Research Review
Data Science and Knowledge Engineering
2010-2015

2 June 2017

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Preface

This report summarizes our assessment of the research at the department of Data Science and Knowledge Engineering (DKE) of the University of Maastricht during the period 2010-2015. We would like to thank the management and administration of DKE for the excellent preparation of our visit, which created the perfect conditions for us to perform our task. We really enjoyed the candid and constructive conversations with many of DKE's staff members, PhD students, and collaborators: these really helped us to obtain a better view of DKE's achievements and ambitions. Annemarie Venemans, our secretary, did a marvellous job in guiding us through the process and faithfully documenting our vivid discussions.

We sincerely hope that our conclusions and recommendations will help DKE to further sharpen its vision and policies in support of the socially relevant, high quality research that it aspires and is capable of.

On behalf of the assessment committee,

Tom Heskes (chairman)

1. Introduction

1.1 Terms of reference for the assessment

The quality assessment of research in Data Science and Knowledge Engineering (DKE) is part of an assessment system as specified in the Standard Evaluation Protocol For Public Research Organisations of 2015 by the Association of Universities in The Netherlands (VSNU), the Netherlands Organisation for Scientific Research (NWO), and the Royal Netherlands Academy of Arts and Sciences (KNAW).

The review committee was asked to assess the quality and relevance to society of the research conducted by the department of DKE in the reference period 2010-2015, as well as its strategic targets and the extent to which it is equipped to achieve them.

Three main criteria are considered in the assessment: research quality, relevance to society, and viability. In addition to the criteria above, the assessment considers three further aspects: PhD programmes, research integrity and diversity.

As reflected in the Terms of Reference for the assessment, DKE requested the committee to pay special attention to

- Ambition to perform excellent research in selected areas of artificial intelligence, and of applied mathematics and operations research;
- Ambition to play an active role in societal value creation, especially in subfields of the biomedical domain such as cardiology and the upcoming UM research in systems biology;
- Ambition and aim to have a close alliance of research goals with the UM's initiatives related to data science.

This report describes findings, conclusions and recommendations of this external assessment of DKE.

1.2 The Review Committee

The Board of the Maastricht University has appointed the following members of the committee for the research review:

- Prof. Tom Heskes (chairman)
- Prof. Michèle Breton
- Prof. Michael Luck
- Prof. Jaap Molenaar

More detailed information about the members of the committee can be found in Appendix A. The Board of Maastricht University has appointed dr. Annemarie Venemans as the committee secretary.

1.3 Independence

All members of the committee signed a declaration and disclosure form to safeguard that the panel members judge without bias, personal preference or personal interest, and that the judgment is made without undue influence from DKE or stakeholders. Any existing professional relationships between committee members and programmes under review were

reported. The committee concluded that there was no risk in terms of bias or undue influence.

1.4 Data provided to the Committee

Prior to the site visit, the committee received detailed documentation consisting of the following parts:

- Self-assessment report, including appendices
- SEP 2015-2021

In addition, the committee studied a benchmark document that was provided during the site visit.

1.5 Procedures followed by the Committee

The committee proceeded according to the Standard Evaluation Protocol (SEP). The final assessment is based on the documentation provided by the institute and the interviews with the management, a selection of researchers of the department, PhD students and external contacts of the department. The interviews took place on 11 April 2017 (see Appendix B).

The text of the assessment report was finalised through email exchanges. The final version was presented to the department for factual corrections and comments.

2. Assessment of the institute

Assessments:	Research quality:	3
	Relevance to society:	2
	Viability:	2

2.1 The DKE department

Governance of the department
The department of Data Science and Knowledge Engineering (DKE) is one of the departments of the Faculty of Humanities and Sciences (FHS). The Faculty has three clusters: Governance and Sustainability, Liberal Arts and Sciences, and Science, Technology and Engineering, and Mathematics (STEM). DKE is part of the STEM cluster. FHS is guided by a dean and a collegial board (FHS management team).

Currently, the department consists of 3 full professors, 3 associate professors, 17 assistant professors and 3 postdocs, that are quite evenly distributed over the three research groups.

Research area
DKE comprises three research groups having their focus on Robots, Agents and Interaction (RAI), Networks and Strategic Optimization (NSO), and Bio-Mathematics and Bio-Informatics (BMI):

- RAI addresses research topics centred around autonomous (multi-)agent technology, robotics, and machine learning. It maintains a robot lab, the “Swarm Lab”, which has a diversity of robots for research and educational purposes.
- NSO performs research on the interface of Artificial Intelligence and Operations Research. Topics and applications range from game-theoretic models of strategic optimization in network controlled interactions, search algorithms for finding best strategies in games, combinatorial optimization in phylogenetics, to the analysis of (evolutionary) competition in biological and biomedical settings.
- The research of BMI is on signal and image processing in biomedical engineering and medicine, machine learning applications on medical and bioinformatics data, and mathematical modelling of cellular and subcellular processes. Basic research includes topics in systems and control theory (identification, parameterization) and rigorous numerical mathematics.

2.2 Research quality

The committee came to the conclusion that, when translating its opinion into the categories of the SEP 2015-2021, the overall quality of the research falling within its remit qualifies as *3 (good)*. The committee’s opinion is based on the following considerations.

As a starting point, the quantitative data provided in the self-assessment report give a good picture of the research activities at DKE and of the productivity of its researchers during the reference period. The data show that the department on average produces 6.28 publications per research fte per year. Of this, the number of peer-reviewed journal papers is 1.84 per research fte per year. The benchmark study shows that DKE’s research output, in terms of number of publications per fte staff, is comparable to that of well-established research units in Sweden and the UK (Artificial Intelligence & integrated Computer Systems, Linköpings Universitet, Sweden and Computer Science and Informatics, University of Essex, UK).

The committee grades this productivity as good and appreciates the mix of output. The committee noted that some individual staff members are very good in terms of research output, but also noted wide variability in terms of productivity between individual staff members. Since there are varying publication standards across the fields within the department, the committee recommends taking a critical look at the journals and conferences that are considered top in the respective fields of research.

The quality of most of the research is good to very good. The department does interesting and valuable research covering many research areas. The department has provided a list of ten publications that it considered its most important research output. The committee noted that the three publications from the BMI group appeared in top journals of the field (first quartile impact factor in the JCR) and have been cited 133 times; the four publications from the NSO group appeared in very good journals (first to third quartile impact factor) and have 78 citations: two of the three publications from the RAI group appeared in very good journals (third quartile impact factor), while the total number of citations for these three publications (36 citations) is relatively low.

The committee noticed that the department has clearly grown in the level of research funding since 2010, due on reduced activities and increasing student numbers. Over the period 2010-2015, the department's reserves developed from (roughly) negative 250 k€ to positive 1,500 k€. However, external funding has been relatively low (less than 25% in 2015). For example, during the assessment period nobody in the department was awarded a personal Veni, Vidi, or Vici grants. The committee noted that recently the department was awarded with two Horizon 2020 grants. Hopefully, these grant applications can serve as model for other applications, because the committee feels that the department is in a good position to achieve more Horizon 2020 grants, given the applied focus of its research.

Recently, the Institute of Data Science (IDS) was founded, a UM research institute that (according to the website) conducts research at the interface of biomedicine and data science and develops standards to facilitate navigating through the knowledge landscape. During the site visit, DKE explained that they expect this institute to be complementary to DKE. However, the committee had the impression that, rather than setting a pro-active agenda, DKE is taking too much a wait-and-see attitude with respect to IDS. It urges DKE to take the lead in establishing a fruitful collaboration and proactively reveal its wishes and needs.

Based on the self-assessment report and interviews with staff members, the committee noticed a high work load of the staff, which is manifest in a high teaching load and managerial work load. Currently, eighty courses are taught, about thirty of which are external courses. Given the necessity to maintain research time, the only option seems to be to increase the efficiency in teaching. The committee also suggests a critical analysis of the pros and cons before taking on new educational tasks.

During the site visit, it was explained that a lot of managerial duties are covered at department level. The committee noted that while the group has the perception of being a small department, in fact, the committee's view is that DKE is a medium-size department, with the accompanying amount of managerial duties. The relatively low percentage of senior staff (full and associate professors) leads to a high managerial work load among relatively few.

In the opinion of the committee, the quality should be improved by attracting more senior staff. Senior staff could not only increase high quality output, but can also support more junior staff in writing grant applications and provide support in mentoring and organizational tasks.

2.3 Relevance to society

The committee came to the conclusion that, when translating its opinion into the categories of the SEP 2015-2021, DKE research generally qualifies as *Very Good (2)* as far as relevance to society is concerned.

DKE used the following indicators of societal relevance to pursue its work that could lead to important societal impact: interdisciplinary and multidisciplinary publications, citations and H-indices, joint research cooperation across faculties, funding acquisition success, publications aimed at a more general audience, and contact with companies and institutes.

The committee noted that a relevant impact is provided. Although there is some variation across research groups, it became clear that the published papers create an important and permanent transfer of knowledge to a broader audience (the position paper by Tuyls and Weiss on multiagent learning in the AI Magazine being a prime example) as well as to other scientific domains, in particular through a wide variety of papers on areas including medicine, physiology, cardiology, neuroscience, biology, ecology. The committee also noted that the department developed software that is actually used extensively. DKE is strongly oriented towards application domains. A key societal group that DKE has managed to build up good research connections with, is the medical field, especially in cardiology, biomedical engineering, and systems biology.

Based on the self-evaluation report and the interviews during the site visit it became clear that DKE collaborates with several institutes, such as with the MaCSBio institute and CARIM. Especially in the BMI research group, joint PhD projects with other institutes have been started.

DKE is active in various networks (e.g., Data Science Platform, Big Data Alliance, Dutch Mathematics Platform, Dutch Informatics Platform, KION) and has initiated contacts with JADS, a data science cooperation of Tilburg University and Eindhoven University of Technology.

With regard to societal relevance, the committee is of the opinion that unless the successes, the collaboration with industry can still be improved. During the site visit it heard about the KE@Work initiative, a special track to give students the possibility to get relevant work experience, to build up a professional network, to enhance their professional skills and to apply what they have learned in class to real life situations. The committee applauds such an initiative, but encourages the department to then also utilize these contacts with industry to start new or intensify existing research collaborations.

2.4 Viability

Whilst the previous two sections contained an assessment of the performance of DKE during the reference period, this section is more forward-looking. The committee came to the conclusion that, when translating its opinion into the categories of the SEP 2015-2021, DKE ranked as *Very good (2)* for viability.

The self-evaluation report states that DKE has the ambition to develop into an internationally visible and well-recognized centre of expertise in data science and knowledge engineering. The committee believes that there is a great potential to live up to this ambition. Steady signs of quality improvement could be observed across the review period. Besides that, the department is financially sound and receives support from the faculty board by acknowledging the importance of DKE for Maastricht University and facilitating its research ambitions. In addition, the group of staff members is stable and quite committed. According

to the management team of DKE, this group will be extended with five new staff members in the near future.

However, the committee believes that the department needs to take some serious steps to stay viable. According to the self-evaluation report, DKE currently aims to cover four kinds of research: a) its own basic research into methods; b) applied and interdisciplinary research; c) research as a service to other scientific parties; d) contract research for companies and institutes. The department already mentioned this diversity as a threat and the committee agrees. In its opinion there are too many focal points and it is not possible to address all these research lines at the right level in a substantial way. DKE needs to find a balance between fundamental and applied research and between core research and service-related research. Ideally, DKE's research lines are laid out such that within each research line the different types of research strengthen and inspire each other. Given its embedding in a university that is quite application minded, more weight on applied research is understandable, but in the long term should remain fuelled by basic research into methods that defines DKE's unique character.

Based on the self-evaluation report and site visit the committee noted that DKE very well identified possible threats and weaknesses, but did not yet act accordingly. For example, the SWOT analysis of the self-evaluation report mentions that "due to fluctuations in demand and the diversity of topics, DKE runs the risk of not always having sufficient capacity to fulfil ambitions and expectations, likely affecting its reputation". Both in the self-evaluation report and during the site visit, a response to this threat was absent.

The committee could not find a well-articulated vision on a strategy for the positioning of the group in the future in documents like the self-evaluation report. A more explicit vision, focus and strategy are required, and choices about the appropriate themes and services need to be made. Therefore, the department needs to work towards a clarification of the department structure in terms of management and external visibility. Hereby it needs to keep in mind that it is not a small department anymore, but a department of intermediate size.

DKE asked the committee to pay special attention to three aspects. Most of these have been brought up in the previous sections. In summary, the committee gives the following response to these points:

1) Ambition to perform excellent research in selected areas of artificial intelligence, and of applied mathematics and operations research

As discussed in more detail in Section 2.2, the committee considered the research in these areas to be very good. It might be helpful to characterize the focus on the selected areas more strongly and clearly.

2) Ambition to play an active role in societal value creation, especially in subfields of the biomedical domain such as cardiology and the upcoming UM research in systems biology

DKE established various collaborations, mainly in the biomedical domain, leading to the creation of relevant societal value. The MaCSBio Institute and the Institute of Data Science institute offer further opportunities to extend this (see Section 2.3). However, it will be important for DKE to be pro-active in these interactions.

3) Ambition and aim to have a close alliance of research goals with the UM's initiatives related to data science

Given its extensive expertise and experience in data science research and education, DKE indeed should indeed play an active, if not leading role in the new Institute of Data Science. It

will be important to ensure clarity of the relationship between them, with DKE not taking on a subsidiary position, and not being seen to do so.

2.5 PhD programme

In the period 2010 – 2015 a total of 24 PhD students enrolled in DKE (regular PhD students, PhD students with a grant from another country, and external PhD students). Of 24 started projects, 8 projects (33%) were completed in 4 years, 15 projects (62.5%) were completed by the end of 2015, while 3 projects (12.5%) were stopped (and restarted with new candidates, counted as new projects). Another 6 projects (25%) were still pending by the end of 2015.

DKE does not host its own graduate school with an organised PhD training programme, but participates in three different schools: The Dutch Research School for Information and Knowledge Systems (SIKS), the Dutch Institute of Systems and Control (DISC), and the Dutch Network on the Mathematics of Operations Research (LNMB). Each student decides which courses of the schools best fit in its research theme.

The committee interviewed current and former PhD students in various stages of development of their PhD research about their supervision, research facilities, graduate school, and possible constraints of their research. Members of the committee were impressed by the quality and enthusiasm of the students they met. It appears that PhD students are well embedded and integrated into the research structure of the department. The graduate students spoke very highly of the supervision they received and the match between projects and their own interests. They appreciated the flexible, informal atmosphere of the department. In its meeting with the PhD students the committee repeatedly heard that the environment of DKE had attracted them to Maastricht.

The students the committee spoke with during the site visit were confident with the courses they could attend. They appreciated the amount of freedom in choosing the courses that fit into their research field. The committee applauds the flexibility given to the students, but advises to provide some stronger guidance for supervisors and students on requirements for attending courses. The Faculty aims to develop a PhD peer community of PhD students of the STEM cluster of about 20 PhD's a year. The committee encourages this plan.

Based upon numbers in the self-evaluation report the time for completing a PhD thesis appears to be too long. Of 24 started projects, 8 projects (33%) were completed in 4 years, 15 projects (62.5%) were completed by the end of 2015, while 3 projects (12.5%) were stopped (and restarted with new candidates, counted as new projects). Another 6 projects (25%) were still pending by the end of 2015. According to the self-evaluation report this was partly due to the absence of full professors in 2008 and an understaffed setting in the period 2010-2011. The committee recommends to keep monitoring the completion rate and, if necessary, to take further measures that will lead to a substantial increase in the number of post graduates completing their PhD within the four-year period in the coming years.

2.6 Research integrity

Faculty and staff of the faculty are subject to the Maastricht University rules regarding academic integrity. The research staff must adhere to the "Code of conduct for academic practice" as formulated by the VSNU in 2004 and revised in 2012 and 2014. The UM has also adopted a "Code of conduct for the use of personal information in scientific research", a "Code for transparency in animal testing", and a "Research data management code of conduct".

The committee is pleased that at Maastricht University standard procedures have been launched to facilitate storage of research results. It recommends that DKE will take a leading role in storage and collecting data and in making data more transparent along the general lines issued by the university.

However, the committee was not convinced that research integrity is an integral part of the culture of the DKE department. This could be achieved not only by procedures and compulsory courses for PhD students, but especially by discussing these aspects in the context of everyday life at the department. It is therefore important that, going forward, research staff and students make a collective effort in engaging with research integrity issues, including those emerging from the increased empirical work with humans and associated personally identifiable data.

2.7 Diversity

The self-assessment report is very limited in relation to discussing the diversity of the department. It stated that 'In line with existing law and the "Code of conduct for academic practice", DKE strives to provide its staff in equal circumstances with equal chances and facilities'. However, it did not describe the policies it takes to enhance diversity.

The committee strongly recommends the faculty to take further action to promote more gender balanced and diverse environments, teams and committees, and further to raise the awareness and improve the knowledge of discriminatory mechanisms in academic environments and how to consciously counteract these. There are quite a lot good examples of institutes with a deeper appreciation of the diversity environment and how to react on it, that can be used as inspiring examples to promote diversity.

2.8 Summary and recommendations

The DKE department at Maastricht University has a number of strengths and challenges. The quality and societal relevance of the research in the period under review is good to very good. Because of the financially better position and the acquisition of new staff, the committee acknowledges a positive trend in recent years, which, by taking the proper measures, can form a fine basis for further improvements in the (near) future. The committee is convinced that the department has a lot of opportunities, but should actively look for ways to develop its own distinguishing features.

The recommendations are the following:

1. The committee recommends to formulate and to discuss internally the nature and value of the department's culture more explicitly and to relate this to a more explicitly formulated vision, goal and strategy for the future;
2. According to the committee, there is an imbalance between senior and junior staff. The committee recommends to attract more staff at senior level;
3. The committee noticed that the department has difficulties to obtain second and third stream funding. Although the committee is aware of the strong competition for personal grants, it recommends the department to make more effort overall to get second stream funding. In particular, professional support of junior staff for the acquisition of external funding seems needed;
4. With regard to the PhD programme the committee recommends to develop an adequate support structure for PhD students including research ethics, data management, supervisory oversight;

5. The committee recommends to develop a department specific research integrity and diversity strategy with a focus on particular concerns connected to its own research and application areas.

Appendix A: Curricula vitae of the Committee members

Tom Heskes (chair) Prof. Tom Heskes conducts research on artificial intelligence, machine learning, and data science. He uses probability calculus and statistics to develop and better understand novel data science tools. He is specifically interested in causal discovery: how to disentangle cause and effect from "big data". The developed techniques are employed in various projects, especially within the medical domain, neurosciences and bioinformatics. As former director of a spin-off company, Tom Heskes has ample experience in working with practical applications of artificial intelligence and machine learning. He was director of research of the Institute for Computing and Information Sciences between 2009 and 2014 and is currently director of education.

Michèle Breton received a B.Sc.A., industrial engineering and M. Ing, operations research, from École Polytechnique de Montréal respectively in 1975 and 1977 and a Ph.D. in Computer Science from Université de Montréal in 1986. Since 1977, she has been at HEC Montréal where she is presently professor of Management Science and director of Academic Affairs. Her current research interests include dynamic programming and dynamic game theory applied to dynamic problems in management, more specifically in the energy, environment and finance sectors. She is a member of the Royal Society of Canada.

Michael Luck is a computer scientist who undertakes research into agent technolgoies and intelligent systems, based in the Department of Informatics at King's College London, in central London, United Kingdom. He was Head of Department from 2011 to 2013, and since 2013 he has been Executive Dean of the Faculty of Natural and Mathematical Sciences. From 1993 to 2000, Luck was based in the Department of Computer Science at the University of Warwick and from 2000 to 2006, in the School of Electronics and Computer Science at the University of Southampton. He has led the AgentLink European Co-ordination Action for Agent-Based Computing and is co-author of several books, including Understanding Agent Systems and Agent-Based Software Development.

Jaap Molenaar works since about 10 years at Wageningen University and Research, holding a Chair in Applied Mathematics and being head of Biometris, the WUR Centre for quantitative methods for the Life Sciences. Molenaar started his scientific career at the Free University, Amsterdam, writing a PhD thesis in theoretical physics on a topic from solid matter physics. Later, he worked at Radboud University, Nijmegen, and TU/e, Eindhoven. At the University of Twente he was personal professor, with as research field the modelling of polymer flow. His present specialization is Systems Biology, i.e., the application of mathematical models in the Life Sciences, working on topics like reconstruction and analysis of dynamical networks. He published many papers and several books on topics related to mathematical modelling, mostly in the context of dynamical systems theory. He supervised several PhD students and greatly appreciates to cooperate with colleagues from other disciplines, such as Biology, Physics, Chemistry, Health, and Nutrition.

Appendix B: Programme of the site visit

Monday 10 April		
Time	Part	Collocutors
18.00	Welcome drinks	
18.30 -	Preparation + dinner	Committee only

Tuesday 11 April		
Time	Part	Collocutors
09.00 – 10.00	Preparatory meeting	Committee only
10.00 – 10.45	Programme management	Chair DKE: Gerhard Weiss, DKE Professors: Ralf Peeters, Frank Thuijsman Dean FHS: Bernadette Jansma, Director FHS: Fred Offerein, Support: Ermo Daniëls
10.45 – 11.00	Break	
11.00 – 11.45	Researchers	Ronald Westra, Pieter Collins, Rachel Cavill, Steven Kelk, Mark Winands, Rico Moeckel, Kurt Driessens, Stelios Asteriadis, Matus Mihalak
11.45 – 12.00	Break	
12.00 – 12.45	PhD students	Katharina Schüller, Li You, Chiara Sironi, Matthijs Cluitmans, Michael Clerx, Kirill Tumanov, Bijan Ranjbar-Sahraei
12.45 – 14.00	Lunch	Committee only
14.00 – 14.45	DKE Research Collaborators and Contacts	Paul Volders (CARIM), Ilja Arts (MaCSBio), Frans Smeets (FHML), Rainer Goebel (FPN-CN), Ronald Peeters (SBE), Michel Dumontier (IDS), Richard Houben (2BMedical)
14.45 – 15.00	Break	
15.00 – 15.30	Programme management	Chair DKE: Gerhard Weiss, DKE Professors: Ralf Peeters, Frank Thuijsman Dean FHS: Bernadette Jansma, Director FHS: Fred Offerein, Support: Ermo Daniëls
15.30 – 17.00	Internal meeting	Committee only
17.00 – 17.30	Presentation of preliminary results and closing drinks	Plenary

Appendix C: Quantitative data

Table 1 Research staff in FTE

	2010	2011	2012	2013	2014	2015
Scientific staff	6.85	8.35	8.23	9.07	8.72	8.91
Post-docs	3.56	4.50	3.56	2.06	2.16	2.54
Total research staff	**10.41**	**12.85**	**11.79**	**11.13**	**10.88**	**11.45**
Support staff	0.70	0.70	0.70	0.70	0.70	1.03
Visiting fellows	0	0	0	0	0	0
Total staff	**11.11**	**13.55**	**12.49**	**11.83**	**11.58**	**12.48**
PhD students (n)	13	14	16	14	9	10

Table 2 Main categories of research output

	2010	2011	2012	2013	2014	2015
Refereed papers	16	21	26	19	15	29
Non-refereed papers	1	1	3	5	4	5
Books	0	0	0	0	0	0
Book chapters	11	8	15	1	18	11
PhD theses	4	3	2	3	2	5
Conference papers	28	29	45	36	36	27
Professional publications	15	10	8	12	15	11
Publications aimed at the general public	0	0	0	1	0	1
Conference and workshop abstracts	7	9	23	14	10	7
Conference and workshop demonstrations	0	4	4	4	1	1
Technical reports	2	2	0	7	1	2
Edited books	1	0	4	1	0	0
Edited journals (special issues)	0	0	1	0	0	0
Edited conference proceedings	1	2	4	1	2	1
Editorials in journals and proceedings	2	0	1	0	0	0
Editorials for the professional field	8	5	0	0	0	0
Book reviews	3	0	2	0	0	0
Media appearances	2	2	1	2	3	3

Table 3 Funding

	2010	2011	2012	2013	2014	2015
Funding						
Direct funding	19.5	24.2	22.9	20.2	18.7	23.9
Research grants	2.3	3.7	7.2	8.8	5.9	4.7
Contract research	7.2	6.8	5.2	3.7	2.7	2.4
Other	0.2	0.3	0.1	0.2	0.1	0.0
Total funding	**29.1**	**34.9**	**35.4**	**32.8**	**27.4**	**30.9**
Expenditure (k€)						
Personnel costs	2,356	2,507	2,765	2,461	2,469	2,654
Other costs	999	1,120	855	826	771	813
Total expenditure	**3,355**	**3,627**	**3,620**	**3,287**	**3,240**	**3,467**

Table 4 PhD candidates

Enrollment				Finished								Total graduated		Not yet finished		Discontinued	
				≤ 4y		≤ 5y		≤ 6y		≤ 7y							
Starting year	M	F	total	#	%	#	%	#	%	#	%	#	%	#	%		#
2007	3	0	3	1	33	1	33	0	0	0	0	2	67	1	33	0	0
2008	5	0	5	2	40	1	20	1	20	1	20	5	100	0	0	0	0
2009	2	0	2	1	50	0	0	0	0	0	0	1	50	1	50	0	0
2010	7	0	7	2	29	2	29	1	14	0	0	5	71	1	14	1	14
2011	5	2	7	2	29	0	0	0	0	0	0	4	80	3	43	2	29
total	**22**	**2**	**24**	**8**	**33**	**4**	**17**	**2**	**8**	**1**	**4**	**15**	**63**	**6**	**25**	**3**	**13**

Appendix D: Explanation of the SEP scores

Category	Meaning	Research quality	Relevance to society	Viability
1	World leading/ excellent	The research unit has been shown to be one of the few most influential research groups in the world in its particular field	The research unit makes an outstanding contribution to society	The research unit is excellently equipped for the future
2	Very good	The research unit conducts very good. internationally recognised research	The research unit makes a very good contribution to society	The research unit is very well equipped for the future
3	Good	The research unit conducts good research	The research unit makes a good contribution to society	The research unit makes responsible strategic decisions and is therefore well equipped for the future
4	Unsatisfactory	The research unit does not achieve satisfactory results in its field	The research unit does not make a satisfactory contribution to society	The research unit is not adequately equipped for the future