wo-master Data Science
and Society

Tilburg University

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1 Executive summary

The Accreditation Organisation of the Netherlands and Flanders (NVAO) received a request for an initial accreditation procedure regarding a proposed wo-master Data Science and Society at Tilburg University. NVAO convened an expert panel, which studied the information available and discussed the proposed programme with representatives of the institution and the programme during a site visit.

The following considerations have played an important role in the panel's assessment.

The new Master's programme Data Science and Society is based on the existing track Data Science: Business and Governance of the Master's programme Communication and Information Sciences. Tilburg University intends to present this track as an independent degree programme.

The track Data Science: Business and Governance started in September 2015 and is part of the Jheronimus Academy of Data Science, a partnership on education and research among Tilburg University, the Technical University Eindhoven, the municipality of 's-Hertogenbosch and the province of Noord-Brabant. The new Master will also be a part of the Jheronimus Academy of Data Science.

The intended learning outcomes are adopted from the 'original' programme Communication and Information Sciences. They are modified to some extent to include the requirements of the Data Sciences. The panel learned that specifically outcomes in law and business are added.

It is not the ambition of the programme to deliver 'hard core' data scientists, but graduates that have to be *data savvy* and also are able to be the 'linking pin' between data science and society or other disciplines. For the panel it is convincing that Data Science is introduced and combined with other disciplines. In this respect the intended learning outcomes clearly address societal demand for graduates that are qualified as the intended 'linking pin'.
The representatives that the panel has spoken, express a strong demand for graduates with a combined expertise in data science and social science.

The programme convincingly demonstrates that the intended learning outcomes are at master level.

The legitimation for this programme is building upon a background in relevant 'social' disciplines including humanities, economics and law and is bringing in data science and exploring the social background further.

Clearly only the combination of being *data savvy* in a specific field and having an appropriate level of professionalism (substantive expertise) in that field, guarantees the 'linking-pin' in data science as intended by the programme at master level.

The Master Data Science and Society is a 60 EC programme, consisting of four terms, with the final term completely reserved for the thesis Data science in Action. In this thesis the students combine data science with social science.

In general, the panel believes that the curriculum contains a coherent programme that supplies the students with a firm base to combine Data Science and Social Science. Considering the fact that the programme's duration is one year, choices have to be made. It is also obvious that not all the links between Data Science and Social Science can be covered in-depth. The panel concludes that the students do not obtain Master's level on all (data science) subjects, but that the interdisciplinary character makes for an enrichment of the societal part of the programme at Master's level and thus for an overall Master's level of the programme.

The Social Sciences dimension is well represented in two subjects: a) Data Science Regulations and Law and b) Analytics for Business and Governance.

The panel has no doubt on the level reached in the understanding of data science tools and methodology. The programme clearly also provides integrative skills, but the level achieved in the field in which data-science is applied is not sufficiently defined and taken into account in the design of the programme.

Electives chosen to build upon knowledge acquired in the bachelor in combination to an appropriate admission policy will provide for this.
The panel therefore formulates as a condition to define individual study pathways for students leading to the realisation of this intended learning outcome, in combination with an admission policy geared toward accepting students that are or can become substantive experts in the field in which data science is applied.

The learning by doing didactical approach is recognized by the panel. Students and teachers provided convincing examples and it was convincingly demonstrated in the documents.

Both the staff and the students indicate that the workload is considerable.

The assessments of the master are regulated by the Education and Examination Regulations (EER). The Tilburg School of Humanities and Digital Sciences Examining Board assures that these objectives are met and that there is a sufficient level of variation in the assessment methods.

The panel studied 18 out of 87 theses from graduates since 2015. The panel focused on recent papers from graduates in 2017 and 2018. Each panel-member studied lower marked, mediocre and good to very good graded papers.

The overall conclusion is that the panel had no doubt that master level is achieved. It found not one thesis that was below standard.

The papers all demonstrate sufficient skills in the application of data-science methodologies or tools. The papers also reflect good skills in methodology and statistics. Graduates demonstrate to be proficient in relevant data-science tools.

In addition to the findings of the panel on the quality of the theses, alumni and representatives from the working field convinced the panel that the graduates are of sufficient master level.

The conclusion of the panel is that the programme partially meets standard 2. It satisfies the other standards.

The conditions encompass the strengthening of a structured individual study path towards the intended profile of the graduate as a 'linking-pin' in the application of data science in a field in which the graduate acquired substantive expertise. In relation to that the panel also recommends to reflect on the Learning Outcomes in the light of the interdisciplinary intentions of the programme and take the heterogeneous background of the students into consideration. Currently this remains rather implicit and informal. The panel however found no indications that this jeopardized the basic quality of the programme. On the contrary, assessments and theses studied convinced the panel that a sufficient level is reached and graduates definitely are 'data savvy' and on a master level.

Given these considerations, the panel advises NVAO to take a conditionally positive decision regarding the quality of the proposed programme wo-master Data Science and Society at Tilburg University.

The Hague, 25 September 2018

On behalf of the assessment panel convened for the initial limited accreditation assessment of the wo-master Data Science and Society at Tilburg University,

Prof. dr. Maarten van der Steen   Willem Hendrikx
(chair)   (secretary)

2 Introduction

2.1 The procedure

NVAO received a request for an initial accreditation procedure including programme documents regarding a proposed wo-master Data Science and Society. The request was received on the 6th of December 2017 from Tilburg University.

An initial accreditation procedure is required when a recognised institution wants to award a recognised bachelor's or master's degree after the successful completion of a study programme. The procedure for initial accreditation is slightly different as compared to the approach for programmes that have already been accredited. In general initial accreditation is an ex ante assessment of a programme. The programme becomes subject to the normal accreditation procedures once initial accreditation has been granted. In this specific case the existing track Data Science: Business and Governance (DSBG) of the master's programme Communication and Information Sciences is turned into an independent degree programme. The DSBG track started in September 2015. Initial accreditation in this case results in recognition and registration as a separate programme. As the programme already has been delivered for some years, the assessment also takes an 'ex-post' view, including the study of assessments and theses of students. Also standard 4 Achieved learning outcomes is included in this assessment.

To assess the program, the NVAO convened an international panel of experts (see also Annex 1: Composition of the panel). The panel consisted of:
Chair:
− Prof. dr. ir. Maarten van Steen, scientific director Digital Society Institute, University of Twente; professor of large-scale distributed systems, University of Twente; chair ICT-Research Platform Netherlands.
Panel members:
− Prof. dr. Wim Van Petegem, policy coordinator Learning Technologies, Faculty of Engineering Technology, Katholieke Universiteit Leuven;
− Prof. dr. Elena Marchiori, professor of machine learning for natural sciences, head of section Data Science, Institute for Computing and Information Sciences, Faculty of Science Radboud University Nijmegen The Netherlands;.
Student member:
− Lennart van Doremalen, PhD candidate Subatomic Physics Universiteit Utrecht.

On behalf of the NVAO, drs. Frank Wamelink and drs. Willem Hendrikx were responsible for the process coordination and the drafting of the experts' report.

The new programme fits into the broader Jheronimus Academy of Data Science (JADS) initiative to develop a portfolio of educational programmes in data science partly in collaboration with Eindhoven University of Technology (see: paragraph 3.3. below). Three panel members: van Steen, Van Petegem and van Doremalen, participated early in 2016 in the assessment of two other programme's in the JADS initiative: wo-bachelor Data Science and the wo-master Data Science and Entrepreneurship. The panel thus has a broader view on this initiative.

The composition of the panel reflects the expertise deemed necessary by NVAO. (Annex 1: Composition of the panel). All the panel members signed a statement of independence and confidentiality.

The panel has based its assessment on the standards and criteria described in the NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2016, nr 69458).

The following procedure was undertaken. The panel members prepared the assessment by analysing the documents provided by the institution (Annex 3: Documents reviewed). The panel organised a preparatory meeting on 7 June 2018 i.e. the day before the site visit. During this meeting, the panel members shared their first impressions and formulated questions for the site visit.

The site visit took place on the 8th of June 2018 at Tilburg University. During this visit, the panel was able to discuss the formulated questions and to gather additional information during several sessions (Annex 2: Schedule of the site visit). Afterwards, the panel discussed the findings and considerations and pronounced its preliminary assessments per theme and standard. At the end of the site visit, the initial findings were presented to the institution.

Based on the findings, considerations and conclusions the secretary wrote a draft advisory report that was first presented to the panel members. After the panel members had commented on the draft report, the chair endorsed the report. On 18th of September 2018 the advisory report was sent to the institution, which was given the opportunity to respond to any factual inaccuracies in the report. The institution replied on 20th September 2018. All suggested corrections were adopted. Subsequently the final report was endorsed by the panel chair. The panel composed its advice fully independently and offered it to NVAO on 25th of September 2018.

2.2 Panel report

The first chapter of this report is the executive summary of the report, while the current chapter is the introduction.

The third chapter gives a description of the programme including its position within the institution, the Tilburg University and within the higher education system of the Netherlands.

The panel presents its assessments in the fourth chapter. The programme is assessed by assessing the themes and standards in the Initial Accreditation Framework. For each standard the panel presents an outline of its findings, considerations and a conclusion.

The outline of the findings are the objective facts as found by the panel in the programme documents, in the additional documents and during the site visit. The panel's considerations consist of the panel's judgments and subjective evaluations regarding these findings and their relative importance. The considerations presented by the panel are at the basis of a concluding overall assessment.

The panel concludes the report with a table containing an overview of its assessments per standard.

3 Description of the programme

3.1 General

Country   : The Netherlands
Institution   : Tilburg University
Programme   : Data Science and Society
Level   : master
Orientation   : wo
Degree   : Master of Science
Location(s)   : TILBURG
Study Load (EC) : 60 EC
Field of Study   : Sectoroverstijgend

3.2 Profile of the institution

Tilburg University (TiU) is centred in the heart of the region Noord Brabant in the south of The Netherlands, rooted in the city of Tilburg. TiU welcomes over 13,000 students, 2,000 employees and employes over 270 PhD students. The university hosts over a hundred different nationalities. TiU is a public research university, founded in 1927 as a Roman Catholic University.

The mission of Tilburg University, according to the website, is to contribute to solving social issues by developing and transferring knowledge and bringing together people from various disciplines and organizations. They work together with companies, organizations, government, and citizens to develop new insights and solutions which create value for society. Innovation is created by conducting research, by learning, and by understanding. TiU's motto is Understanding Society.

At Tilburg University teaching and research are organised within five schools: Tilburg School of Economics & Management, Tilburg Law School, Tilburg School of Social and Behavioral Sciences, Tilburg School of Humanities and Digital Sciences and Tilburg School of Theology. Together they offer 71 programmes: 22 Bachelor's programmes and 49 Master's programmes. 41 of the programmes are in English. All figures are from June 2017.

Tilburg University is among the best in the world. TiU ranks in the Top 200, according to the THE Rankings. In 2016 the university is ranked 2th in the Social Science Research Network and 11th in the THE Rankings for Economics and Management.

3.3 Profile of the programme

The new Master's programme Data Science and Society is based on the existing track Data Science: Business and Governance of the Master's programme Communication and Information Sciences. TiU intends to present this track as an independent degree programme.

The track Data Science: Business and Governance started in September 2015 and is part of the Jheronimus Academy of Data Science, a partnership on education and research among

Tilburg University, the Technical University Eindhoven, the municipality of 's-Hertogenbosch and the province of Noord-Brabant. The new Master will also be a part of the Jheronimus Academy of Data Science.

The programme is located at the campus of Tilburg University. The duration of the programme is one year (60 EC) and the teaching language is English. The core objective of the proposed programme is to educate students in the use of data technology in public and private decision making. This includes both data analysis and social and legal aspects of the use of data, such as questions concerning privacy and data ownership.

The programme is aimed at Bachelor graduates in the social sciences, humanities, law or economics, who want to continue their studies using data technology.

The Master programme Data Science and Society (DSS) has no equivalent in the Netherlands, although more or less similar programmes run in Finland, Switzerland, Austria and the UK. There are of course more programmes on Data Science, but these are mainly technology-driven. According to the information file, it is now becoming clear that in order to make the most out of the field's potential, aspects as legal, human, and social values need to be taken into account as well.

DSS combines technical knowledge and skills with knowledge of public and private decision making, including legal and ethical aspects. Graduates of the programme possess knowledge and skills concerning data science methodology, business analytics and governance and law. They are able to apply their knowledge and skills to problem solving and decision making. The labour profile of the graduates is particularly suitable for positions that require a linking-pin mentality.

The programme consists of four terms. The first two terms focus both on regulation and law and on specific data science skills. In the second and third terms there is room for electives (compulsory choice). In the third term the students write their project proposal for their thesis project Data Science in Action. The fourth term is entirely dedicated to their thesis. In this thesis (Data Science in Action) they combine their bachelor subjects with data-science methods.

The information file indicates that no other institution of higher education in the Netherlands offers a programme with a similar profile. The programme is new in the Netherlands and therefore also for Tilburg University.

4 Assessment per standard

This chapter presents the evaluation of the standards by the assessment panel. The panel has reproduced the criteria for each standard. For each standard the panel presents (1) a brief outline of its findings based on the programme documents and on documents provided by the institution and the site visit, (2) the considerations the panel has taken into account and (3) the panel's conclusion. The panel presents a conclusion for each of the standards, as well as a final conclusion.

The assessment is based on the standards and criteria described in the NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2016, nr 69458). Fundamental to the assessment is a discussion with peers regarding the content and quality of the new programme.

Regarding each of the standards, the assessment panel gives a substantiated judgement on a three-point scale: meets, does not meet or partially meets the standard. The panel subsequently gives a substantiated final conclusion regarding the quality of the programme, also on a three-point scale: positive, conditionally positive or negative.

4.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Outline of findings
The intended learning outcomes are adopted from the 'original' programme Communication and Information Sciences. They are modified to some extent to include the requirements of the Data Sciences. From the interviews the panel learned that specifically outcomes in law and business are added.

More specific the general objectives, according to the information file, are:
A. To educate students to have broad knowledge, skills and understanding that go beyond the Bachelor's level in the following fields:
   a. Data-science methodology
   b. Business analytics
   c. Governance and Law related to data-driven businesses
B. To train students to identify patterns and to gather insights from large datasets, and to translate those insights into actionable solutions and recommendations
C. To train students to make judgements in the fields of data-science research and research questions
D. To train students to communicate with specialist in the field of data science, as with nonspecialist, and to work in multidisciplinary teams.

These general objectives are translated into specific Intended Learning Outcomes on: a. Knowledge and Understanding, b. Applying knowledge and understanding, c. Making judgements, d. Communication and e. Learning skills.

Based on the information file the panel struggled with how to appreciate the combination of "data science" and "society", in the name of the programme. The panel tried to capture what the intended ambition is for the 'society'-part of the programme. On the one hand the domain of data science is clearly present in the intended learning outcomes and also addressed in the programme; on the other hand the panel had questions for the domain of society. In the dossier the programme defines this as: "substantive expertise" …that "enables him or her to identify which problems need to be solved"…"are multidisciplinary".

In the discussions with the program management, staff and students, the panel learned that it is not the ambition of the programme to deliver 'hard core' data scientists, but graduates that have to be data savvy and also are able to be the 'linking pin' between data science and social sciences or other disciplines. For the panel it is convincing that data science is introduced and combined with other disciplines. In this respect the intended learning outcomes clearly address societal demand for graduates that are qualified as the intended 'linking pin'.

Data science is strongly related to the digitisation of society. Tilburg University has the intention to address these developments in its education. The programme fits into this strategic goal that is strongly supported by the board of the university. The programme fits into the broader JADS initiative to develop a portfolio of educational programmes in data science partly in collaboration with Eindhoven University of Technology.

The programme convincingly demonstrates that the intended learning outcomes are at master level. This is also confirmed by the fact that the track preceding this programme was already accredited as part of an master programme.

Benchmark with other comparable international programmes learns that there are comparable programmes in the field of data science that focus on the humanities, social sciences and/or analytics for decision making. The common denominators of these programmes are in data mining and information retrieval.

Considerations
The panel discussed the intended profile of the graduates with the representatives of the programme. The panel has established that the programme has a strong multidisciplinary focus, which, however wasn't completely represented in the intended learning outcomes.

The legitimation for this programme is building on a background in relevant 'social' disciplines including humanities, economics and law and to bring in data science and explore the social background further.

Up to this point the intended learning outcomes are acceptable. But the panel recommends to further develop and improve the intended learning outcomes and strengthen the multidisciplinary skills. The improved learning outcomes should also be benchmarked with the international reference frameworks in data science to keep up with developments in the field.

Finally, the panel has established that there is a strong commitment from the professional field with the master programme. The representatives that the panel has spoken, express a strong demand for graduates with a combined expertise in data science and social science.

Explicit inclusion of the professional field could further clear articulation of the learning outcomes corresponding to the qualification of the graduate as a 'linking pin' between data science and a field of application.

Conclusion
The programme meets standard 1.

4.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Outline of findings
The Master Data Science and Society is a 60 EC programme, consisting of four terms, with the final term completely reserved for the thesis Data science in Action. In this thesis the students combine data science with social science. See the following schedule for the contents:

TERM 1			
Data Science and Regulation and Law 1 (3 EC)	Research Skills: Data Processing (3 EC)	Data Mining for Business and Governance (6 EC)	Statistics and Methodology (6 EC)

TERM 2		
Data Science and Regulation and Law 2 (3 EC)	Research Skills: Data Processing Advanced *or* Statistical Programming with R (3 EC)	Electives (compulsory choice) (6 EC)

TERM 3		
Analytics for Business and Governance (6 EC)	Electives (compulsory choice) (6 EC)	Thesis / Data Science in Action (project proposal) (3 EC)

TERM 4
Thesis / Data Science in Action (15 EC)

The schedule above is for students starting in September; students starting in January follow an adjusted curriculum. All courses in the same term run in parallel.

Teaching methods
The teaching is aimed at activating students. The core principle of the program is learning by doing. This principle applies to both the more practical programming courses as to the more theoretical ones. Practical seminars in the computer room and for instance legal cases in the law courses, are all building blocks in order to prepare the students for their thesis project, called Data Science in Action.

Research

The master Data Science and Society aims to offer a research-intensive education that Is integrated in the curriculum. In a number of courses, such as Research Skills, Analytics and Methodology, the students are prepared for their thesis programme Data Science in Action. Since the thesis is usually written in cooperation with public or private organizations a strict procedure applies to ensure the scientific integrity of the research.

Admission

Students admitted to the programme are required to have a bachelor's degree that include basic courses on statistics and methodology. They come from a variety of bachelor's programmes from the fields of social sciences, humanities, economics or law. Sufficient knowledge of statistics and methodology is a prerequisite for the programme and if not available this has to be achieved in a pre-master programme. This is clearly stated in the admission criteria. From 2018 there will be a special pre-master programme for bachelors from universities of applied sciences.

Staff

The teaching staff assigned to the master Data Science and Society is employed by Tilburg University and works at one of the four schools involved in the programme. The panel has seen the CV's of the staff. All staff members have extensive academic experience in the subject matter of their courses, and all have a Ph.D. degree. Ph.D. candidates assist the lecturer during most practical seminars. Most lecturers combine research and education.

Tilburg University has introduced the University Teaching Qualification (UTQ). At the moment 50% of the teaching staff of the programme has passed the UTQ and 20% is in the process of passing the qualification. All lecturers are accustomed to teaching in English.

Considerations

In general, the panel believes that the curriculum contains a coherent programme that supplies the students with a firm base to combine data science and social science. Considering the fact that the programme's duration is one year, choices have to be made. It is also obvious that not all the links between data science and social science can be covered in-depth. The panel concludes that the students do not obtain master's level on all (data science) subjects, but that the interdisciplinary character makes for an enrichment of the societal part of the programme at master's level and thus for an overall master's level of the programme.

The social-sciences dimension is well represented in two subjects: a) Data Science Regulations and Law and b) Analytics for Business and Governance.

For a master programme the panel expects that it builds upon knowledge and the level achieved by the student at bachelor level. For this particular programme, this should also apply for the social science component. The electives in individual cases can be chosen in such a manner that this is ascertained. But students are free to choose and there is no clear policy to safeguard an appropriate level in the domain of the social sciences. Clearly only the combination of being data savvy in a field in which an appropriate level of professionalism (substantive expertise) is reached, makes the 'linking-pin' in data science as intended by the programme.

As argued at different points the panel has no doubt on the level reached in the understanding of data science tools and methodology. The programme clearly also provides integrative skills, but the level achieved in the field in which data science is applied is not sufficiently defined and taken into account in the design of the programme. Electives chosen to build upon knowledge acquired in the bachelor in combination to an appropriate admission policy might provide for this (see admission policy and conditions). The panel therefore formulates as a condition to define individual study pathways for students leading to the realisation of this intended learning outcome.

The compulsory part of the curriculum is well designed and sufficiently organized. The panel is glad to see that the many electives supply adequate opportunities for different directions and substantive expertise in the field in which data science is applied.
The learning by doing didactical approach is recognized by the panel. Students and teachers provided convincing examples and it was convincingly demonstrated in the documents.

It is in the thesis trajectory that the combination of data science and social science reaches its full benefits. The thesis integrates all relevant aspects of data science in a real life situation. Most theses are written in close cooperation with public or private organizations.

Admission policy
The panel believes that the admission policy of the master's programme is executed appropriately according to the admission criteria set. The entry requirements for statistics and methodology guarantee a proper basic level on these subjects. The panel was informed that the levels for these subjects are as one may expect from a bachelor in social sciences.

The panel struggled however with how the programme builds upon knowledge acquired in the specific bachelor to acquire the intended 'substantive expertise in the field in which the data science is applied'. Building further on this background achieved in the bachelor is needed to legitimize this programme. The panel therefore formulates as a condition to develop enrolment criteria for the programme related to the background in the previous disciplines of the individual student and define a clear prerequisite level of knowledge in the domain of social sciences.

Quality assurance
The panel discussed in depth the instruments that are used to assure the quality of the programme. The quality assurance fits in the overall quality assurance of Tilburg University.

Teaching staff
The panel is confident about the quality of the teaching staff. Lecturers are enthusiastic and are well qualified for delivery of the programme. The panel has seen a lot of commitment within the team and a strong cooperation between the institutions that take part in the programme. The coordinating lecturers meet on a regular base to discuss possible issues concerning the program.

Student's workload
Both the staff and the students indicate that the workload is considerable. There are several causes for this. An important cause is the steep learning curve in the area of data sciences. In addition, it appears that many students follow a second master in addition to this master, usually in the field of social sciences. However, this heavy study load is not seen as a

disadvantage by the students; they are happy with the possibility to use the tools of data sciences within their own field.

Students feel proficient in the use of the data-science tools. They feel there is sufficient guidance and they can use state-of-the-art lab facilities. The panel was impressed by the DAF lab, which offers 3D augmented-reality means for examining data structures, among other applications.

Conclusion
The programme partially meets standard 2.

As argued by the panel the programme needs to refine admission policy and programme design to safeguard the achievement of substantive expertise in the field in which the data science is applied.

4.3 Standard 3: Assessment

The programme has an adequate system of student assessment in place.

Outline of findings
The assessments of the master are regulated by the Education and Examination Regulations (EER). Due to the practical nature of a considerable part of the programme practical assignments play an important role. They have an important formative function. Knowledge is assessed through written exams and skills through assignments.

The relation between the learning objectives and the exam questions and practical assignments are laid down in an assessment matrix, which is published as well. The program council and the academic director monitor the assessment plan and course objectives of the program. The Tilburg School of Humanities and Digital Sciences examining board assures that these objectives are met and that there is a sufficient level of variation in the assessment methods.

The panel found that the assessment criteria are available in advance. After the exams students may have access to their graded work.
The panel studied the assessment matrix and a selection of exams. It established that the assessment matrix is well designed and meets the standards as defined by Tilburg University in its assessment policy. The panel recommends to evaluate and further specify the learning goals on communication for this programme.

Also the interview with the examination board confirmed that the quality of assessments is well safeguarded. In addition the Tilburg University provides for the possibility to consult an assessment specialist to enhance professional assessments.

The thesis students are required to develop a project proposal for their thesis Data Science in Action. This proposal contains the research question and the methodology to be used. Only after the approval of this research plan, students are permitted to proceed. A document describing the assessment criteria of the project proposal and the thesis is available for the students. Draft and final versions of the thesis are supervised by an assigned supervisor.

Considerations

The panel was convinced by the evaluation of the assessments. It noted that the examination board is strict in maintaining entrance criteria; furthermore the examination board expressed the need to further specify some aspects in the assessment policy for the new programme.

The panel noticed that there is a discrepancy between the objectives to train the students in communication and the assessment matrix. The panel also recommends to explicit specify the multidisciplinary of the courses in the assessments.

Conclusion

The programme meets standard 3.

4.4 Standard 4: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Outline of findings

In the information dossier it is stated that in the thesis, the students demonstrate that they master the intended learning outcomes. The thesis is an individual project in which students perform a large-scale data-driven analysis. In the thesis, students integrate knowledge and skills acquired earlier in the program.

The thesis project is a Data Science in Action enterprise. Learning goals define that students combine the technical, legal, and entrepreneurial skills acquired earlier in the program with insights provided by lecturers and companies involved in the different projects. The Data Science in Action project prepares students to work as all-round data scientists in a variety of fields.

The thesis results from this project and is usually written in close cooperation with public or private organizations.

Guidance is provided by lecturers from the programme. The guidance is matched with the subject of the project.

The panel studied 18 out of 87 theses from graduates since 2015. The panel focussed on recent papers from graduates in 2017 and 2018. Each panel member studied lower-marked, mediocre and good to very good graded papers.

The overall conclusion is that the panel had no doubt that master level is achieved. It found not one thesis that was below standard.

The papers all demonstrate sufficient skills in the application of data-science methodologies or tools. The papers also reflect good skills in methodology and statistics. Graduates demonstrate to be proficient in relevant data-science tools.

In addition to the findings of the panel on the quality of the theses, alumni and representatives from the working field convinced the panel that the graduates are of sufficient master level.

The programme convincingly argues that graduates have no trouble finding a job. The track Business and Governance started in September 2015. Graduates in general quickly find a job. At the moment of the writing of the application dossier there are 72 graduates of which 63 found a job. At that moment the work status of the remaining 9 is unknown. Almost all jobs match with the knowledge and skills that graduates have acquired during the program.

The demand for graduates is also indicated by the fact that private companies and nonprofit organizations regularly, and in some cases repeatedly, ask our students to do their final project in their organization.

Considerations
In conclusion the panel established that the intended learning outcomes are sufficiently met. The theses are definitely at master level and graduates prove that they are able to perform as a linking pin in domains in which data science is applied. They demonstrate sufficient apprehension of data science (are 'data savvy').

Based on the intended outcomes, the profile of the programme and the integrative character of the thesis project, the panel is of the opinion that the accent on "society" could be strengthened. As the programme has the explicit intention to bridge from Exact sciences to Humanties and Social Sciences, this multidisciplinary bridging skill could be reinforced and more prominently visible from the theses.

Conclusion
The programme meets standard 4

4.5 Qualification and field of study (CROHO)

The panel advises to award the degree 'master of science' to the wo-master Data Science and Society. The panel supports the program's preference for the CROHO field of study 'sectoroverstijgend'.

4.6 Conclusion

The conclusion of the panel is that the programme partially meets standard 2. It satisfies the other standards. The overall conclusion on the programme is 'conditionally positive' since the improvements needed to meet standard 2 to full extent are feasible within a period of two years.

Requirements
The conditions encompass the strengthening of a structured individual study path towards the intended profile of the graduate as a 'linking-pin' in the application of data science in a field in which the graduate acquired substantive expertise. In relation to that the panel also recommends to reflect on the Learning Outcomes in the light of the interdisciplinary intentions of the programme and take the heterogeneous background of the students into consideration. Currently this remains rather implicit and informal. The panel however found no indications that this could jeopardize the basic quality of the programme. On the contrary,

assessments and theses studied convinced the panel that a sufficient level is reached and graduates definitely are 'data savvy'. The growth of the number of participating students however demands further elaboration on the requirements below.

The panel recommends to:
- further specify the Intended Learning outcomes: benchmark with (inter) national frameworks in the data-science field, include the multidisciplinary perspective more clearly and articulate a vision focused at the enrichment of other disciplines with data science;

and formulates the following conditions to be met:
- develop enrolment criteria for the programme related to the background in the other disciplines of the individual student and define a clear starting level in the 'societal domain';
- evaluate the programme as a whole and its individual courses on the contribution to the Intended Learning outcomes. Give specific attention to the objectives in the domain of communication. Strengthen where needed;
- develop a system of 'suggested individual study paths' for students as a structured combination of courses that build upon and enrich the disciplinary background of the students. Advance that students build on the strengths and what they already learned in the bachelor to develop 'substantive expertise in the field in which the data science is applied'.

5 Overview of the assessments

Standard	Assessment
Intended Learning outcomes *Standard 1 : The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements*	Meets the standard.
Teaching-learning environment *Standard 2 : The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.*	Partially meets the standard.
Student assesment *Standard 3: The programme has an adequate system of student assessment in place.*	Meets the standard.
Achieved learning outcomes *Standard 4: The programme demonstrates that the intended learning outcomes are achieved..*	Meets the standard.
Conclusion	Conditionally positive

Annex 1: Composition of the panel

Chair:

– Maarten van Steen (University of Twente): Professor distributed systems at the University of Twente, scientific director of Digital Society Institue, and chair of IPN, a national platform representing all academic ICT research in The Netherlands. Van Steen studied Applied Mathematics at the University of Twente, and obtained a MSc (cum laude) in 1983. His field of study was combinatorial optimization and notably graph theory. In 1988 he was awarded a Ph.D. in computer science from Leiden University, where he researched operating. After his graduation, Van Steen spent approximately five years working for TNO research, and switched back to academic life in 1993 (Erasmus University Rotterdam), to join VU Amsterdam in 1994 as an assistant professor. He was appointed full professor in 2002, and became head of the Computer Science department in 2010 and remained so until moving to the University of Twente. More on his research, publications, (previous) teaching, and textbook writing can be found on: http://www.distributed-systems.net.

Panel members:

– Prof. Dr. Elena Marchiori, Is Professor of machine learning for natural sciences and head of the section Data Science section, at the Institute for Computing and Information Science (iCIS) of the Faculty of Sciences, Radboud University. Marchiori studied applied mathematics at the University of Padua (Italy). In 1992 she was awarded a Ph.D. degree on formal methods. After her PhD she was employed as a Post-Doctoral Researcher at the Centrum voor Wiskunde en Informatica, and at Leiden University. In 1996 she became Assistant Professor at the University Ca' Foscari of Venice. In 1999 she moved to the VU Amsterdam. In 2008 she joined the Institute for Computing and Information Science at the Radboud University as associate professor, where she was appointed full professor in machine learning for natural sciences in 2015. Her current research interests include the development and application of machine learning methods, in particular graph-based and deep learning techniques for image, spectral and sensor data analysis.

– Prof. Dr. Ir. Wim Van Petegem holds an MSc degree in Electrical Engineering from the University of Ghent (Belgium), an MSc degree in Biomedical Engineering from the KU Leuven (Belgium) and a PhD degree in Electrical Engineering from KU Leuven (1993). He has worked at the University of Alberta, Edmonton (Canada), at the Open University of the Netherlands and at the Leuven University College (Belgium). From 2001 till 2012 he was the head of the Media and Learning Center and later he became Director of the Teaching and Learning Department at KU Leuven (Belgium). Currently he is Professor at the Faculty of Engineering Technology at KU Leuven, and policy coordinator learning technologies. He is expert in multicampus and engineering education. He is teaching courses on media production and development of learning materials, and on professional and intercultural engineering skills. He is actively involved in different networks of universities (like SEFI, EDEN, and MEDEA). His research interests are in the field of multimedia production, new educational technology, networked e-learning, virtual mobility, lifelong learning, open and distance learning, knowledge transfer, science communication, engineering education and soft skills for engineers. He and his team are involved as contractor, partner, coordinator, expert, or evaluator in many implementation

and development projects mostly financed by the European Commission (DG Education and Culture). He is also heavily engaged in development cooperation with the South.

Student member:

– Lennart van Doremalen is a PhD candidate at the institute of Subatomic Physics at Utrecht University. He studied the research master 'Experimental Physics' and the bachelor 'Physics and Astronomy' at the same university. During his studies, he was co-founder of the student party Lijst Helder and student representative for this party in UU's University Council. From 2009 until 2010, he was the student board member of the Department of Physics. In 2012, he organised the International Conference of Physics Students (ICPS) in collaboration with fellow students. In addition, Lennart was an active member of the national student union LSVb, the local student union VIDIUS, and fulfilled several functions as board member or advisor next to his studies. He is also co-founder of the Utrecht municipality council party Student & Starter.

Secretaries
Willem Hendrikx (external) and Frank Wamelink (policy advisor, NVAO)

Annex 2: Schedule of the site visit

The panel visited Tilburg University on 8th of June 2018 as part of the external assessment procedure regarding the wo-master Data Science and Society.

08.30-08.45 Faculty Club Meeting with the Rector Magnificus and TSHD board : welcome
   prof.dr. Emile Aarts, Rector Magnificus
   prof.dr. Wim Drees, Dean TSHD
   mr. Cécile de Vos, Managing Director TSHD

8.45 – 09.30 Faculty Club Meeting of the committee and study of documents (private)

09.30-10.15 Faculty Club Session 1 – Program Management
   Session starts with a short presentation (5 minutes) - dr. Marie Postma
   dr. Marie Postma, Program director
   prof. dr. Pieter Spronck, Head of Department DCA
   dr. Herman de Regt, Vice-dean of Education
   drs. Loes Jongen, Head of the Education Support Team TSHD

10.15 – 10.30 Faculty Club Short break (private)

10.30 – 11.15 Faculty Club Session 2 – Teaching staff
   prof. dr. Eric Postma, TSHD
   dr. ir. Martijn van Otterlo, TSHD
   dr. Andrew Hendrickson, TSHD
   dr. Katrijn van Deun, TSB
   dr. Kyle Lang, TSB
   dr. Gul Gurkan, TiSEM
   dr. Hans Weigand, TiSEM
   dr. Colette Cuijpers, TLS
   dr. Maurice Schellekens, TLS

11.15 – 11.30 Faculty Club Short break (private)

11.30-12.00 Campus tour

   Tour guide: Dennis de Groot, student Data Science: Business and Governance
   DAF Lab: prof. dr. Max Louwerse

12.00 – 12.30 Session 3 – Student cases and projects

   dr. Grzegorz Chrupala
   dr. ir. Martijn van Otterlo
   dr. Maryam Alimardani
   + selected posters and presentations

12.30 – 13.00 Faculty Club Lunch panel and study of documents (private)
13.00– 13.45 Faculty Club Session 4 – Examination Board and Program Committee
   dr. Rein Cozijn, Head Exam Committee TSHD
   dr. Menno van Zaanen, Admissions and member Exam Committee TSHD
   dr. Amy Hsiao, Test Committee
   dr. Martin Atzmüller, Program Committee
   dr. Carol Ou, Program Committee
   drs. Denise Lindenau, Academic Advisor

13.45 – 14.00 Faculty Club Short break (private)

14.00 – 14.45 Faculty Club Session 5 – Students
    Lars van Geet
    Dominique van Deursen
    Danique Sabel
    Jessica Maarleveld
    Thodoris Karozis

14.45-15.15 Faculty Club Short break (private)

15.15 – 15.45 Session 6 – Alumni and representatives from the working field
    Spyroula Masiala, Graduate DSBG - PhD candidate Tilburg University
    Vera de Jong, Graduate DSBG - Data Scientist Nationale Nederlanden
    Tom Terneusen, Graduate DSBG - Officer / Cadet Ministerie van Defensie
    Bart Broere, Graduate DSBG - Data analyst Dutch Forensic Institute
    Rob van den Hurk, Senior Advisor Economy and Higher Education Tilburg
    Municipality

15.45 – 17.15 Committee deliberations (private)

17.15 Brief feedback by the chairman of the committee

Annex 3: Documents reviewed

Programme documents presented by the institution
- Information dossier
- Appendices to the information dossier:
- Appendix A Intended Learning Outcomes
- Appendix B Overview of the curriculum
- Appendix C Concise description of courses
- Appendix D Teaching Staff

- Documents made available during the site visit
  o Curricula vitae of teaching staff
  o Course materials
  o Study Guide
  o Information materials
  o Policy documents on examination and assessments
  o Posters and presentations on student projects
  o Assessment policy
  o Assessment matrices
  o Assessments
  o A selection of theses

Annex 4: List of abbreviations

ba   bachelor

EC   European Credit

hbo   hoger beroepsonderwijs

ma   master

NVAO   Nederlands-Vlaamse Accreditatieorganisatie

wo   wetenschappelijk onderwijs

The panel report was ordered by NVAO for the initial accreditation of the programme wo-master Data Science and Society of Tilburg University.