

wo-bachelor Data Science  
(joint degree)  
Eindhoven University of  
Technology  
Tilburg University

3rd February 2016

## Table of Contents

<b>1</b>	<b>Executive summary</b>	<b>3</b>
<b>2</b>	<b>Introduction</b>	<b>5</b>
	2.1 The procedure	5
	2.2 Panel report	6
<b>3</b>	<b>Description of the programme</b>	<b>7</b>
	3.1 General	7
	3.2 Profile of the institutions	7
	3.3 Profile of the programme	8
<b>4</b>	<b>Assessment per standard</b>	<b>9</b>
	4.1 Intended learning outcomes: Standard 1	9
	4.2 Teaching-learning environment: Standard 2	11
	4.3 Assessment: Standard 3	16
	4.4 Graduation guarantee and financial provisions: Standard 4	18
	4.5 Conclusion	18
<b>5</b>	<b>Overview of the assessments</b>	<b>19</b>
	<b>Annex 1: Composition of the panel</b>	<b>20</b>
	<b>Annex 2: Schedule of the site visit</b>	<b>22</b>
	<b>Annex 3: Documents reviewed</b>	<b>24</b>
	<b>Annex 4: List of abbreviations</b>	<b>25</b>

## 1 Executive summary

The Accreditation Organisation of the Netherlands and Flanders (NVAO) received a request for an initial accreditation procedure, including programme documents, regarding a proposed joint degree (wo) bachelor's programme Data Science at Eindhoven University of Technology (TU/e) and Tilburg University (TiU). NVAO convened an expert panel, which studied the information available and discussed the proposed programme with representatives of both institutions and the programme during a site visit. Since the programme is meant to be a joint degree programme, the panel considered the joint degree requirements as well. The following considerations have played an important role in the panel's assessment.

The panel concludes that the intended learning outcomes meet international standards for bachelor level (as reflected in the Dublin descriptors), the academic orientation and the requirements of the disciplinary and professional field. Also, the interdisciplinary scope of the programme is reflected in the intended learning outcomes.

The benchmark statement gives a well-informed and promising answer to new developments in data science and the professional field. It fills in the needs of the data science business for graduates with this specific bachelor's profile. The programme is at the heart of the developments in the field. The professional field shows high demand for students with a bachelor's degree in data science. In addition, students are well prepared for admission in a master's programme.

The panel supports the formation of a Scientific Council to stay attuned to developments in the field. The panel recommends appointing more external representatives in this council.

A further recommendation of the panel is –beyond the scientific field– to continuously monitor the aims and goals of the programme in relation to the technological and industrial developments in the field of data science to remain in line with the business needs.

The panel acknowledges that the curriculum is systematically designed. The content of the courses, working methods, case studies, literature and lecturers are well aligned with the intended learning outcomes. Relevant subfields are addressed in the programme; the interdisciplinary character of the programme is well reflected and sustained in the courses by a collaborative effort of lecturers from both universities. The panel recommends safeguarding relevant and sufficient statistics and programming courses in the programme.

The programme is coherent and the Data Challenges courses have an integrating role in this respect. These courses give students the opportunity to implement the learned knowledge and skills and to further develop these with real world data cases. The panel is convinced that relevant scientific literature at the appropriate level will be used.

The educational concept and didactical formats suit the bachelor's programme. While the new learning methods are ambitious but not always in place yet, the panel is confident the programme will adopt these and will give more attention to this in the future. The panel believes that the number of contact hours is sufficient for tutoring and guidance. Guiding and intake of the students is adequate. The upholding of the student community is being taken seriously.

The programme will be taught by competent and – as demonstrated during the site visit – enthusiastic lecturers. The panel notes that the staff is well equipped to provide the programme. The panel also concludes that lectures are well connected to the field of data science. Based on the description of the facilities and the site visit the panel concludes that the programme-specific facilities will be adequate. The site visit confirmed that the tuning of organisational and administrative processes between both universities is strenuously worked on.

The panel considers the joint degree characteristics of the programme to be adequately implemented. The two institutions cooperating in the programme participate on an equal basis in the curriculum, each of the institutions designing and offering courses, in the staff deployment, renowned researcher and lecturers of each of the institutions lecturing in the programme, and in the facilities, each of the institutions providing lecture rooms, laboratories and equipment.

With respect to the assessment system, the panel concludes that this is adequate and that the examination board will safeguard the quality of the assessments and the bachelor level of the graduates. Different assessment methods are used, related to the goals of the different courses. The panel appreciates the use of multiple assessment methods in the courses. The weighing has been made explicit and for each module assessment forms have been developed.

The panel concludes that the necessary financial provisions have been made to facilitate the start of the programme in study year 2016 – 2017. In addition,, the programme ensures that students will be guaranteed the opportunity to finish their programme.

Given these considerations, the panel advises NVAO to take a positive decision regarding the quality of the proposed academic bachelor's programme Data Science of Eindhoven University of Technology (TU/e) and Tilburg University (TiU) and to grant the programme the initial accreditation. As the programme meets the joint degree requirements, the panel also advises NVAO to grant the programme the status of a joint degree programme.

The panel supports the request for the programme to be registered under "Technology" as its field of study (CROHO-onderdeel).

The Hague, 3rd February 2016

On behalf of the Initial Accreditation panel convened to assess the programme,

Marianne van der Steen  
(chair)

Titia Buising  
(secretary)

## 2 Introduction

### 2.1 The procedure

NVAO received a request for an initial accreditation procedure including programme documents regarding a proposed academic (wo) bachelor's programme Data Science (joint degree). The request was received on November 4<sup>th</sup> 2015 from Eindhoven University of Technology and Tilburg University.

An initial accreditation procedure is required when a recognised institution wants to offer a programme and award a recognised bachelor or master's degree. To a certain extent, initial accreditation demands a different approach to the accreditation procedure for programmes already being offered. Initial accreditation is in fact an ex ante assessment of a programme, and a programme becomes subject to the normal accreditation procedures once initial accreditation has been granted.

Because of the international nature of the programme, the NVAO convened an international panel of experts. The panel consisted of:

- Marianne van der Steen (chair), professor of Entrepreneurship in Healthcare and founding director of the European Executive MBI Life Sciences & Health program, at the Julius Center, UMC Utrecht, The Netherlands, associate professor at the Faculty of Health, Medicine and Life Sciences, Maastricht University (MERLN);
- Wim van Petegem, professor at the Faculty of Engineering Technology at KU Leuven, Expert Multicampus & Engineering Education at the Faculty of Engineering Technology. Involved in research, development and implementation of multicampus engineering education, with special focus on internationalisation, innovation, entrepreneurship, development cooperation, and profiling;
- Maarten van Steen, professor distributed systems at the University of Twente, scientific director of CTIT, and chair of IPN, a national platform representing all academic ICT research in The Netherlands;
- Lennart van Doremalen (student) Master student Experimental Physics, Utrecht University.

On behalf of the NVAO, Frank Wamelink (policy advisor) and Titia Buising (secretary), were responsible for the process coordination and the drafting of the experts' report.

This composition 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 had the task to apply a combination of Frameworks and regulations in its assessment:

- Initial Accreditation of a new program. The 'limited' version of this framework applies since both institutions satisfied the requirement for a positive institutional assessment. The panel has based its assessment on the standards and criteria described in the NVAO Initial Accreditation Framework (Stcrt. 2014, nr 36791);
- Requirement for a joint degree program as stated in the Framework leading to Joint Degrees. The panel assessed the joint degree aspects of the proposed programme on the

basis of the NVAO Protocol for Dutch Applications for Initial Accreditation leading to a joint degree (7 June 2010, version February 2011);

- In addition the panel decided on the labelling of the field of study in the National Register (CROHO Sector). This was based on comparison with similar programs and additional argumentation as part of the application.

In the report the panel follows the Framework for limited accreditation and will add argumentation on the Joint degree aspects if relevant.

In preparing the accreditation, the following procedure was undertaken. The chair and the process coordinator discussed the application documents; main themes for questioning; assessment methods; audit attitude; interview techniques, teamwork of the panel and review of the documentation during the afternoon of Monday the 11<sup>th</sup> January. This resulted in a first explorative list of themes to be discussed during the site visit that was shared with the panel members by e-mail. Next to that additional instructions have been provided on the organisation of the site visit and additional information to be studied by the panel.

The panel members studied the application documents (Annex 3: Documents reviewed) regarding the proposed programme. Their first impressions were sent to the secretary of NVAO, in order to outline these remarks within the accreditation framework and detect the items to be clarified during the site visit.

Based on its first findings, the panel organised a preparatory meeting before the site visit. The site visit took place on January 18<sup>th</sup> and 19<sup>th</sup> at Eindhoven University of Technology and Tilburg University (Annex 2: Schedule of the site visit). The site visits of the bachelor programme Data Science and the master programme Data Science and Entrepreneurship were combined. Delegations were interviewed on both initiatives, and for the lecturers involved two separate interviews were held (one for each programme).

The panel formulated its preliminary assessments per theme and standard immediately after the site visit. These were based on the assessment of the programme documents and on the findings of the site visit.

## **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 TU/e and TiU and within the higher education system of the Netherlands.

The panel presents its assessments in the fourth chapter. The programme is assessed on 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 outlines 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 are its evaluations of these findings and their importance in view of the themes and standards. These considerations logically lead to a concluding assessment.

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

## 3 Description of the programme

### 3.1 General

Country	: The Netherlands
Institution	: Eindhoven University of Technology Tilburg University
Programme	: Data Science (joint degree)
Level	: bachelor
Orientation	: academic (wo)
Specialization	: not applicable
Degree	: Bachelor of Science (BSc)
Location(s)	: Eindhoven and Tilburg
Study Load (EC)	: 180 EC
Field of Study (CROHO sector)	: Technology

### 3.2 Profile of the institutions

#### *Eindhoven University of Technology*

Eindhoven University of Technology (TU/e) is a research university specializing in engineering science & technology. Recently all undergraduate education has been brought together in the Bachelor College. This Bachelor College has been set up to be the home to the university's Bachelor's study programs. The Bachelor College gives bachelor students more freedom and the choice to either follow a broad-based program or to opt for a very specialized science program. The Bachelor College currently offers fifteen majors.

Post-Bachelor education at Eindhoven University of Technology is provided by the TU/e Graduate School. The Graduate School offers 15 graduate programs each focused on a specific field of research. A graduate program consists of one or more master programs with the possibility to continue with a Technological Designer or PhD program in the same field. In total 22 master programs are offered.

#### *Tilburg University*

Tilburg University's (TiU) goal is to actively contribute to society. The university aims to contribute to solving social issues by developing and transferring knowledge and bringing together people from various disciplines and organizations. Understanding Society is the university's motto. TiU's education is research-based and research-driven. The education is organised in five schools: the School of Economics and Management, Law School, School of Social and Behavioural Sciences, School of Humanities and School of Theology. These areas also represent the fields of research. The university offers 19 bachelor's programs and 48 master's programs.

#### *The initiative*

The bachelor's programme Data Science is part of a larger initiative called the Grand Initiative on Data Science (GRIDS). GRIDS is developed in close cooperation with governmental and commercial partners. With GRIDS, both universities want to develop an innovative and compelling set of educational academic programs in data science. These programmes cover a broad scope of domains such as engineering, business, science and entrepreneurship. Together the universities aim to lead the data science revolution by

educating the next generation of data science professionals. The GRIDS programmes are characterized by interdisciplinary coursework and cutting edge research. GRIDS aims to offer four programmes:

- bachelor programme Data Science (joint degree);
- master programme Data Science and Entrepreneurship (joint degree);
- master programme Data Science Business & Society (at TiU, starting as a track in existing programmes);
- master programme Data Science in Engineering (at TU/e, also starting as a track in existing programmes).

The programme management of the joint new bachelor's programme will be located at TU/e. The programme management of the joint new master's programme will be positioned at TiU.

### **3.3 Profile of the programme**

The proposed bachelor programme Data Science is a full time, three-year programme, comprising 180 EC. The programme aims to attract 80 students in the first year, leading up to 200 students per year starting 2018. The programme aims to educate independent academic thinkers, with a solid background in data science that can approach problems with curiosity, creativity and an enterprising spirit.

The proposed programme is a joint degree programme. The panel notes that the programme is not only new for both universities, the programme is also unique for the Netherlands. The information dossier indicates that no other institution of higher education in the Netherlands offers a programme with a similar profile. The site visit confirmed the necessity for this specific bachelor's programme in the data science business.



## 4 Assessment per standard

This chapter presents the evaluation by the assessment panel of the standards. 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 conclusion of the panel. The panel presents a conclusion for each of the standards.

### 4.1 Intended learning outcomes: Standard 1

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

#### *Outline of findings*

The universities developed a subject benchmark statement<sup>1</sup>, with the intention to describe the field of data science and the envisioned characteristics of the graduates. The statement was newly developed because no internationally accepted subject benchmark statement has thus far been written for this relatively new field of study. Industry enterprises, governmental institutions and academic institutions endorsed this statement (for example Brand Loyalty, Bol.com, KPN, the University of Hamburg, the University of Leuven and the Federation of Universities of Technology in The Netherlands).

As mentioned the subject benchmark statement articulates several envisioned characteristics of graduates. These reflect amongst others a T-shaped understanding of data science. T-shaped graduates combine broad technical expertise with domain-specific knowledge that enables them to identify which problems need to be solved. Both an understanding of legal, business and ethical aspects of data science and a technical understanding of data science is needed. Moreover, graduates need an understanding of recurring themes in data science such as data identification, storage, data mining, visualization etcetera, and the relation between theory and practice. Graduates are also expected to be able to add actionable value to data and to be aware of the broad applicability of data science. In addition, problem solving skills, communication and organization skills, project experience, life-long learning and professional responsibility are deemed important.

Based on the benchmark statement the goals of the programme have been defined. The programme aims to deliver T-shaped undergraduates who combine a strong technical base with an interdisciplinary perspective of data science and deep knowledge and skills in solving real-world data science problems. The interdisciplinary perspective is reflected in knowledge of computer science, mathematics, statistics, business, society, ethics and law. The real-world data science challenges concern for example data storage, data streaming and processing, data mining, process mining, visualization and data analysis and modelling.

---

<sup>1</sup> For the proposed bachelor programme Data Science and the proposed master programme Data Science and Entrepreneurship

In addition to the technical aspects, students learn to understand the ethical, social and legal issues that affect the opportunities and limitations in the field of data science.

In addition a comparison with similar programmes of institutions in Germany (Technische Universität Dortmund), the United States of America (Northern Kentucky University), the UK (University of Warwick, University of Swansea) and the Netherlands (the University of Twente and Leiden University) was made. Regarding the latter two it is noted that Leiden University offers a minor in Data Science in the bachelor's programme computer science. Compared to the proposed programme, this minor offers only an accessible introduction into data science. The bachelor's programme Business and IT of University of Twente focuses on bridging the gap between business and technology. This programme offers a course on data and information. From the descriptions of the other curricula, it is evident the contents of the international programmes are to a large extent comparable to this bachelor's programme.

The aims of the programme have been translated into nineteen intended learning outcomes. These learning outcomes are validated against the internationally accepted requirements for bachelor-level as defined by the Dublin descriptors. The intended learning outcomes cover for example in-depth knowledge and understanding of theories, principles, methods and techniques from data science and the ability to store and manage data so that the data can be explored and analysed. Graduates have the ability to identify the problems or questions that can be addressed using specific data sets. In addition, graduates are expected to be able to visualise their results and to work in multidisciplinary teams. Graduates also show lifelong learning skills and a reflective and critical attitude.

A Scientific Council will be set up as a further provision to maintain learning outcomes and a curriculum that meets academic requirements. The council will consist of experts from both universities and an external representative. It is the intention to discuss the content of the programme with the council. Also, TU/e and TiU commissioned a market survey of the professional field. One of the findings is that data scientists are highly desired by different industries. During the site visit the representatives of the professional field confirmed that there is an urgent and high demand for the envisioned graduates.

The programme is designed as a joint degree programme of TU/e and TiU. TU/e provides technical expertise, whereas TiU offers the expertise in business, law and social issues. Offering the program in collaboration offers a strong synergy. In the delivery of courses the fields of expertise of both institutions is combined. The faculties involved have a long history in multi- and interdisciplinary initiatives, as was revealed in the discussions during the site visit. The discussions with the executive boards and deans of the faculties from both universities indicated that the lecturers involved in the (development of the) programme meet regularly and discuss the learning outcomes and the curriculum extensively on so called 'away days'.

#### *Considerations*

The panel is convinced that the intended learning outcomes meet international standards for bachelor level, the academic orientation and the requirements of the disciplinary and professional field. The benchmark statement gives a well-informed and promising answer to new developments in data science and the professional field. It fills in the needs of the data science business for graduates with this specific bachelor's profile. The programme is at the heart of the developments in the field. The professional field shows high demand for students with a bachelor's degree in data science. In addition, students are well prepared for admission in a master's programme.

The panel supports the formation of a Scientific Council to stay attuned to developments in the field. The panel recommends appointing more external representatives in this council.

The panel is satisfied by the arguments the programme put forward to meet the bachelor level as defined by the Dublin descriptors. The panel concludes that the interdisciplinary scope of the programme is reflected in the intended learning outcomes.

A further recommendation of the panel is –beyond the scientific field– to continuously monitor the aims and goals of the programme in relation to the technological and industrial developments in the field of data science to remain in line with the business needs.

From the interviews and the documentation, the panel determines that the cooperation between the two institutions is solid and starts from a clear and shared understanding of the aims and objectives of this endeavour bringing the respective expertise of the participating faculties, schools and institutions into a fruitful synthesis. The panel regards this to be a sound foundation for this joint degree programme and a major factor for the continuity of the programme in the future.

#### *Conclusion*

Based on the above-mentioned considerations, the panel concludes that the programme meets this standard.

## **4.2 Teaching-learning environment: Standard 2**

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

#### *Outline of findings*

##### A. Curriculum

The programme will be taught in English and comprises twelve quartiles of 15 EC each. The programme follows the structure of TU/e's Bachelor College. The programme consists of four types of courses:

- Basic (and mandatory) courses for engineers (30 EC).
- Data science courses (90 EC). This also includes the major and the final bachelor's project (10 EC).
- USE (User-Society-Enterprise) packages. Students choose a package. This includes a dedicated package Data Challenges (15 EC).
- Elective courses, to specialize or to gain a broader perspective (45 EC). This can also include several minors. The programme offers students a number of pre-defined sets of courses.

The programme offers the students an opportunity to develop a personal profile, with ample room for elective courses. In addition to these courses, students will be encouraged to study abroad. The site visit indicated that the Bachelor College offers room for discussions about the content of basic courses at the Bachelor College.

The programme starts with an introductory course Perspectives on Data Science. This course offers students an overview of the core elements of data science and the broader economic, normative and social setting of the field. The first year mainly offers (basic)

technical skills as statistics, programming, data mining and an introduction to legal and ethical aspects of data science.

In the second year the focus is on deepening disciplinary knowledge and skills. As in the first year, the second year also includes Data Challenges courses. These courses introduce students to real-life data science problems that they have to solve in small teams. Present throughout the programme, the Data Challenges courses constitute an interdisciplinary and integrative series of courses in which students learn to set up, conduct and report on large-scale data-driven analyses. In small groups students address questions with a practical relevance. The final Data Challenge course is programmed in the third year. During the second and third years students will take elective courses and, in the third year, embark on the final bachelor's project.

Research and scientific methods are present throughout the program: in the Data Science Research Methods course, the aforementioned Data Challenges and the final bachelor's project. In the Data Science Research Course students learn the fundamentals of the 'scientific method' and skills to independently assess and solve methodological problems in the use of data-intensive methods in engineering, business and society and entrepreneurship. In the Data Challenges courses students solve real-life problems in a scientific way. Also as a part of other courses real (large) data sets or simulated data sets are used to train the analytical skills of the students. In the final bachelor's project students address a real-life problem that requires substantial scientific research. The problems addressed ideally come from the societal partners participating in GRIDS (see paragraph 3.2).

In the information provided, the connections between the programme and the research programmes of the involved faculties are persuasively described. In addition, the interviews showed that lecturers will bring in data sets and results from their own research on data science.

Specific attention is given to the development of academic skills during the programme. Also in this aspect the programme follows the model of TU/e Bachelor College. This implies that a well-defined set of Academic skills is not part of a separate course but is taught in several courses (and skills are separately assessed in these courses. For example, the Perspectives on Data Science course covers the skills 'teamwork', 'presentation' and 'reflection'. These skills are also assessed in the course. All academic skills will be assessed three times during the programme. The academic skills involve 5 EC in total. The site visit showed that lecturers are, and new lecturers will, be trained in assessing these academic skills. This is a well-established practice but still in development and prone for improvement. During the discussions with the Examination Committee it became clear that the current interpretation of the academic skills and the assessment of these skills is currently subject of evaluation.

The discussion with the lecturers convinced the panel that the Data Challenges courses are an important and challenging aspect of the programme. In the course of these Data Challenges the complexity of the problems and the data-sets grows and the sophistication of the scientific methods applied increases. During the programme students get more autonomy in formulating a research question and analysing the data. In articulating the research questions, students are guided by their lecturer and by researchers familiar with the specific data set. Students can apply the knowledge and skills learned in other courses

in the Data Challenges courses. The second Data Challenge course for example, is directly related to the second year Innovative Thinking course.

The panel also discussed the role of statistics and programming in the programme. These topics are both addressed in one particular course each. The discussions with the lecturers revealed that even though the amount of dedicated courses to these topics is quite limited, statistics and programming are part of other courses. Programming skills for example are also part of the Data Challenges courses.

#### B) Learning outcomes

The panel evaluated whether and how the intended programme learning outcomes and competences formulated by the programme have been translated in the curriculum. During the site visit, it studied the correspondence between the programme learning outcomes, the Dublin-descriptors and the modules, as presented in the matrix provided by the programme. In addition, the panel gained insight by examining the examination regulations, the course descriptions and the scientific literature used. Also the lecturers have been interviewed on the contribution of their courses to the realisation of learning objectives. This convinced the panel that the intended learning outcomes are systematically cross-matched to the different courses. In the study guide and course descriptions, the content, learning objectives and assessment forms of each course are described, so the student is well informed about the goals and content of the courses.

#### C) Educational concept and contact hours

The programme aims for research-based learning, co-creation with practice and the use of innovative teaching methods. To encourage the interdisciplinary character of the programme, the courses have been developed and will be taught by teams of lecturers from both universities. In addition to lectures and tutorials blended learning will be used in the programme. The latter will comprise off- and online teaching methods such as virtual lectures, chat sessions, online assignments and a digital learning platform. The teaching methods are outlined in the course descriptions.

The discussions with the lecturers showed that there are experiences with the envisioned new learning methods in both universities however not yet fully implemented in this particular new programme.

The assignments, case-studies and assessments in the programme will help the student to develop professional skills (next to domain specific knowledge and skills) and a reflective and critical attitude towards data science.

The number of contact hours will vary per module. The majority of courses consist of 6 or 8 contact hours per week. The total amount of minimum contact hours (over the three years) is 1088 hours.

During the site visit the panel discussed with several representatives the building of a coherent student community of bachelor students. This might seem to be problematic since students enrol in one of the two universities and become part of the academic community of their 'home' institution. It is however an explicit choice to make the bachelor students participate in the broader community of both institutions. The programme will clearly be delivered at both institutions. The panel is convinced since it became clear that students will form one cohort, travel together between Tilburg and Eindhoven and take all courses

together. The discussions also revealed that in group work, students from both universities will be mixed.

#### D) Guidance and intake

Coaches will guide students throughout the programme. Academic advisors will be available at both universities for study counselling. At the end of the first year, students receive a binding study advice (the standard is 45 EC).

Students are admitted if they: a) have a vwo diploma including mathematics B or b) have finished an hbo propaedeutic year and demonstrable knowledge of mathematics B at vwo level. Students enrol in their university of choice (TU/e or TiU) and will be automatically secondary enrolled at the other university. At both universities study-matching activities are available for students. The programme wants to start with 80 students in the first year, increasing up to 200 students in the next years.

#### E) Staff

The panel was provided with an overview of the staff members involved in the programme, their role in the programme, level of education and expertise. Staff members from both universities collaborate in the programme. All staff members are actively involved in research and have a PhD. In particular courses PhD students and tutors will work with small groups of students on real-world data problems. Next to that, guest lecturers will be invited. All academic staff involved will meet twice a year to discuss the (development of the) programme and developments in the field of data science.

Coordination of the programme lies with the programme director at TU/e. Two deputy directors, one at TU/e and one at TiU, will support the programme director. The programme director is responsible for the (scientific) content, the organisation and the administration of the programme. The deputy directors are linking pins to each university and are responsible for the local organisation of the programme. The programme director and the deputy directors will work closely together. Moreover, they will meet at least once a year with all course coordinators. The programme is thus well embedded in the organisational structures of both universities, having still sufficient autonomy.

The intended staff – student ratio will be 1:25 in 2016 and 1:24.7 in the latter years. In addition, guest lecturers will be involved in the programme. The discussions with the lecturers made clear that both universities invest in extra hours for staff involved to develop the courses and materials. Moreover, new lecturers are hired for this joint programme (in total 7 FTE).

#### F) Programme-specific services and facilities

In this joint degree programme, students take courses either in Tilburg or in Eindhoven, as TiU and TU/e both offer their own share of the courses at their respective campus. Joint courses are divided between the two locations. This implies that students will travel between the two locations. To facilitate this, teaching is scheduled at only one university campus a day. At both locations ample teaching and learning, ICT and catering facilities are available. In addition, the electronic learning environment is available for students and lecturers. This environment will be used for interaction, sharing information, discussions and peer reviews. The student administration will be located at TU/e.

#### *Considerations*

The panel acknowledges that the curriculum is systematically designed. The content of the courses, working methods, case studies, literature and lecturers are well aligned with the intended learning

outcomes. The programme follows the structure of TU/e's Bachelor College. The site visit showed that this provides an opportunity for a broad base in data science and for students to specialise or broaden their knowledge base.

The panel determines that relevant subfields are addressed in the programme; the interdisciplinary character of the programme is well reflected and sustained in the courses by a collaborative effort of lecturers from both universities. The panel recommends safeguarding relevant and sufficient statistics and programming courses in the programme.

The panel ascertains that the programme is coherent and that the Data Challenges courses have an integrating role in this respect. These courses give students the opportunity to implement the learned knowledge and skills and to further develop these with real world data cases. The panel is convinced that relevant scientific literature at the appropriate level will be used.

The panel establishes that the educational concept and didactical formats suit the bachelor's programme. While the new learning methods are ambitious but not always in place yet, the panel is confident the programme will adopt these and will give more attention to this in the future. The panel believes that the number of contact hours is sufficient for tutoring and guidance. The programme management takes the upholding of the student community seriously and takes appropriate measures. The panel supports this.

Guidance and intake of students are adequate. The tutor will play an important role in the guidance. In addition, the lecturers will monitor student's progress during the modules.

The panel notes that the programme will be taught by competent and – as demonstrated during the site visit – enthusiastic lecturers. It is of the opinion that the staff is well equipped to provide the programme. The panel also concludes that lectures are well connected to the field of data science. Based on the description of the facilities and the site visit the panel concludes that the programme-specific facilities will be adequate. The site visit confirmed that the tuning of organisational and administrative processes between both universities is strenuously worked on.

The panel considers the joint degree characteristics of the programme to be adequately implemented. The two institutions cooperating in the programme participate on an equal basis in the curriculum, each of the institutions designing and offering courses, in the staff deployment, renowned researcher and lecturers of each of the institutions lecturing in the programme, and in the facilities, each of the institutions providing lecture rooms, laboratories and equipment. The programme is well connected with the organisational structure of both institutions. This provides plenty expertise, facilities and checks-and-balances. On the other hand the programme remains sufficiently independent in order to develop its own course.

#### *Conclusion*

Regarding the above-mentioned considerations, the panel concludes that the programme meets this standard.

### 4.3 Assessment: Standard 3

*The programme has an adequate assessment system in place.*

#### *Outline of findings*

##### Assessment system

A dedicated exam policy is developed for the joint bachelor's programme and the joint masters' programme. Assessment is seen as a tool of learning and a tool for learning. The test plan describes for each course which intended learning outcomes are assessed and how. The test plan will be discussed between the programme management and the examination committee on a yearly basis.

With interim tests students will be activated and students receive feedback in an early stage. Moreover, interim tests help students prepare for the final exam. The study guide will give students information about the number and forms of interim tests

The final grade for basic and first year courses will consist of the results of at least two interim tests and a final test. For second and third year courses this will be based on at least one interim test and a final test. The form of the tests will be aligned with the content and goals of the specific course.

A broad mix of assessment methods is used: online pre-exams, quizzes, peer-review sessions, case study assignments, computer assignments, poster presentations, written examinations, research papers and homework assignments. Each course uses several assessment methods. The course descriptions provide clear information on the assessment methods used, the assessment criteria, the weighing of the different methods, and the caesura. The Calculus course for example is assessed with interim examinations (each 10%), assignments (10%) and a written final examination (70%). Also at the beginning of the course, students are informed about the assessment criteria.

##### Final project

The bachelor's project is the finalisation of the programme. In this project students set up, conduct and report on academic research in the domain of data science. It includes a literature review and an extensive study of a relevant and contemporary research topic. Ideally, the research problem addressed is related to one of the partners in GRIDS. Moreover, students will combine their theoretical work with a (semi) controlled data project to explore the ramifications of their work and to pursue a (partial) validation of the reported work.

The supervision and assessment of the bachelor's project will be documented in a thesis manual. The assessment will take place by two assessors, one from each university. An assessment form has been developed and addresses the manuscript, the presentation, the thesis defence and the execution of the project.

##### Examination committee

A new examination committee will be installed for the bachelor's programme and the master's programme Data Science and Entrepreneurship combined. The board will consist of faculty members from both universities and an external member from the professional field. The committee will choose its chair from its members. At least two members of the committee will have specific



expertise regarding assessment. The examination committee will appoint examiners per course on a yearly basis.

The examination committee will supervise the quality of the exams in a three-year cycle. Checks regard the alignment of the content and form of the assessment, the execution and organisation of the exams and the quality requirements as stipulated in the assessment policy. The examination committee will also assess the quality of the bachelor's thesis by reviewing a random sample on a yearly basis.

The discussions with the examination committee showed that in constructing tests always two lecturers will be involved. Low or high scoring percentages on tests can lead to further investigation by the examination committee. To ensure the reliability of the tests, so-called testing matrices will be made. The intended members of the examination committee showed to be well informed about the tasks and role of the examination committee and demonstrated a sufficiently independent and critical attitude towards the quality of the assessments and the upholding of the bachelor level.

In the interview the examination committee expressed some concerns on the timely realisation of the tuning of the administrative processes at both universities. A separate project group is responsible for all organisational and administrative aspects of the joint programme. Based on an additional interview with representatives from this project group, the panel ascertained that the concerns of the examination committee will be dealt with in a professional and efficient manner. The panel is convinced that the concerns will not materialize.

#### *Considerations*

The panel concludes that the programme has an adequate assessment system in place. The exam policy and rules and regulations regarding assessment and examination support this conclusion. The panel notes that various assessment methods are used, related to the goals of the different courses. The panel appreciates the use of multiple assessment methods in the courses.

From the documentation presented and the information acquired in the meeting with the examination committee, the panel obtained a clear view on the responsibilities and the workings of this committee. The panel considers these to be appropriate and to be a safeguard for the quality of the examinations in the programme and the procedures in this respect. The panel also concludes that the examination board will safeguard the quality of the assessments and the bachelor level of the graduates.

#### *Conclusion*

Regarding the above-mentioned considerations, the panel concludes that the programme meets this standard.

#### 4.4 Graduation guarantee and financial provisions: Standard 4

*The institution guarantees students that they can complete the entire curriculum and makes sufficient financial provisions available.*

##### *Outline of findings*

TiU and TU/e guarantee that students have the right to complete the programme. In case the programme would be ended prematurely, students will be able to take exams until two years after the regular duration of the programme. TU/e and TiU will reimburse additional costs incurred by the students, if any.

A budget statement was presented, showing the income and expenses for the coming years. It shows that the programme will reach a stable situation in academic year 2020 – 2021.

##### **Considerations**

The panel is convinced that the programme is supported by the authorities of the TU/e and TiU and sufficient budget has been provided for the development and initial execution of the programme. Moreover, the commitment is high because the programme is part of the larger GRIDS initiative from both universities, in which also governmental and commercial organisations are involved. The panel recognizes that at both universities, the necessary financial provisions have been made to facilitate the start of the programme in study year 2016 – 2017. In addition,, the panel regards the guarantee, presented by the institutions, for the students to be able to complete the programme to be solid.

##### **Conclusion**

Regarding the above-mentioned considerations, the panel concludes that the programme meets this standard.

#### 4.5 Conclusion

The panel concludes that the quality of the programme is satisfactory for all four standards. It ascertains that the programme has defined clear intended learning outcomes and developed a coherent curriculum, including adequate guidance and intake criteria, and a variety of didactical formats, all executed competent and enthusiastic staff. In addition,, the panel considers the assessment system and thesis procedure to be adequate. The final judgment is therefore positive.

## 5 Overview of the assessments

Standard	Assessment
<p>1. <i>Intended Learning outcomes</i>  <i>The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements</i></p>	Meets the standard
<p>2. <i>Teaching-learning environment</i>  <i>The curriculum, staff and programme-specific services and facilities enable incoming students to achieve the intended learning outcomes.</i></p>	Meets the standard
<p>3. <i>Assessment</i>  <i>The programme has an adequate assessment system in place.</i></p>	Meets the standard
<p>4. <i>Graduation guarantee and financial provisions</i>  <i>The institution guarantees students that they can complete the entire curriculum and makes sufficient financial provisions available.</i></p>	Meets the standard
<p><b>Conclusion</b></p>	<b>Positive</b>

## Annex 1: Composition of the panel

**Marianne van der Steen** is Professor of Entrepreneurship in Healthcare and the founding director of the European Executive MBI Life Sciences & Health program and associate professor at the Julius Center, UMC Utrecht, the Netherlands. She is also appointed at the Faculty of Health, Medicine and Life Sciences, Maastricht University (MERLN). Before, she was Director and Professor of Innovation & Entrepreneurship at Antwerp Management School and visiting Professor Biomedical Entrepreneurship (HTSR/MIRA) at the University of Twente. Her research focus is on biomedical entrepreneurship, specifically on the growth of ventures & transformation of venture management teams. Marianne van der Steen holds a PhD in innovation economics (1999) at the University of Twente. She has received several grants from the National research council (NWO; ZonMW-NGI). She has received an award from the US government (US International Leadership award) and the Female Leadership award from University of Twente. Her latest publication is a Harvard Business School case: "Building an Integrated Biopharma Company: Crucell" (A) and (B) (HBS N2-815-085, February 2015). Marianne is one of the founders of PANAXEA B.V., a spin-off company of the University of Twente. Since 2006, she has been involved as consultant, business developer and coach in life sciences start-ups in the Netherlands and Belgium.

**Maarten van Steen** (University of Twente): Professor distributed systems at the University of Twente, scientific director of CTIT, 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 modelling operating systems (and built one). 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>.

**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. 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. He is expert in multicampus and engineering education. He is actively involved in different networks of universities (like EuroPACE, SEFI, EDEN, IACEE, MEDEA and the Coimbra Group). His current 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 and science communication. 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.

**Lennart van Doremalen** studies the master Experimental Physics at Utrecht University. He was a member of the University Council of this university for two years. He is one of the founding members of the party Student & Starter for the municipal council of Utrecht. During his studies he held numerous board, chair and advisory positions. He also was a member of the organization committee for the International Conference of Physics Students, held in 2012.

Secretary  
Titia Buising (trained by NVAO)

Procesoördinator  
Frank Wamelink (policy advisor, NVAO)

## Annex 2: Schedule of the site visit

<b>Day 1, Eindhoven</b>		
09.00 – 09.15	Reception of panel	Frank Baaijens
09.15 – 12.00	Internal consultation	
12.00 – 13.00	Lunch	
13.00 – 13.45	Representatives Executive Boards and Depts/Schools	Frank Baaijens Emile Aarts Ingrid Heynderickx Jakob de Vlieg Corien Prins Lex Meijdam
13.45 – 14.45	Program management and development team of both programs	Edwin van den Heuvel Leontien van der Knaap Willem-Jan van den Heuvel Eric van der Geer Michel Westenberg
14.45 – 15.15	Break	
15.15 – 16.00	Guided tour	Puck Mulders
16.00 – 16.30	Examination committee BSc – MSc and both programme committees	Rik Kaasschieter Jack van Wijk Herbert Hamers Colette Cuijpers Ed Nijssen
16.30 – 17.30	Representatives data science field	Ruud Jansen (BrandLoyalty) Karin Dekker (Achmea) Pascal Lubbe (SAS) Erik-Jan van der Linden (Magnaview) Koen van Holten (Boels Zanders Advocaten)
<b>Day 2, Tilburg</b>		
09.00 – 09.15	Reception	Emile Aarts
09.15 – 10.00	Teaching staff BSc	Johan van Leeuwen Daniel Oberski Dirk Fahland Marie Postma Richard Engeln Alessandro di Bucchianico Dick den Hertog Anton Vedder
10.00 – 10.45	Teaching staff MSc	Wil van der Aalst Ksenia Podoyntsyna Ronald Leenes Mike Papazoglou Jack van Wijk Wijnand Ijsselstein

		Arjan van den Born Eric Postma
10.45 – 11.15	Break / Mariënburg film	
11.15 – 12.00	Representatives graduate school	Patrick Groothuis Arjan van den Born Sjoerd Romme Willem-Jan van den Heuvel Wil van der Aalst
12.00 – 12.45	Lunch	
12.45 – 13.15	Guided tour	Pim Beimans
13.15 – 14.00	Students from related programmes	Rik Schepens Sako Arts Pam Pijnenborg Tom Terneusen Vasiliki Tsiftoglou Kia Eisinga
14.00 – 15.30	Internal consultation by panel	
15.30 – 16.00	Feedback by panel	

## Annex 3: Documents reviewed

Information dossier, including

1. Subject-specific reference framework and the learning outcomes of the programme;
2. Overview of the curriculum in diagram & table form;
3. Outline description of the curriculum components for the first year, stating learning outcomes, attainment targets, teaching method(s), assessment method, literature (mandatory and recommended), teacher and credits;
4. Relationship between learning outcomes and courses;
5. Additional information Joint Degree;
6. Assessment criteria final bachelor's project;
7. Professional skills: integration in the core courses (major)
8. Exam policy;
9. Education policy;
10. Program and examination regulations;
11. Overview of allocated staff with names, positions, scope of appointment, level and expertise;
12. Overview of the contacts maintained with the professional field;
13. Staff-student ratio;
14. Intended number of face to face hours;
15. Profile of the examination committee;
16. Macro efficiency decision Ministry of Education;
17. Report on the institutional quality assurance assessment Tilburg University;
18. Report on the institutional quality assurance assessment Eindhoven University of Technology;
19. Marktonderzoek Mariënborg, Dialogic;
20. Cooperation agreement between TU/e and TiU.

Documents made available during the visit:

Study materials for all first-year BSc courses



## **Annex 4: List of abbreviations**

ba	bachelor
EC	European Credit
GRIDS	Grand Initiative on Data Science
ma	master
NVAO	Nederlands-Vlaamse Accreditatieorganisatie
TiU	Tilburg University
TU/e	Eindhoven University of Technology
wo	wetenschappelijk onderwijs

The panel report has been ordered by NVAO for the initial accreditation of the programme wo-bachelor Data Science of Eindhoven University of Technology and Tilburg University.

Accreditation Organisation of the Netherlands and Flanders (NVAO)  
Parkstraat 28  
P.O Box 85498 | 2508 CD DEN HAAG  
T 31 70 312 23 00  
E [info@nvaio.net](mailto:info@nvaio.net)  
W [www.nvaio.net](http://www.nvaio.net)

Aanvraagnummer 004317