elaborated in well-defined, detailed learning outcomes. Standard 2, The teaching-learning environment, was assessed as good. The panel established that the curriculum, staff and programme-specific services and facilities enable the students to achieve the intended learning outcomes. The panel assessed standard 3, Assessment system, as satisfactory. The Faculty has an adequate assessment policy, and the Board of Examiners is performing its legally mandated tasks.

Standard 4, Achieved learning outcomes, was assessed as satisfactory. The panel concluded that the graduates had achieved the intended learning outcomes.

Considering the assessments of the four criteria for the master's programme Systems Engineering, Policy Analysis and Management, the panel assesses the programme as satisfactory.

Conclusion

The panel assesses the *master's programme Systems Engineering, Policy Analysis and Management* as 'satisfactory'.

APPENDICES

APPENDIX 1: CURRICULA VITAE OF THE MEMBERS OF THE ASSESSMENT PANEL

Panel chair

Professor Rob Van der Heijden graduated in 1981 from Eindhoven University of Technology as a building engineer. He received his PhD in Building Engineering from the same university in 1986. From 1987-1993 he worked as Associate Professor at the Faculty of Civil Engineering of TU Delft. In 1994, he was appointed Full Professor in Transport and Logistics at TU Delft. Radboud University Nijmegen offered him a position as Full Professor in Urban and Regional Planning in 2001. Between 2008-2010, he was Scientific Director of the Institute of Management Research and Vice-Dean of Research at the Nijmegen School of Management (NSM). He was Dean of the Nijmegen School of Management from 2011-2016. Since June 2016, he has been Professor in Innovate Planning Methods within the NSM. His research is in the fields of spatial planning, decision making and governance with a special focus on issues of transport, logistics and infrastructure development.

Panel members

Professor Harrie Eijkelhof has specialised knowledge of didactics and teaching methods in science education. Until his retirement in 2014, he was Director of the Freudenthal Institute for Science and Mathematics Education at the Faculty of Science at Utrecht University (2011-2014). Previously, he was Professor of Physics Education at the Faculty of Physics and Astronomy at the same institution (1997-2011). Professor Eijkelhof has ample experience in teaching, educational models, didactics, assessment and the professional development of executives in university education. From 2005 to 2010, he was Vice-Dean of Undergraduate Studies at the Faculty of Science, Chairman of the Board of Studies of the Undergraduate School, member of the Examination Board of Liberal Arts and Sciences and a member of the Advisory Board of Education at Utrecht University.

Professor Arthur Petersen joined the Department of Science, Technology, Engineering and Public Policy at University College London full-time in September 2014 after more than thirteen years' work as scientific adviser on environment and infrastructure policy with the Dutch government. Additionally, he is Professorial Fellow at the Dutch National Institute for Public Health and the Environment – RIVM (since April 2016) and Research Affiliate at the Massachusetts Institute of Technology (since 2009). From 2011-2016, he was Adjunct Professor of Science and Environmental Public Policy at VU University Amsterdam. Professor Petersen studied Physics and Philosophy, obtained doctorate degrees in Atmospheric Sciences at Utrecht University (1999) and in the Philosophy of Science at VU University Amsterdam (2006). He now conducts research in Anthropology and Political Science. Most of his research focuses on managing uncertainty.

Maarten van Ruitenbeek, BSc (student member) is a first-year master's student in Industrial Engineering and Management at the University of Groningen. Besides his studies, he follows the High Tech Systems and Materials Honours Programme in collaboration with Royal Philips Drachten and tutors first-year bachelor students in Industrial Engineering and Management. He completed his bachelor in Industrial Engineering and Management Science at the University of Groningen in 2016. In 2015-2016, he was president of TBV Lugus, the student association of Industrial Engineering and Management in Groningen.

Professor Hens Runhaar is a Special Professor of Management of Biodiversity in Agricultural Landscapes at Wageningen University and Research and an Associate Professor of Environmental Governance at the Copernicus Institute of Sustainable Development at Utrecht University. The integration of environmental objectives into sectoral policies, planning and practices is his main area of interest. Dr Runhaar has researched this subject in various domains – such as transport, urban planning, natural resource management and, more recently, agriculture – encompassing environmental themes such as climate change mitigation and adaptation, environmental health and

biodiversity. Other subjects addressed in his research are science-policy interactions, the framing of environmental problems and the consequences of these framings – including governance practice, effectiveness, and controversies. He has published over fifty scientific papers and (co)edited three special journal issues, most recently a special issue on coastal management for *Environmental Science and Policy*.

Professor Marcel Veenswijk is Full Professor in Management of Cultural Change at VU University Amsterdam. Professor Veenwijk graduated from the University of Leiden with a degree in Public Administration and holds a PhD from Erasmus University Rotterdam. He has worked as a researcher, lecturer and research manager. He has published widely on cultural change, institutional transformation and innovation processes, especially in the context of public sector organisations. The work of his current research group addresses the tensions between institutionalised structures and individual agency, the changing norms in institutional fields, the establishment of newly emerging fields, the breakdown or cut across institutionalised boundaries, and the micro-processes of conflict and identity formation. In addition to his scientific work, he has extensive experience as a consultant. Prior assignments included projects for ABN AMRO, Rijkswaterstaat, ProRail, the City of Amsterdam, Enexis, ING, KLM and several ministries.

APPENDIX 2: DOMAIN-SPECIFIC FRAMEWORK OF REFERENCE

Domain-Specific Frame of Reference Industrial Engineering and Systems Engineering
(As confirmed in Utrecht on 10 March 2016)

This document has been written as a short summary of views on the field of Industrial Engineering and Systems Engineering (IE&SE). These views have been gathered from organizations that focus on the professional development and application of the field http://esd.mit.edu/;http://www.abet.org/). In addition, SE engineers (http://www.iienet.org; http://msom.society.informs.org; http://www.informs.org; http://www.incose.org) and leading academic programs in the field (http://ieor.berkeley.edu/; http://www.isye.gatech.edu/; http://www.cesun.org; http://www.stanford.edu/dept/MSandE/; http://www.epp.cmu.edu/; http://esd.mit.edu/; http://www.seor.gmu.edu/). A few excerpts from these texts are included in the separate text box.

Although there are some clearly common elements in these descriptions, we observe that the various different emphases of these organizations' IE&SE programs have necessitated each of them to formulate their own view of what the field of Industrial Engineering and Systems Engineering represents in education, application, and research. The same also holds for the IE&SE programs at UG, TUD, TUe, and UT. This document gathers the overarching elements of these programs, but we emphasize that each of these IE&SE programs has unique elements that will be highlighted in the self-assessments.

1. Common elements of the field of IE&SE
These common elements concern: (a) the common basis, (b) the focus: (re-)design, implementation, installation, and improvement of products, processes and systems, (c) broadly applied in private and public domains and within and between organisations, (d) the application of quantitative methods (and combination with qualitative methods), and (e) complex problem solving with a scientific and a pragmatic multidisciplinary approach.

(a) The common basis
Industrial Engineering (IE) and Systems Engineering (SE) are interrelated.[2] IE is concerned with the design, improvement, implementation and installation of integrated systems of people, information, materials, equipment and energy. It focuses on the analysis, design and control of (innovative) processes, products and systems in an industrial and/or societal environment, both at the level of individual organisations and supply networks as well as strategic issues. It involves the use of new processes, materials and production- and manufacturing techniques in innovative ways. SE mainly focuses on inter-organisational questions that involve the use of technology and the interests of multiple stakeholders, typically linking public and private organisations. As a consequence the common basis of IE en SE draws upon specialised knowledge and skills in the mathematical, physical, chemical and social sciences together with the principles and methods of engineering analysis and design in order to specify, predict, and evaluate the results to be obtained from the systems involved.

(b) The focus: analysis, design, implementation, and performance improvement of processes, critical infrastructures, and systems
IE&SE is concerned with the design and improvement of operational and/or strategic processes and integrated systems. These processes or systems provide products or services to customers or to the society at large. As such both private and public organisations are concerned. The design and improvement of products, processes and systems considers multiple goals and the availability of limited resources, such as time, money, materials, energy and other resources. Several organizations and multiple stakeholders may be involved (supply chains, alliances, public-private

[2] "Industrial Engineering" refers to the programmes at TU/e and UT, while the term "Systems Engineering" better fits most programmes at TUD.

partnerships) and governance structures can be part of design and improvement initiatives. The scope of design thus may include supply chain networks, production and manufacturing techniques, products, control of systems, implementation, installation and validation. The multidisciplinary, integrated design approach including the design context distinguishes IE and SE's from specialized engineering disciplines. In summary, IE's and SE's may be considered Productivity and Efficiency Professionals.

(c) Broadly applied, both in private and public domains and both within and between organizations
IE&SE is used in a variety of fields. It applies along all steps in the product life cycle, from research and development over design, manufacturing, distribution and disposal. And it applies in all phases of the value chain. Whereas initial applications were mainly limited to industrial settings, we now witness more and more applications in the service industry. Its principles apply as well in all fields of the private as in the public sector. Today there is a fast growth of applications in banking, healthcare, transportation, and the like.

Therefore the term "industrial" can be misleading; this does not mean just manufacturing. It encompasses service industries as well. It has long been known that industrial engineers have the technical training to make improvements in a manufacturing setting. However, many of the same techniques can be used to evaluate and improve productivity and quality in a wide variety of service industries, as well as in the public sector. The term "Systems Engineering" emphasizes this broader scope for design, improvement, and problem solving.

(d) The application of quantitative and qualitative methods
IE&SE is a field of engineering and one important element of its approach to the design and improvement of products, processes and systems is the use of data analytics and quantitative modelling methods. These are derived from fields such as operations research, management science, mathematics, natural sciences, economics, data analysis and statistics, information systems, game theory (gaming, simulation and Q-methods), engineering and social science methods such as interviews and questionnaires.

(e) Complex problem solving with a scientific and pragmatic multidisciplinary approach
Complex problems where value systems may clash and the status of knowledge claims may be disputed are central to IE&SE. In order to be able to solve these kinds of problems, it is necessary to synthesize knowledge from different disciplines (e.g., engineering, natural sciences, (institutional) economics, mathematics, organizational behaviour, law, psychology, although not all disciplines are equally important in all problem domains). IE&SE draws upon specialized knowledge and (analytical) skills in the mathematical, physical, and social sciences, together with the principles and methods of engineering analysis and design. Unlike traditional disciplines in engineering, IE&SE addresses the role of human decision-makers and other stakeholders as key contributors to the inherent complexity of systems. The programmes offer the relevant knowledge and skills from different disciplines and provide a framework for the application and integration of this knowledge in analysing a problem situation and in designing and implementing solutions. In brief, IE's and SE's might support (scientific) decision making.

Besides scientific IE&SE people also ought to be pragmatic people. They work to understand and resolve real problems from society and hence - as stated above - need to combine the knowledge and experience from many disciplines to develop project and process-management expertise and communication skills. They choose their method so as to fit the problem, which means that they combine the quantitative and problem-solving approach of engineers with research methods and qualitative insights from the social sciences.

2. Generic competences
Taking into account the before mentioned common elements of the field generic competencies for industrial and systems engineering are listed below:

- Sufficient understanding of science, technology and technological innovation;
- Keen analytic mind-set combined with a drive to synthesize towards a solution;
- Competent in translating complex issues in workable models and design and execute appropriate research programmes;
- Adequate mathematics skills for modelling and executing research activities;
- 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;
- Able to (re)design products, processes and systems in an IE&SE context;
- Adequate understanding and competences in a number of technical, economic and social disciplines to underpin research programmes;
- An adequate understanding of the drivers of socio-,economic and political organizations in society;
- Able to assess the impact of IE&SE products, processes and systems in a business, societal and global context;
- Able to organize and drive for efficiency and effectiveness;
- Resourcefulness and creative problem solving;
- Excellent communication, listening, and negotiation skills;
- Ability to adapt to many environments, interact with a diverse group of individuals and understand the roles of various stakeholders in the processes;
- Experience in working in an interdisciplinary and international environment;
- Able to identify the arising ethical dilemma and to reflect on this dilemmas.

3. BSc and MSc levels

The specific blend of competencies varies per programme and is laid down more specifically in the final qualifications of each programme. Although the emphasis varies among the programmes, there is a differentiation between the BSc and MSc levels regarding to

- Complexity of the problem situations (in terms of technical and/or stakeholder complexity and/or the number of disciplines involved);
- The amount of information necessary, known, and available from the practical problem situation;
- The level of autonomy.

Bachelors receive a sound general education in basic fields of IE&SE, like Natural Sciences, technology, engineering, optimisation, production- and process techniques, engineering economy, business economy, organisational theory, social sciences, etc...) However, specific choices in these basic fields, varies per programme. They should be able to continue studies on a more in depth and specialised Master's track or they may fill appropriate positions in business.

Master programs in IE&SE generally offer different fields of study in which students can specialise. Examples of such fields are operations management, operations research and management science, CIT, product design and logistics, policy analysis, man-machine systems, performance analysis, supply chain management, process- or production techniques, innovation processes, control engineering, etc.

Whereas bachelors are mainly involved in analysis (as the initial step in the design cycle), Masters typically deal with design questions. Above that they should also be exposed to research questions. Masters should be able to formulate and carry out independent research projects.

The IE&SE Bachelor programs provide an excellent basis for one of the IE & SE Master programs, but students in IE&SE Master programs also can have various undergraduate backgrounds in engineering and other quantitative fields. Graduates of a Master's programme will typically start their career as engineers, project or planning managers, functional managers, policy analysts/advisers, engineering consultants and the like. But they may as well start an academic track through further involvement in research (e.g. PhD and academic positions). They should be

able to move later on to managerial positions (e.g. as CTO). Some may prefer to become private entrepreneurs.

Excerpts from: http://www.iienet.org/Details.aspx?id=282

Institute of Industrial Engineers (IIE) **Definition of Industrial Engineering:**

'IE is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialised knowledge and skill in mathematical, physical and social sciences together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the results to be obtained from such systems'

Excerpts from http://www.stanford.edu/dept/MSandE/about/MSandE-5yr.pdf

Stanford Engineering established the Department of Management Science and Engineering five years ago with a logic and a purpose: engineers know how to analyze and solve problems and they thoroughly understand technology. With this quantitative background and additional training, for example in social sciences or finance, engineers should therefore be leaders in management and public policy.

The department's eight research areas [are]: organizations, technology management and entrepreneurship; production and operations management; decision analysis and risk analysis; economics and finance; optimization and the analytical tools of systems analysis; probability and stochastic systems; information science and technology; and strategy and policy. MS&E also includes several centres and programs such as the Energy Modelling Forum and the Centre for Work, Technology and Organization. In addition, it hosts the Stanford Technology Ventures Program. The department's strengths are also manifest in the talents of students and alums who work in investment banking, management consulting, and other fields that have not been closely associated with engineering in the past. These fields will be in the future because a deep understanding of technology has become critical to their operations. "For example, a growing number of people address finance problems using methods that have been traditionally associated with engineering systems analysis," says Paté-Cornell, referring to the fast-growing specialty of financial engineering. Paté-Cornell's hope is that more engineers will also join the ranks of government and use their skills to shape and implement policies.

MS&E students gain the training that they need to be leaders in finance, industry, policy, or other specialties by completing a core engineering curriculum, followed by a concentration in an area such as finance, operations research, production, or public policy.

Excerpts from www.isye.gatech.edu

Georgia Tech: Industrial engineering (IE), operations research (OR), and systems engineering (SE) are fields of study intended for individuals who are interested in analyzing and formulating abstract models of complex systems with the intention of improving system performance. Unlike traditional disciplines in engineering and the mathematical sciences, the fields address the role of the human decision-maker as key contributor to the inherent complexity of systems and primary benefactor of the analyses. In short, as practitioners and researchers in IE/OR/SE, we consider ourselves to be technical problem solvers. We are typically motivated by problems arising in virtually any setting where outcomes are influenced by often complicated and uncertain interactions, involving a variety of attributes that affect system performance. Against this backdrop, students have historically been attracted to our academic programmes with a variety of career objectives and from a host of disciplines and academic interests.

APPENDIX 3: INTENDED LEARNING OUTCOMES

Master's programme Systems Engineering, Policy Analysis and Management

Master's graduate in SEPAM

1. is competent in one or more scientific disciplines
- has a thorough mastery of the multidisciplinary field of analysis, design and management of multi-actor systems extending to the forefront of knowledge and practical skills.
- is capable of applying this knowledge to multi-actor engineering and management problems in at least one of the following technological domains: Transport & Logistics, Energy & Industry, Information & Communication (including Information Architecture) or Built Environment & Spatial Development.
- has knowledge in the field of institutional economics, ethics, law, and policy and decision making related to the analysis, design and management of multi-actor systems.
- looks actively for structure and connections in problem structuring, systems analysis and design, policy modelling and design, and decision support in complex and unpredictable professional environments.
- has the skill and the attitude to apply essential facts, concepts, principles and theories relevant to the analysis, design and management of multi-actor systems independently in the context of more advanced ideas or applications.
- is able to make sound judgements in the absence of complete data.
- is able to reflect on standard methods and their presuppositions; is able to question these; is able to propose adjustments, and to estimate their implications.

2. is competent in doing research
- is able to reformulate ill-structured research problems. Also takes account of the system boundaries in this. Is able to defend the new interpretation within a multi-actor context.
- given the process stage of the research problem, chooses the appropriate level of abstraction.
- is able, and has the attitude to, where necessary, draw upon other disciplines in his or her own research.
- is able to assess research related to problem structuring, systems analysis and design, policy modelling and design, and decision support on its scientific value.

3. is competent in designing
- is able to reformulate ill-structured design problems to synthesise knowledge and to solve problems in a creative way when dealing with complex issues. Also takes account of the system boundaries in this. Is able to defend this new interpretation against the parties involved.
- given the process stage of the design problem, chooses the appropriate level of abstraction and select appropriate views and models and deal with complex issues both systematically and creatively.
- is able, and has the attitude, where necessary, to draw upon other disciplines in his or her own design.
- is able to assume leading roles, including management roles, in (inter)national companies and research organisations, and be able to contribute to design.
- possess the qualities needed for employment in circumstances requiring sound judgement, personal responsibility and initiative, in complex and unpredictable professional environments.
- is able to formulate new research questions on the basis of a design problem.

4. has a scientific approach
- is able to identify and take in relevant developments.

- is able to critically examine existing theories, models or interpretations in the field of multi-actor systems design.
- has great skill in, and affinity with the use, development and validation of models which can contribute designing new solutions; is able consciously to choose between modelling techniques. ·
- is able to document adequately the results of research and design processes with a view to contributing to the development of knowledge in the field and beyond, and is able to publish these results in a scientific way.

5. possesses basic intellectual skills

- is able to critically reflect on his or her own thinking, decision making and acting, and to adjust these on the basis of this reflection.
- is able to ask adequate questions, and has a critical yet constructive attitude towards analysing and solving real life problems in the field.
- is able to form a well-reasoned opinion in the case of incomplete or irrelevant data, taking account of the way in which that data came into being.
- is able to take a standpoint with regard to a scientific argument in the field, and is able to assess this critically as to its value.

6. is competent in co-operating and communicating
- is able to communicate in writing in English about research and solutions to problems with colleagues, non-colleagues and other parties involved.
- is able to communicate verbally in English about research and solutions to problems with colleagues, non-colleagues and other involved parties.
- is able to debate about both the field and the place of the field in society.
- is able to perform project-based work in (inter)national settings.
- is able to work within an interdisciplinary team and in a team with great disciplinary diversity, and is able to assume the role of team leader.

7. takes account of the temporal and the social context
- understands relevant (internal and external) developments in the history of the fields concerned. This includes the interaction between the internal developments (of ideas) and the external (social) developments, and integrates aspects of this in scientific work.
- is able to analyse and to discuss the social consequences (economic, social, cultural) of new developments in relevant fields with colleagues and non-colleagues, and integrates these consequences in scientific work.
- is able to analyse the consequences of scientific thinking and acting on the environment and sustainable development.
- is able to analyse and to discuss the ethical and the normative aspects of the consequences and assumptions of scientific thinking and acting with colleagues and non-colleagues (both in research and in designing), and integrates these ethical and normative aspects in scientific work

APPENDIX 4: OVERVIEW OF THE CURRICULUM

Master's programme Systems Engineering, Policy Analysis and Management

First year

<table>
<tr><td colspan="2">First semester</td><td colspan="2">Second semester</td></tr>
<tr><td>First period</td><td>Second period</td><td>Third period</td><td>Fourth period</td></tr>
<tr><td rowspan="2">SPM4111 Introduction to Designing MAS 2 EC</td><td>SPM4123

Designing MAS from an Engineering Perspective 8EC

SPM 7010 Creativity and Communication</td><td rowspan="2">SPM4142 MAS Design: An integrated view 3 EC</td><td colspan="2">SPM 4416

Strategic Management of Large Engineering Projects 6 EC

SPM7030 Interdisciplinary Collaboration</td></tr>
<tr><td>SPM4133

Designing MAS from an Actor Perspective 8EC

SPM 7020 Management and Negotiation</td><td colspan="2">Domain Modules 9 EC</td></tr>
<tr><td colspan="2" rowspan="2">Domain Modules 9 EC</td><td>SPM4423

Legal Aspects of MAS Design 5 EC

SPM7050 Critical Reading</td><td rowspan="2">SPM 5920

SEPAM Design Project 7 EC</td></tr>
<tr><td>SPM4415

Ethical Aspects of Design & Manag.</td></tr>
</table>

	of Technology 3 EC SPM 7040 Collective reasoning	SPM7060 Advanced self-reflection and communication skills

Second year

First semester		Second semester	
First period	*Second period*	*Third period*	*Fourth period*
		SPM 5910 SEPAM Master Thesis Project 30 EC	
Specialisation 15 EC			
Domain Specialisation 9 EC			
SPM 5905 Thesis project definition 6EC (4x per year SPM7070 Networking	SPM 5905 SPM 7070	SPM 5905 SPM 7070	SPM 5905 SPM 7070

Foundations

Ethics and Law

Domain Specialisation

Skill

Project

APPENDIX 5: PROGRAMME OF THE SITE VISIT

Programme site visit degree programmes 12 and 13 December 2016

Location: Faculty of TPM Jaffalaan 5 2628 BX Delft

Monday 12 December 2016

8.15 Arrival of audit committee

8.15-8.30 Welcome

Mr Prof.dr. T.S. (Theun) Baller	Dean TPM
Mr Prof.mr.dr. E.F. (Ernst) ten Heuvelhof	Director of Education TPM

8.30-9.00 Preparatory meeting committee

09.00-10.00 Education management team (EMT)

Mr Prof.mr.dr. E.F. (Ernst) ten Heuvelhof	Director of Education TPM
Mr Dr.ir. I. (Ivo) Bouwmans	Director of Studies TB
Ms Dr.ir. Z. (Zofia) Lukszo	Director of Studies SEPAM
Mr Dr.ir. B. (Bert) Enserink	Director of Studies EPA
Mr Dr. R.M. (Robert) Verburg	Director of Studies MOT
Ms Drs. J.K. (Jenny) Brakels	Manager Education &Student Affairs
Mr M.A. (Mathijs) Bijkerk BSc	Commissioner MSc Curius
Ms C.A. (Elsemiek) Smilde	Commissioner BSc Curius

10.00-10.30 Meeting audit committee (incl. break)

10.30-11.00 Students B Technische bestuurskunde (TB)

Ms M.M.G.C. (Menghua) Prisse	1st year
Mr P.X. (Pepijn) Thijssen	2nd year; Commissioner Bachelor Education FSC TPM 2016-2017
Ms A.C. (Claire) Post	2nd year
Ms M. (Mira) Groot	3rd year
Mr. J.B. (Jelle) van der Lugt	3rd year
Mr A.P. (Toon) Jansen	4th year

11.00-11.30 Students M Systems Engineering, Policy Analysis and Management (SEPAM)

Ms I. (Inés) Martínez Bustamante	1st year; BSc international
Mr J. (Joris) Zwijnenburg	1st year; BSc TB
Ms. L. (Leonie) Vogelsang	1st year; BSc TB
Mr Á.A. (Álvaro) Papic González	2nd year, BSc International
Mr S.F. (Stephan) Kool	3rd year; BSc TB
Ms F.C. (Fransje) Oudshoorn	3rd year; BSc TB

11.30-12.15 Lecturers B TB and M SEPAM

Ms Dr.ir. C. (Els) van Daalen	Associate professor, Systems Dynamics and Systems Modelling
Mr Dr. J.A. (Jan Anne) Annema	Assistant professor, Transport Policy
Ms Dr.ir. P.W. (Petra) Heijnen	Assistant professor, Energy & Industry
Mr Dr.ir. L.J. (Laurens) de Vries	Associate professor, Energy economics and regulations
Dhr. Dr. S (Stephan) Lukosch	Associate professor, Design Methodologies, requirements engineering, collaboration
Dhr. Dr. H. (Haiko) van der Voort	Assistant professor, Organisation science, process management, regulation
Mr Ir. H.W. (Herman) de Wolff	Assistant professor, Land development
Mr Prof.dr.ir. M.F.W.H.A. (Marijn) Janssen	Full professor, ICT

12.15-14.30 Meeting audit committee (incl. lunch)

14.30-15.00 Students M Management of Technology

Ms. A.F. (Lieke) van den Eijnden	1st year, BSc Life Science & Technology
Ms S. (Silvia) Fernandez Gelonch	1st year, BSc Industrial Technologies Engineering
Mr A.D.B. (Abe) Scholte	1st year; BSc Industrial Design Engineering
Ms P.D.L.A. (Pamela) Nunez Araya	2nd year; BSc Electromechanical Engineering
Mr J.A. (Juan) Carvajal Rodriguez	2nd year; BSc international
Mr M.A. (Misha) Grift	2nd year; BSc HBO, Commissioner MOT education FSC TPM 2016-2017

15.00-15.30 Lecturers M Management of Technology

Mr Prof.dr.ir. M.F.W.H.A. (Marijn) Janssen	Full professor, e-government, business processes
Ms Dr. H.K. (Heide) Lukosch	Assistant professor, Participatory systems, augmented reality
Mr Dr. J.R. (Roland) Ortt	Associate professor, Breakthrough technologies, innovation management
Mr Prof.dr. C.P. (Cees) van Beers	Full professor, Frugal innovations, developmental economics, innovation management
Mr Dr. G. (Geerten) van de Kaa	Assistant professor, Business strategy, standardisation

15.30-17.00 Meeting audit committee (incl. break)

17.00- 17.30 Alumni

Ms J.E.L. (Joke) Blom BSc	BSc TB, student MSc Transport, Information and Logistics

Mr T.T. (Tim) Romijn BSc	BSc TB, student MSc Engineering and Policy Analysis
Mr Y. (Yi) Yin MSc	MSc SEPAM, PhD student at ICT, VRE4EIC project
Ms ir. D.M. (Diana) Vonk Noordegraaf	MSc SEPAM, PhD TRAIL, Consultant at TNO
Ms ir. K.K. (Kaveri) Iychettira	MSc EPA, PhD student at SETS Joint Doctorate on Energy Policy at TU Delft, KTH Stockholm and Comillas, Madrid
Mr J. (Jerome) Vincendon MSc	MSc MOT; Technical Consultant at Gen25
Mr A. (Amir) Piltan MSc	MSc MOT; PTech B.V., Owner and Director

19.00-21.30 Diner audit committee

Tuesday 13 December 2016

8.15 Arrival of audit committee

8.30-9.00 Preparatory meeting committee (optional: walk-in hour)

9.00-9.30 Students M Engineering and Policy Analysis

Ms I.M. (Isabelle) van Schilt	1st year; BSc TB, Commissioner EPA education FSC TPM 2016-2017
Ms M.B.C. (Marijne) Kramer	1st year, BSc TB
Mr J.C. (Jasper) Meijering	1st year, BSc TB
Mr G.P.S. (Gurvinder) Arora	1st year, Bachelor of Technology in Mechanical Engineering
Mr J.P. (Juan Pablo) Nieto	2nd year, Telecommunication Engineer

09.30-10.00 Lecturers M Engineering and policy Analysis

Mr Prof.dr. W.M. (Martin) de Jong	Full professor, Urban and infrastructure development in China
Mr Dr. E. (Erik) Pruyt	Associate professor, System Dynamics Modelling, Exploratory Modelling and Analysis
Mr S. (Scott) Cunningham	Associate professor, Operations research, data science, tech policy
Mr Prof.dr.ir. A. (Alexander) Verbraeck	Full professor, Large-scale models, discrete event simulation, data analysis
Mr Dr.ir. L.M. (Leon) Hermans	Assistant professor, Actor models, policy analysis, water governance
Mr Dr. S.T.H. (Servaas) Storm	Assistant professor, Macroeconomics and development economics, CGE modelling

10.00-11.00 Meeting audit committee (incl. break)

11.00-12.00 Members Boards of Studies

Ms Dr.ir. M.P.M. (Tineke) Ruijgh - van der Ploeg	Chair Board of Studies TB
Mr Dr. P.W.G. (Pieter) Bots	Chair Board of Studies SEPAM

Mr Dr. J.A. (Jan Anne) Annema	Chair Board of Studies EPA
Mr Dr. M.P.M. (Maarten) Franssen	Chair Board of Studies MOT
Mr M. (Mike) Band	Student member Board of Studies TB
Mr M.E. (Martijn) Cligge	Student member Board of Studies SEPAM
Ms R. (Rhythima) Shinde	Student member Board of Studies EPA
Mr T. (Tim) Joosten	Student member Board of Studies MOT

11.00-11.30 Tour Faculty

12.00-13.00 Meeting audit committee (incl. lunch)

13.00-14.00 Members Board of Examiners

Mr Prof.dr. R.W. (Rolf) Künneke	Chair Board of Examiners TPM
Mr Prof.dr. W.K. (Willem) Korthals Altes	Member Board of Examiners TPM
Ms Drs. J. (Jolien) Ubacht	Chair Meeting of Graduation coordinators

14.00-14.30 Preparation final meeting management (incl. break)

14.30-15.30 Final meeting management

Mr Prof.dr. T.S. (Theun) Baller	Dean TPM
Mr Prof.mr.dr. E.F. (Ernst) ten Heuvelhof	Director of Education TPM
Mr Dr.ir. I. (Ivo) Bouwmans	Director of Studies TB
Ms Dr.ir. Z. (Zofia) Lukszo	Director of Studies SEPAM
Mr Dr.ir. B. (Bert) Enserink	Director of Studies EPA
Mr Dr. R.M. (Robert) Verburg	Director of Studies MOT
Ms Drs. J.K. (Jenny) Brakels	Manager Education &Student Affairs

15.30-17.30 Meeting audit committee – first findings

17.30-17.45 Plenary presentation first findings – ENG

17.45 Drinks TB-café

APPENDIX 6: THESES AND DOCUMENTS STUDIED BY THE PANEL

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

4012089	4318307	1362100
9975319	1365584	1311158
4003624	4007328	1516701
1527304	9011326	1505157
1541013	1541021	4006356

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

- Annual report Board of Examiners 2014-2015;
- Minutes of the Programme Committee;
- Course dossiers, including the tests of a selection of master courses;