Research Review
Computer Science

2009-2014

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Preface

Computer science is a fascinating field, which is evolving at a fast pace. It is exciting in itself, but in addition the technology based on this science has a disruptive effect on all aspects of our society as well as on other fields of scientific research. Many aspects of information and communication technology develop at an exponential rate and this fact creates many new research challenges for the field of computer science. This field is both interesting and very important. Therefore assessing the quality of computer science research on a national scale in the Netherlands was a challenging, but also a very interesting task.

Many people, staff members of computer science departments, staff members of national graduate schools as well as the members and the secretary of the review committee have worked very hard to perform this quality assessment of computer science research in The Netherlands over the period 2009 - 2014. I sincerely thank all people involved in this difficult task for their dedication as well as for the pleasant and informative interaction during the site visit.

The result of all this work is presented in this report. I am very pleased that the main conclusion of the review committee is that computer science research in the Netherlands is of a very high quality, broad and with high impact in international perspective. The committee was pleased to note an increase in collaboration on a national level. We have identified research of top quality in several places, but at the same time we have not shun our criticism. All our critical remarks are meant to be constructive and we hope our recommendations will contribute to further growth and prosperity of the field.

Gerard van Oortmerssen
Chairman of the committee

1. Introduction

1.1 The scope of the assessment

The quality assessment of research in computer science 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 perform an external review of the research in Computer Science of nine universities and three research schools in the Netherlands. The main objective was to assess the quality and relevance to society of the research conducted by Dutch departments of Informatics and Computer Science between 2009 and 2014 as well as their strategic targets and the extent to which they are 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 also considers two further aspects: PhD programmes and research integrity. International trends and developments in science and society were taken into account in the analysis.

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

1.2 The Review Committee

The boards of the nine participating universities have appointed the following members of the committee for the research review:

- Prof. dr. Gerard van Oortmerssen (chair)
- Prof. dr. Christel Baier
- Dr. Mary Czerwinski
- Prof. dr. Xiaohui Liu
- Prof. dr. Bashar Nuseibeh
- Prof. dr. Lothar Thiele
- Prof. dr. Wolfgang Wahlster

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

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 the judgment is made without undue influence from the institute, the programmes or other 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.

1.3 Procedures followed by the Committee

The committee received detailed documentation consisting of the following parts:

- Self-evaluation report of the unit under review, including all the information required by the Standard Evaluation Protocol (SEP) with appendices;
- Copies of key publications.

Prior to the committee meeting, each research unit was assigned to two reviewers, who independently formulated a preliminary assessment. The final assessments were made by the entire committee, based on the documentation provided by the institute, the key publications and the interviews with the management and with the leaders of the programmes. The interviews took place on 7 November – 10 November 2015. After the interviews the committee discussed the scores. The drafts for the assessment report were finalised through email exchanges. The final version was presented to the research units for comments concerning factual inaccuracies.

The assessments were carried out in accordance with the guidelines as formulated in the new protocol SEP 2015 - 2021 which differs substantially from the protocol used in the previous assessment, SEP 2003 - 2009. In particular, the categories and scores are different and therefore cannot be compared with the scores in the Assessment Report Computer Science 2002 - 2008. The major changes in the SEP protocol presented a challenge to the assessment committee.

The committee decided that the scores should be interpreted according to the description of the meaning of the four numerical scores. In case of research quality, the gap between scores two and three seems to be too large. The committee is of the opinion that every department it assessed conducts internationally recognised research. Therefore, it graded research, which is good rather than very good also with a two.

The committee would like to emphasise that the scores are only one element in the assessment and should be considered in combination with the qualitative evaluation, the context as well as the differences between subfields of computer science.

1.4 Comments on the process

The basic point of departure for this assessment was, similar to the previous one, to be a national assessment, in which all computer science research at a university was considered as one single unit, irrespective of the administrative organisation. In practice, a unit often consists of several departments, groups or sections. Sometimes a unit may even be a collection of computer science research groups across several departments, while some universities have computer scientists working in (virtual) institutes, which are multidisciplinary in nature. It is important to note that a national assessment requires a uniform basis: comparable granularity of organisational units and self-assessment reports of equal size and detail. Also it is worth mentioning that there are a few universities which did not participate in the assessment, but which have some computer science researchers embedded in various non-computer science departments.

The downside of a national assessment such as this is the number of assessments the committee has had to make within a short period of time. On reflection, the committee feels that there should have been more time available for internal deliberations and reporting during the site visit. Furthermore, as the assessment was on the institution level, it was hard to consider all relevant research in great depth, given the type of information required from the institutions. In general, there appears to be more emphasis on the research strategy and organisational aspects than on content in the SEP.

With respect to the concept “unit” it should also be remarked that an organisational unit in computer science often does not include all the relevant research that is carried out at a university. The committee observed that at several universities well-known researchers specialising in fields like logic and computational linguistics, who are considered as computer scientists by their international peers, were not included in the present assessments because of their positioning within the university organisation.

Most universities obviously put a lot of effort into the writing of their self-assessment reports. In many of the documents the committee missed the spark of exciting research and a clear vision for the future. This may have been due to understandable report length limits, but could indicate a need to better promote and publicise the range and depth of activities.

2. General observations and recommendations

2.1 Evolution of the Computer Science Research Field

Computer science is a relatively young field, which has changed the world and our daily lives in an unprecedented way. This change is set to continue and even accelerating. In addition to its impact on our society, the field itself is evolving continually and its scope is widening. New topics continue to emerge, with recent examples including data science, machine learning and the internet of things.

As computer science has changed business and society as a whole, the field itself is also changing academic research and driving science in many other disciplines. Because of its dual importance for society as well as for scientific research, computer science and ICT are often regarded as providing enabling technology. This is unwise, because it may result in neglecting the importance of investing in computer science itself.

The extremely fast evolution of computer science and the technologies (ICT) built on its groundbreaking results present challenges to the field. During the present assessment several of these challenges were visible. As an example, one of the self-evaluation reports mentions as a threat:"….research is increasingly taken over by big and rich industrial players (Google, Facebook, Yahoo!, Microsoft) and developed at a much faster rate than at universities". Another example is multidisciplinary research, which may blur the boundaries of computer science, because computer scientists collaborate with experts in mathematics, electrical engineering, social and life sciences, and the humanities. Here the challenge is to identify multidisciplinary research questions that provide opportunities for high quality scientific research in both computer science as well as in the other disciplines. During the site visits, the committee has heard several examples of multidisciplinary projects that indeed had such a character.

2.2 Overall status and developments of computer science research in the Netherlands

From the early years of computer science as a discipline, the Netherlands has had a strong position with high quality researchers, often with high international impact. Results of Dutch computer science research have led to products with worldwide applications. Examples are the computer language Python, algorithms for digital coding of compact discs and algorithms for car navigation systems. Dutch computer scientists have also made major contributions to the development of WiFi and Bluetooth, as well as the Web Ontology Language OWL.

In the previous national assessment of Computer Science 2002 – 2008, the assessment committee noted the following general conclusion on the health of the field: "In general, computer science in the Netherlands is a vibrant enterprise. As a country, the Netherlands remains among the top nations in computer science research, and in the absolute top in a number of sub-areas." Following this positive general conclusion about the health of the field, the committee warned that the discipline of computer science in the Netherlands was under siege, due to declining funding.

The present committee is pleased to conclude that the overall assessment of the quality of Dutch computer science research made by the previous committee is still valid. This conclusion is also supported by a recent Canadian study, which shows that computer science as a whole in the Netherlands is broad and has a high impact, a position which is close to that of the USA and UK[1].

The committee has seen various positive developments over the past period. The new generation of staff and PhD students is very motivated and of high quality. There is increased collaboration, among computer scientists within units, within universities with other disciplines, but also among computer scientists from different universities. Examples of such cooperation are, for instance, the national graduate schools, the institute NIRICT of the three Technical Universities, the large research programme COMMIT and the participation in EIT Digital.

The COMMIT programme was a five year, public-private partnership project with a total of more than 100 partners and a budget of 100 million euros, half of which was funded by the national proceeds of natural gas exploitation. The programme not only stimulated collaboration between researchers and companies and societal organisations, but was also extremely beneficial for community building of computer scientists on a national scale.

The committee recommends that this aspect of collaboration should also receive special attention in future assessments: monitoring the external networks and interaction, including this as an item to judge the viability of units and giving clear assessment and recommendations on the complete system of research in addition to that of individual units.

Where the previous assessment committee recommended that the field should organise itself and collectively advocate for computer science with the national funding agencies, the present committee is pleased to conclude that indeed the field has organised itself in IPN and participates in the national ICT team for the Top Sectors. It is important to strive for recognition of computer science as an important area for science, economy and society.

On the downside, the committee is concerned, because the research capacity is under pressure and is not keeping pace with the growing importance of computer science, both for science in general and for society. There are several causes for this concern:

- A significant growth in the number of students results in increased educational obligations for existing staff; although more students lead to more funding, there is a time delay of sometimes several years so that overloading of staff is inevitable. The demand for computer scientists and data scientists is expected to grow further in the near future;
- Available sources of government funding declined and emphasis shifted from fundamental to more applied research;

[1] Sack JR, Bauer M, Condon A, Dudek G, Frappier M. Computer Science Research in Canada: Strengths, Challenges and Recommendations. Prepared by the NSERC Computer Science Liaison Committee

- The government policy for stimulation of innovation focuses on the so-called “top sectors” in industry, and ICT is wrongly not considered to be a top sector;
- Since the COMMIT programme is in its final stage and funding for follow-on activities is unclear, there is concern about maintaining much-needed momentum;
- Shifts in available sources of funding and decreasing success rates lead to increased time needed for writing proposals;
- While so-called valorisation activities and collaboration with industrial and societal partners have greatly increased, thanks to projects like COMMIT, this development has resulted in less room for more foundational and “long-term” research. A healthy balance should be restored.

The viability of the field is at risk, since funding is decreasing while the need for research is increasing and the number of students will grow further in the near future. The committee therefore recommends making strong representations towards university boards and government in order to increase funding for computer science research.

2.3 Human Resources / organisational structure

One problem in the Dutch academic system is regarding the official status of assistant and associate professors. The interviews revealed that assistant and associate professors are not completely independent and, for example, they may not play the role of the official primary supervisor for their PhD students. It would be advisable that the Dutch universities work together towards the necessary legislation changes. The committee strongly recommends that associate professors should have the right to supervise and promote their own PhD candidates (like in most other countries around the world) so that these positions become more attractive for talented staff from abroad.

The committee commends the increased use of tenure-track positions, which have a reported success rate of 80%. However, there should be a starter kit funding package for assistant professors like in the Junior Research Groups (2 additional FTEs for 5 years) of DFG in Germany, so that they can concentrate on internationally highly competitive research and position themselves as leaders in the field.

In general, the staff are young and of high quality. Diversity, however, is a point of concern, both in terms of gender as well as of nationality. There is fierce international competition for the best talents. Globalisation is a process, which also affects universities and this aspect should be reflected in the staff composition as well.

Another point of concern is the high workload of staff. Universities should anticipate further growth in the number of students in computer science instead of lagging behind with respect to recruitment of staff.

The increasing importance of multidisciplinary research presents challenges with respect to talent development, organisation and management. In addition to specialised computer scientists there is a need for academic staff, who are both deep in their scientific discipline but can also connect to other disciplines and application domains. Some of the reviewed research units have addressed this issue and talk about staff with a T-profile.

With respect to embedding multidisciplinary research, the committee observed that some universities have already created multi-disciplinary network organisations. The committee applauds these initiatives.

The committee realises that, compared to mono-disciplinary research, multidisciplinary research is more complex and challenging, and where the outlets of top quality research projects are still limited. In order to facilitate and stimulate multidisciplinary research, more effort seems to be needed, also with respect to funding, peer review processes, and venues for sharing results. Involvement of computer science in multidisciplinary research contributes to the success and visibility of other sciences. It is very important to foster the importance of fundamental research in computer science and pay due attention to the visibility and importance of computer science.

2.4 PhD education, Graduate Schools, Local and National

PhD education in computer science is of high quality in the Netherlands. There are local and national graduate schools which are complementary: local schools provide training in general research skills whereas the national schools offer specialised advanced courses in computer science. The system of national schools has some clear additional benefits. For students they are not only a source of knowledge, but also a platform that allows them to build a social network in their research field. Since the staff of these schools consists of volunteers from different universities, the schools are also a meeting place for researchers, thus stimulating collaboration.

Although the official time to complete a PhD is four years there are only a few students able to meet this requirement. Typically, about sixty percent of students will have finished within five years. The average graduation time in computer science is considerably longer than in most other European countries. A systematic investigation of the cause might provide useful insights. For example, is there a correlation between the funding scheme and the duration of the PhD completion? These insights might help to establish guidelines for the computer-science departments of all Dutch universities with the general goal to shorten the graduation time, while maintaining high quality standards.

2.5 Research Integrity

All universities comply with the national VSNU guidelines on research integrity, and most universities have extended these with their own specific guidelines, advisory committees and procedures. In many cases, research integrity is also integrated in the educational program of PhD students.

Integrity is more than conducting academic research in an honest and methodologically correct way. Computer science research increasingly concerns topics with inherent ethical dimensions, be it privacy, security, or potentially negative effects that results may have on society. These issues need to be properly addressed, and it is good to note that most, if not all, of the units that have been assessed indicated that they do pay good attention to these issues.

The existence of formal procedures can be checked easily, but it is much more difficult to assess the extent to which integrity is part of the lived reality. The committee recommends research integrity as well as ethical aspects of computer science research to be an integral part of the culture of computer science research units; 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 a research group.

3. Assessment of the institute – University of Amsterdam and VU University Amsterdam

Assessments UvA:	Research quality:	2
	Relevance to society:	1
	Viability:	2 (jointly with VUA)
Assessments VuA:	Research quality:	2
	Relevance to society:	1
	Viability:	2 (jointly with UvA)

3.1 Research area

UvA

The informatics institute at UvA focuses on research in three main areas: information, complexity and system engineering. The institute consists of seven research groups:

- Machine learning
- Collaborative networks
- Information language processing systems
- Intelligent sensory information systems
- Computational science
- System and network engineering
- Theory of computer science

According to the self-evaluation report, the vision of the informatics institute of UvA is (1) to create impact from concept to application, (2) to create high quality by setting high standards and (3) to create contact by being inspired in society. The focus of the institute matches with the university-wide research priority areas on communication and information. Besides connections to other institutes of UvA, the institute is well connected with the local industry, the computer science department of VUA and the software-engineering, database and information-retrieval groups at the research institute CWI. There is also a close connection to TNO that provides an excellent basis to bring research into application. The collaboration with CWI, TNO and other associated organisations is formally documented by the appointment of senior staff members of the organisations as part-time professors at UvA. The future research agenda is aligned to the merge with the department for compartment of computer science at VUA. Based on the current strengths of the informatics institute of UvA, the emphasis for the research groups at UvA after the merger with the computer science department of VUA will be on data science, computer vision and machine learning.

VUA

The VUA department of computer science is concerned with understanding the foundations, the mechanisms, and the technologies for developing and deploying advanced information-processing systems. The research at the computer science department VUA can be grouped into six research themes: Artificial Intelligence, Bioinformatics, Computer Systems, Information Management and Software Engineering, Knowledge Web & Media, and Theoretical Computer Science.

Strategy of the department is collaborative, linking knowledge from many fields within and outside computer science. One of the initiatives beyond the department that aim at a strong interdisciplinary outreach and impact is the establishment of the Network Institute, the VUA interdisciplinary research collaboration concerned with the Networked World that also includes the faculties of Humanities, of Economics and Business, and of Social Sciences.

3.2 Research quality

UVA

The overall impression of the research quality is very positive. It was a bit unfortunate that the self-evaluation report of UvA falls short on a presentation of the scientific highlights that

have been achieved in the evaluation period. During the site visit in Amersfoort, it turned out that the main strengths of the informatics institute are the research areas information retrieval, computational science, computer networks and computer vision, and more recently machine learning.

The informatics institute at UvA has a long-standing high reputation. Its international visibility is clear from the fact that several institute members have high level appointments in scientific committees, including the current chair of the informatics section of Academia Europae and the editor-in-chiefs for the Elsevier's "Journal of Computational Science" and "Future Generation of Computing Systems" and ACM Transactions on Information systems. During the evaluation period 2009-2014, two members of the institute received prestigious awards for their outstanding research work in databases and computational sciences. The institute was very successful by acquiring personal research grants of NWO (four VENI grants, five VIDI grants and two VICI grants) and two ERC starting grants. Furthermore, several institute members received best paper awards and other prizes illustrating the recognition of the work by individual institute members for the society.

The self-evaluation report contains a citation analysis in terms of tables with the h-indices and number of publications and a comparison to the University of Edinburgh (the latter together with the computer science department of VUA). Although the committee finds that the index-based analysis should not be overestimated, it agrees that the result of this analysis can be seen as a further indication for the high scientific impact and the potential of many junior researchers at the informatics institute at UvA. According to the appendix of the self-evaluation report, the committee finds the research output in terms of the number of published journal articles, peer-reviewed conference papers, books, book chapters and completed PhD theses very good for all groups and stable over the evaluation period. Besides the personal research grants mentioned above, the institute participated in more than thirty EU-FP7 projects and already acquired nine grants in H2020. The institute also received funding for PhD students from Russia, US and the COMMIT-programme.

The management of UvA (and later VUA) reported on the plan to complement the expertise of the theory group by a new professor for algorithms and complexity theory. This is highly appreciated. The newly established recruitment procedure and tenure-track system has been praised by the committee and should be continued. A further development of the tenure-track system to increase the independency of junior researchers would be highly desirable.

VUA

The overarching research theme can be described as in the self-evaluation report: "We live in a Connected World, where networked computing devices outnumber humans." The committee sees that several world-leading research groups within the department contribute to this focus on the "Networked World". This holds notably for the scientific research related to the semantic web, to computer systems and to the theory of computer science.

A further central role in the scientific outreach of the department has the internally and externally highly recognised research group on security, a major aspect in the connected

world. This success is also due to the new generation of very talented young researchers that joined the department in recent years. Another very strong pillar of the international recognition of the computer science department is the research in “Internet of Things (IoT)” that integrates several important research domains such as collecting, communicating and processing massive amount of streaming data, privacy, and machine learning. Only a small percentage of the staff can be considered to underperform in terms of international scientific recognition.

From the provided citation analysis it gets obvious that research quality (if measured through citations) has a high priority in comparison to quantity (if measured by the number of publications). It is internationally recognised that the research culture at the computer science department of the VUA is focused on (cross-disciplinary) collaborations and quality above quantity. The committee applauds this.

Part of the academic reputation and outreach can be evaluated by looking at the involvement of the department in international and especially European research activities. The research is not only well aligned with the current research agenda, but research staff also contributed to the definition of the current and future focus areas of the EU (FP7, H2020). According to the self-evaluation report, the department contributed and coordinated a considerable number of EU projects and coordination actions. However, the department is not yet visible in major European strategic groups such as the EiT. It can be expected that the situation improves after the planned merge with the informatics institute of the UvA.

The self-evaluation report contains a detailed comparison between the combined CS department at VUA and the informatics institute at UvA with a major UK university, namely Edinburgh. Whereas the committee agrees to some of the observations, there are doubts that the statistics based on h-index and several compensating factors provides the means for a substantiated comparison. Nevertheless, the committee is convinced that the resulting assessment is correct: The combined computer science research effort of VU and UvA can be considered to be internationally leading in several areas.

A major factor for a sustainable high teaching and research quality is the hiring policy of a department as well as the embedding of new staff members. At the computer science department of VUA, hiring appears to be mainly based on the quality of the candidate, openings are relatively broad. The committee agrees with this policy. There are major improvements how new scientists are welcomed and guided: New hires are well embedded into the department and undergo special training and mentoring programmes.

In terms of the structural and hierarchical organisation, the CS department can be considered to be closer to the flat American model than to the traditional European one. Newly elected assistant professors are still dependent on full professors in terms of resources, i.e., they do not lead an independent group yet. On the other hand, the staff members we talked to appear to be highly satisfied with the current model. It would be highly welcome if these movements towards a more flat hierarchical structure are supported by the possibility to officially supervise PhD students. Unfortunately, the Dutch educational system doesn’t allow assistant and associate professors to award PhD theses.

Not so much in the self–evaluation report, but certainly during the interviews, the committee learned about the specific culture of high solidarity, joining efforts and communication. Staff involved is aware of the specificity of the institute's culture that binds them together and of the positive impact it has on the quality of their work. In general, staff members and students are highly proud of the group spirit in the department.

As has been described in the self-evaluation report and in the interviews with the management, the department faced a dramatic decline in facilities and support between 2009 and 2014. This situation was due to a decision of the university to cut the support structures without installing a proper replacement system. It appears that the management of the department did its best to overcome and compensate for this critical situation.

In terms of research funding, it is reported that the direct funding declined by almost a factor of three over the whole period 2009-2014. This development was compensated by an increase in externally acquired funding by a factor six. Due to this fact, the department appears to be financially healthy despite the on-going budget cuts.

Such an increase in external funding requires a major investment of the staff for proposal writing, reporting and project administration. In addition, the number of students has grown substantially in recent years leading to an increasing teaching effort. As a consequence, staff members observe a decreasing time left for research. This situation is a reason for concern because staff members should be given the opportunity to establish themselves as internationally leading researchers in their field.

3.3 Relevance to society

UvA

There is ample evidence of the relevance of the research to society. The report lists a number of software products that have been developed in the evaluation period. This as well as the numerous industrial cooperations and awards from non-academic institutions (including the ICT personality award 2012, the Innovation award from the Ministry for Economic Affairs) as well as international conferences with a broad scope (such as the WorldComp award 2009) yield a clear evidence that the scientific work of the institute has received a lot of attention beyond specific research communities and a high impact for the society. Furthermore, several institute members are members of the advisory boards in industry and societal bodies.

Compared to other computer science departments, the number of spin-off companies is moderate. The management explained that the creation of spin-off companies did not fit with the traditional culture of UvA so far. However, the potential has been recognised and the management provides now more support in this direction and therefore expects more spin-off companies in the future. A clear success was the creation of the spin-off Euvision and the sale of this company to Qualcomm in 2014.

VUA

In general, the department concentrates on specific emerging computational challenges on the sciences and in society. Their research subjects are well matched to understand better our changing society, especially in terms of past and future changes due to ICT systems that connect and interact with people and organisations. The strong collaboration with other sciences provides evidence that it is not only the goal to improve our understanding of this development but also to influence it for our mutual benefit.

A major result of this focus on the "Networked World" is the establishment of the "Network Institute", an interdisciplinary research collaboration concerned with the Networked World. The institute includes the impact of networks on issues related to security and privacy. Its cross-disciplinary character is apparent as it also includes the faculties of Humanities, of Economics and Business, and of Social Sciences. There are also other recent initiatives that show the dedication of the department towards collaboration with scientists and other experts in various domains: the Amsterdam Data Science initiative (ADS) as well as the Amsterdam Academic Alliance Data Science programme (AAA-DS). The committee applauds the leading role of the CS department in many Dutch integrative centres and initiatives.

Also worth mentioning is the world leading work that originated from a branch of cognitive computing in collaboration with IBM Research. This is the idea of augmenting the human's intelligence with systems that learn through interaction and assist, with widespread applications in teaching and human-machine interfaces.

One of the major traditions and great successes of the computer science department at VUA is the concentration on tools and open software in order to increase the societal use and impact of their research work. Impressive examples are the distributed programming software IBIS (about 60,000 downloads), the operating system MINIX (more than 3 Million hits to the website and 600,000 downloads) and the programming language SWI prolog (150,000 downloads per year), the whole-system taint analysis solution Argos (12.000 downloads), the semantic data integration platform for drug discovery OpenPHACTS (147 Million hits from 500 organisations between March 2013 and December 2014 from academic and commercial users such as GSK, AstraZeneca, Entagen and Johnson&Johnson) and the multiple sequence alignment tool Praline (used 100,000 times so far). This success of the research in terms of impact is simply impressive.

Besides these research results that are used by hundred thousands of users worldwide, there is also more regional impact, e.g. through the development of the Distributed ASCI Supercomputer (DAS) that has been used for over 100 PhD theses (about 40 theses in 2009-2014).

The department has extensive collaboration with industry and applied research such as Google, Microsoft, Amazion, Symantec, Philips, Yahoo, SAP, IBM, CISCI, INFOSYS as well as local industry. But as has been outlined above, the department strongly believes in the concept of open software, and it is extremely successful in this respect. As a consequence, there was no special focus on the generation of spin-off companies. There are a lot of users that potentially can or have been valorising the research results. It can be expected that the anticipated merger with the informatics institute of UvA will push also this aspect of innovation.

3.4 Viability

UvA and VUA

The committee clearly endorses the courageous step for merging the informatics institute at UvA and the computer science department of VUA. The joint department has the potential to become one of the few worldwide leading institutes for Computer Science.

The merger is an initiative of the computer science departments of UvA and VUA and a reaction to the changing internal and external environment. Therefore, the department shows an impressive ability to react to this kind of challenges.
This joint effort will strengthen the computer science in the Amsterdam area substantially. This development provides great opportunities for the future in terms of education, research and impact. The two research units have already a long history in hiring in a complementary manner and the merger would be an administrative confirmation what is going on anyway. The corresponding opportunities are related to attracting better talent by getting the best European students instead of fighting over them, merging various research lines, and joining the educational programme. The management has been guiding this process and it appears that at the staff and PhD student level, the major changes ahead are well accepted and the unavoidable difficulties in the transition phase are known. The management has been governing the process very well while being aware of the corresponding threats such as the future financial situation and the merger of the different accounting systems and policies, the fact that they will be considered as two entities in EU funding schemes, and merging the different cultures. The management does not expect a growth in computer science in terms of funding from universities and external funding. This is in sharp contrast to other countries such as Germany and should be considered a major threat.

One major additional challenge is the increasing competition for new staff members and faculty. Whereas the self-evaluation report was somehow short on this most important aspect, the interviews show the general awareness. In particular, there is hiring going on worldwide in the general area of big data and data science; almost every university is expanding in this area and there will be a fierce competition. The corresponding processes at UvA and VUA changed substantially in recent years. For example, new tenure trackers are evaluated and supervised by externals, many of them are international and/or have substantial international experience. Whereas the future hiring strategy is well adapted for the joint department, there are several decisions necessary in the near future concerning the importance of areas such as theory, security and privacy, interfaces, autonomous systems and robotics. It is recommended to reconsider these areas and carefully weigh their value in comparison to the anticipated expansion areas.

The future strategy is mainly related to the foundation of the joint computer science department in Amsterdam. There will be six big clusters and across these clusters three major research themes (data & decisions, performance & security, socio-technical systems). The research strategy is clear and realistic. In terms of embedding the current strengths and activities of UvA and VUA, the committee understood well the clusters and themes where they will fit in. The themes are orthogonal and all groups at UvA and VUA have their home in one of the three areas, and complementary but related areas are combined. On the other

hand, some more effort may be necessary to make the current research strengths of both the VUA visible in the overall research strategy of the new structure. There may be a risk of fragmentation and dilution. A good step in this direction is the merger of the network institute of VUA with the sister organisation at UvA.

3.5 PhD programmes

UvA

UvA has a well-structured evaluation procedure with evaluation moments after 9, 18, 24 and 36 months and an institute-wide evaluation at the end of the first year. PhD students are encouraged to participate in the events of the national research schools. Additionally, there are university-wide soft skill and career training courses as well as courses on start-ups. In total the PhD students have to achieve 30 EC but are free to choose the courses according to their individual preferences and demands. The PhD students are also involved in educational tasks of the bachelor or master programme.

Given the positive feedback by the doctoral students, the supervision concept and the offer on scientific and training courses seem to cover all demands of the doctoral students. More than 40% of the doctoral students need more than five years until finishing their PhD thesis. To shorten the time until finishing the PhD thesis the institute at UvA has recently relaxed the requirements on publications. The impact of this strategy should be evaluated in the near future and other potential measures should be discussed with colleagues from the VUA. In the interview, the PhD students expressed their concern that only flexible workspaces will be available for doctoral students in the new building.

VUA

It appeared that the PhD students are very well embedded and integrated into the teaching and research structure of the department. The formal proposal document serves as a good roadmap for them in terms of planning their research.

In terms of education, Phd students are required to earn 30 EC, which they can compose with a high degree of freedom. Surprisingly, there are almost no mandatory courses for PhD students. It may be worthwhile to consider such a core for the education in subjects that are important to all of them. In the department there is no local graduate school; there are courses on various subjects like writing and presentation, but they are not compulsory. Some PhD students follow the national graduate schools, on an individual basis.

In general, the research questions of the PhD students align very well with the (externally funded) research projects they actually work on. Nevertheless, the time for finishing the PhD thesis appears to be too long. It is recommended to carefully analyse the corresponding reasons and to take measures that lead to a substantial shortening.

Traditionally, PhD theses in the area of computer science in the Netherlands have a high reputation in terms of their scientific quality. This is as well true in the department at VUA, which graduates about sixteen theses per year. The committee welcomes the concept of the “innovation PhD” scheme that supports a full PhD scholarship of high quality projects if

proposed jointly by two different research groups within the department or by a CS research group and another faculty or university.

3.6 Research integrity

UvA

The informatics institute at UvA together with the computer science department at VUA have established an ethical committee that provides guidelines for project proposals that might address ethical questions. Three researchers of the institute at UvA are members of the Dutch Academy of Science, which – among others – provides recommendations on computer-science specific ethical problems. Information on research integrity will be provided to new PhD students in form of a course "methodology and integrity" that has been recently established at VUA. In the opinion of the committee, the institute is well aware of the ethical dimension of science and has taken reasonable initiatives to sensitise the institute members.

VUA

Each new PhD student has to take a course on research integrity ("methodology and integrity"). In addition, the subject is discussed intensively in scientific reading groups by means of examples. In addition, the department of the VUA and the informatics institute at UvA have been establishing an ethical committee (ECIS) to assess project proposals, which might raise ethical questions. The committee finds this an important pre-requisite for any substantial work in the area of bioinformatics and big data science in general.

3.7 Summary and recommendations

UvA

The informatics institute has a long-standing high reputation with a clear international visibility. The committee classifies the research quality to be very good and sees the potential to become one of the worldwide leading departments after the merger with VUA. The number of software products as well as the numerous industrial cooperations and awards from non-academic institutions yield a clear evidence that the scientific work of the institute has a high impact for the society.

The research unit is very well equipped for the future. Opportunities and risks of the merger of the informatics institute at UvA and computer sciences department at VUA are very well taken into account and the corresponding processes appear to be very well managed. There are still efforts necessary to sharpen the research strength and directions of the new joint department and to re-evaluate the future hiring priorities. The possibility to concentrate the computer science in a single building will further contribute to the joint spirit and foster collaboration.

Recommendations by the committee:

- The planned merger with the department of Informatics VUA has the potential of forming a joint department that is world leading. The committee recommends to continue the process;

- The committee recommends to take care that the strengths and strategic directions of the computer science department at UvA are well represented in the merged department. There may be the danger of fragmentation and dilution;
- As the largest computer-science department in the Netherlands, it is suggested to take the initiative for discussions on nation-wide problems and forming an alliance to realize common interests of all computer-science departments in the Netherlands;
- The committee recommends to put effort to increase the number of spin-off companies;
- The time for finishing the PhD thesis appears to be too long. It is recommended to carefully analyse the corresponding reasons and to take measures that lead to a substantial shortening.

VUA

In summary, the computer science department of the VUA conducts excellent internationally recognised research. The planned merger with the Informatics Institute at the UvA has the potential of forming a joint department that is world leading. The research conducted at the VUA has all the necessary prerequisites.

Looking at the tremendous success of the open source software it can be stated that the department makes an outstanding contribution to society. Other aspects such as the direct valorisation of the research results by generation of spin-off companies has a high potential to be on a similar scale.

The research unit is very well equipped for the future. Opportunities and risks of the merger of the computer sciences department at VUA and the informatics institute at UvA are very well taken into account and the corresponding processes appear to be very well managed. There are still efforts necessary to sharpen the research strength and directions of the new joint department and to re-evaluate the future hiring priorities. The possibility to concentrate the computer science in a single building will further contribute to the joint spirit and foster collaboration.

Recommendations by the committee are:

- The planned merger with the Informatics Institute at the UvA has the potential of forming a joint department that is world leading. The committee recommends to continue the process;
- The committee recommends to take care that the strengths and strategic directions of the computer science department at VUA are well represented in the merged department. There may be the danger of fragmentation and dilution;
- Whereas the future hiring strategy is well adapted to the expected changes in the environment and the merger with UvA, there are several decisions necessary in the near future concerning the importance of areas such as theory, security and privacy, interfaces, autonomous systems and robotics. It is recommended to reconsider these areas and carefully weigh their value in comparison to the anticipated expansion areas;

- The committee recommends to make sure that the research culture at VUA in terms of solidarity, joining efforts and communication is a major strength in the new structure as well;
- The committee recommends to take measures that increase the visibility of the computer science department at VUA in major European strategic groups;
- The increase in external funding requires a major investment of the staff for proposal writing, reporting and project administration. In addition, the number of students has grown substantially in recent years leading to an increasing teaching effort. As a consequence, staff members observe a decreasing time left for research. The committee recommends corresponding discussions with the faculty and university leadership;
- The time for finishing the PhD thesis appears to be too long. It is recommended to carefully analyse the corresponding reasons and to take measures that lead to a substantial shortening.

4. Assessment of the institute – TU Delft

Assessments:

INSY:	
Research quality:	2
Relevance to society:	2
Viability:	2
SCT:	
Research quality:	2
Relevance to society:	2
Viability:	2

4.1 Research area

Computer Science (CS) at TU Delft is organised in two departments, “Intelligent Systems” (INSY) and “Software and Computer Technology” (SCT), hosting the vast majority of the TU Delft’s ICT community. The fundamental research can be characterized as predominantly use-inspired, with sufficient opportunity for curiosity-driven research and occasional pragmatic-applied research in the context of effective technology transfer. Important application domains for use-inspiration of computer science are medical and life sciences technology, as well as technologies for information services and social media.

The INSY department covers the theory, implementation and analysis of (human-centred) information processing and communication algorithms. The SCT department roughly covers the design, engineering and analysis of complex, distributed and cooperative software and computer systems.

4.2 Research quality

INSY

The research quality of this department is high. There are internationally recognised full professors at INSY with an h-index above thirty. The number of peer-reviewed journal publications of the department has increased to an all-times record of 120 in 2014. However, the research in cyber security, started in 2013, is less visible until now.

The department is divided into six research groups, Computer Graphics and Visualization, Cyber security, Interactive Intelligence, Multimedia Computing, Network Architecture and Systems, and Pattern Recognition and Bioinformatics. In the previous assessments recommendations regarding the focus and funding of the Computer Graphics and Visualization (CGV) research group have been made. The committee is of the opinion that this group is in very good shape now. Thus, the recommendations of previous assessments have been followed and have already resulted in increased external funding and publications in this field. The new CGV focus on virtual worlds and high-quality display solutions is adequate in the context of the department’s strategy. The committee is pleased to see that CGV uses medical visualization as an application area including the processing and display of medical data for improved diagnosis and computer-aided surgical planning fits very well with the biomedical focus of TU Delft. In addition, the work in quantum communication is a very promising strategic expansion of the research portfolio.

Best paper awards, high-impact publications, and benchmark winning systems underline that INSY conducts very good, internationally recognised research in recommender and negotiating systems, computer graphics, network architectures, and bioinformatics, as well as privacy protection. This success is also due to the new generation of very talented young researchers that joined the department in recent years. The professional standing (academy membership, fellowships) of two chairs is high, although ACM, ECCAI and AAAI fellowships are still missing. Two ERC starting grants have been acquired.

During the evaluation period a large number of strategic, organisational and personnel changes took place, which, in the opinion of the committee, all resulted in a stronger INSY department with a high-quality staff and a solid funding background.

SCT:
Six research programmes are distinguished in the SCT department: Software Engineering, Parallel and Distributed Systems, Web Information Systems, Algorithmics, Embedded Software, and Computer Engineering (not further presented in this assessment). SCT researchers in Web Information Systems, User Modelling and Data Analytics, in embedded software systems, in Software Engineering and in distributed systems conduct very good research and are internationally visible. Only a small percentage of the staff can be considered to underperform in terms of international scientific recognition. The work on software testing and software repository mining as well as the work on peer-to-peer systems and embedded software (IoT, cyber-physical systems) is important and of very high quality.

The research on algorithmics and the coordination of multi-agent systems is less strong and internationally less visible. In general, theoretical computer science and the mathematical foundations of informatics are not particularly strong at TU Delft. The committee hopes that the new tenure-track position in automated planning, which is announced for 2016, can be filled with an internationally leading early-career candidate, who can increase the visibility of this group and generate a turn-around effect.

The committee noted that the number of conference papers of SCT is quite high. However, the ratio between refereed journals and conference papers seems not optimal. The committee suggests to carefully consider the balance.

4.3 Relevance to society

The committee was impressed by TU Delft's grand-challenge initiatives like the PowerWeb platform addressing key challenges of the energy transition. Their multi-disciplinary research on smart grids comprises the full application stack: from the underlying physical systems (hardware), the design of smart energy management systems (software), to the study of smart grids in relation to their societal and economic environment (peopleware). Their work in two EIT digital projects led already to the Symphony platform for a distributed smart grid experiments based on advanced multi-agent planning. TU Delft is now a gateway for industry on future energy systems that has already led to significant industrial collaborations with important companies in this area including Alliander, Tennet, ABB, and Siemens.
The SealincMedia (Socially-enriched access to linked cultural media) COMMIT project on the design of efficient and effective crowd sourced content annotation for cultural heritage institutions can have a great societal impact of the future of digital museums.

The EU TRADR project develops technology for human-robot teams to assist in disaster response efforts and TU Delft's Interactive Intelligence Group is responsible for the important problem of human-robot teaming.

INSY
Six spin-off companies have been founded by former students and staff members, but the level of direct industrial contracts is comparatively low in the INSY Department. The number of prototypes, fully-fledged demo systems and open-source software tools developed in INSY is too low. A strategy on capitalising on the very good research results of INSY should be

developed with high priority. The committee recommends employing more software engineers for high-quality system development and technology transfer.

The outreach activities for tutoring robotics and coaching research led to more awareness in high schools some international media coverage.

SCT
Three spin-off companies have been reported during the evaluation period. The funding of more than 10 PhD candidates through industry and research contracts from Oracle and Telkom Italia shows the economical relevance of some of the research of SCT. Nevertheless the committee recommends increasing efforts to generate more spin-off companies based on research results.

The P2P client Tribler with more than 10k regular users, the establishment of a P2P streaming standard and the real-time urban analytics tool SocialGlass are underlining the practical use of the research results of SCT. The Spoofax Language Workbench for building programming environments and compilers for domain-specific languages has received contributions from over 40 developers and is used widely in research organisation.

The strategy to focus the Embedded Software group on Internet of Things is supported by the committee and the new lines of research on visual light communication and wireless power transfer are promising.

4.4 Viability

The two departments insisted to give separate self-assessment reports, although they share responsibility for the CS Bachelor and Master educational programmes. However, the dean has an active strategy to create collaboration across departments of the faculty. If a staff member retires, the position becomes open for the faculty as a whole.

Although a merger of the two departments was already recommended in previous assessment reports, the management team of the faculty informed the committee that the board of the university insists to keep the two departments as separate entities. It was argued that the departments have cultural differences and that INSY has more T-shaped academic staff than SCT, since their horizontal T-part is broader than that in SCT. However, the committee believes that a unified CS department would increase the international visibility of CS at TU Delft, since a critical mass of researchers and a broader coverage of modern informatics could be presented to the outside world. In addition, the strategic Delft Data Science (DDS) programme is based on a collaboration of both departments, since only together they can guarantee the expertise that is needed for the programme.

The management of both departments show impressive leadership skills and have an excellent personal network in industry and government as well as the international research community. However, it has not managed to merge the two departments and to unify the traditions and cultures of the two separate units in a win-win synergy strategy. Such a joint

effort would strengthen computer science at Delft substantially and reduce administrative overhead.

INSY
The excellence of the T-shaped academic staff and the agility to renew and adapt the research focus are the greatest assets of the department.

The timely renewal of research in cyber security and quantum technologies together with other strong local academic or company partners was an excellent move for future growth.

The committee applauds that the technology transfer activities will be emphasised in the future strategy by increasing the volume of open-source software tools and platforms, and at generating momentum for entrepreneurial master students or PhD candidates to establish a start-up company after the completion of their doctorate. The committee applauds the plan to reserve budget for an academic visitors programme to increase the visibility of the department and to increase the scouting abilities, especially towards PhD candidates and postdocs.

The research at INSY focuses on smart services in a data-driven economy. Some of the research is inspired by the world of consumer electronics and entertainment. Since the internationally leading IT companies for these fields are based in North America and Asia, the committee believes that it will be very tough for TU Delft to capitalize on their research results in these application areas. Instead, the committee recommends concentrating on societal and economic priorities of the Netherlands by focusing the research on smart services for medical and health sciences, security and privacy, and safety and incident management.

SCT
The relatively young age of the scientific staff together with the very clear succession plans for retiring staff members can be seen as a success of the professional management of the department.

The research on embedded software has been successfully been reorganised and partially been refocused to important Internet of Things (IoT) topics. Thus, the recommendation from the last review to enter the IoT field has been realised. The two new lines of research line on visual light communications (VLC) and wireless power transfer (WPT) are very promising and important for industrial impact.

4.5 PhD programmes
It appeared that the PhD candidates are very well embedded and integrated into the teaching and research structure of the department. The team spirit of the interviewed group of students was excellent. The three advisors (supervisor, co-supervisor, mentor) have clear roles and a committee monitors the progress of the candidates in a professional way.

In terms of education, PhD candidates are required to earn 45 EC, which they can compose from three skill sets with a high degree of freedom. There is a university-wide graduate

school, which has a faculty branch, responsible for the specific doctoral education programme. Some PhD candidates attend the national graduate schools, on an individual basis. There was only a complaint about taking master degree courses, that are quite long and don't give you enough credit.

In general, the research questions of the PhD students align very well with the (externally funded) research projects they actually work on. PhD candidates have the chance to publish alone, if the supervisor has not really contributed to the paper.

The room situation is satisfactory, since in general one office is shared by two PhD candidates. The students appreciated the physical space that is common for hangouts on every floor to increase scientific exchange. The computing infrastructure and the labs were highly appreciated by the interviewed PhD candidates.

The committee is pleased that a PhD council was installed last year on the faculty level to represent the interests of the PhD candidates.

Students get some career advice from their supervisors. In addition, there is a compulsory course on career development. They can also consult with a career centre of the university. Twice a year, companies come to the campus and they can get involved through industrial internships, which are heavily encouraged. There are good collaborations with industry, so it's easy to get lured to a company. There is no problem on career development for the students, but possibly for the university because some students may leave early.

The graduate school pushes hard that the candidates finish after four years, but in most cases an extension of three to four months is necessary to prepare the defence.

The PhD programme was highly professionalized during the evaluation period, but leaves sufficient freedom to adapt to the specific knowledge and project of the PhD candidate. The number of dropout could be reduced significantly during the evaluation period. But the number of PhD candidates that need more than 5 years to finish is still too high. The female enrolment for the PhD programme is quite low and should receive attention (in 2014 only 50% of 2008-2011).

4.6 Research integrity

The committee was pleased with the excellent TU Delft Roadmap for matters of integrity, which gives advice how to deal with ethical dilemmas. The roadmap in the form of a transportation network map is distributed to everyone at TU Delft, whether staff, student or guest. Each new PhD student has to take a half-day course on scientific integrity. Potential conflicts of interest are made transparent by mandatory reports of part-time assignments outside of TU Delft. The Bachelor programme in computer science has a mandatory course that deals with legal and ethical issues.

In the reporting period, no irregularities or plagiarism have been found.

4.7 Summary and recommendations

In summary, both departments conduct good, internationally recognised research. Their societal relevance is very good. The committee applauds the large number of internal collaborations, such as Delft Data Science and Powerweb. Both departments are well equipped for the future, but may perform better if they become larger. The board of the university insists to keep two departments in computer science. The committee found the argumentation of the department heads against a merger not really convincing. It is of the opinion that merger of both institutes might help to increase the international visibility and to recruit excellent new professors and PhD students from abroad.

The committee is satisfied with the PhD programme. It concluded that the students have clear goals, supervision, and evaluation at regular intervals. They receive excellent supervision, career development, and research conditions.

The committee is of the opinion that the measures to ensure research integrity appear to be rigorous and effective. Students are exposed to the problem through a mandatory course and additional activities in the department. The TU Delft Roadmap for integrity is an excellent visualization of the key issues that have to be observed.

Recommendations by the committee:

- The committee recommends to merge both departments into a very strong CS department, that is able to compete with other first-rate departments at top international universities.

Recommendations for INSY:

- The committee recommends to further strengthen the research on cyber security and quantum technology;
- The committee recommends to develop with high priority a strategy to capitalise on the very good research results;
- The committee recommends to concentrate on societal and economic priorities of the Netherlands by focusing the research on smart services for medical and health sciences, security and privacy, and safety and incident management.

Recommendations for SCT:

- The committee recommends to increase efforts to generate more spin-off companies based on research results;
- The committee recommends targeted action towards recruitment of high quality new staff with sufficient diversity in gender.

5. Assessment of the institute – TU Eindhoven

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

5.1 Research area

Computer Science (CS) is a sub-department of the Department of Mathematics and Computer Science (M&CS) at Eindhoven University of Technology (TU/e). The university benefits from a vibrant regional industry, and CS research is inspired by scientific, technological and societal concerns informed by such industry.

CS also plays a major role in the new Data Science Centre Eindhoven (DSC/e) and the Eindhoven Institute of Research in ICT (EIRCIT), which aims to bring together researchers from different departments across the university along inter-disciplinary themes.

CS research is organised around nine research areas, each led by a chair: Algorithms, Applied Geometric Algorithms, Architecture of Information Systems, Formal system analysis, Security, Software engineering and technology, System architecture and Networking, Visualization, and Web Engineering. These research areas represent disciplinary research, and are part of a wider thematic organisation of research across M&CS, namely: (i) data analytics, (ii) software and systems, (iii) stochastics and algorithms, and (iv) computational science.

5.2 Research quality

There are a number of research areas in CS that are of very good quality both in terms of international markers (such as citations and peer recognition) and visibility and impact. During the site visit, the research staff showed passion and enthusiasm for their research, and this was backed up with international indicators of quality and esteem. The committee noted some exceptional pockets of excellence in terms of research outputs and their impact (e.g. citations), but also noted wide variability in terms of productivity of individual staff.

There was a significant and steady drop in publications throughout the period under review, and although the quality of many publications continues to be very good, this drop of productivity (of around 30%) is of concern as it will have an inevitable impact on the quality of the research, given the ambitions of the department for more substantive and impactful interdisciplinary research, and a larger educational offering.

The committee noted the ambitions of the department in terms of growing external research income, increasing student numbers, and general improvements in research sustainability and quality, but was also concerned by the lack of a connected scientific discipline-specific vision across the CS, and the competing pressures between teaching and research that appeared to be having a detrimental impact on productivity and research quality.

As with many, if not all, CS research units in the Netherlands, data science was identified as an area of growth and strategic investment (e.g., via DSC/e). However, for the current review period, the committee was unable to identify substantive research outputs commensurate with the investment, nor any unique scientific approach to researching this emerging discipline.

The committee's interaction with the research staff provided some reassurance of the high quality research that is being undertaken in CS at TU/e, but also noted the impact of the challenging context of increased (teaching) workload, presumably the result of increased student numbers and the development of a new bachelor programme in the period under review. The committee also noted a disconnect between the high quality research narrative put forward by the research staff and the somewhat unfocused narrative put forward by management. This was reflected in the self-evaluation material submitted to the review committee, which appears not to reflect the body of CS research being undertaken.

5.3 Relevance to society

As noted in the introduction, TU/e benefits from a vibrant industrial region and context that has clearly benefitted the institution as a whole and bodes well for the future of the organisation in terms of conducting research and delivering research outputs that are relevant to the local industry and society more generally. This was reflected in the strategic aims and directions explained in the self evaluation report submitted to the review committee, although the self evaluation report was missing many concrete examples of success during the period of review (although some examples were informally enumerated during the review visit such as interaction with companies other than Philips, including Shell, Monsanto and Precision).

The educational programmes offered and their uptakes are clearly strong indicators of successful and relevant contributions to society. Collaborative efforts across TU/e and the Netherlands are commended by the committee.

There are also strong individual efforts to contribute to outreach activities, from MOOCS, to museum exhibits to contributions to industry standards. Again, these are to be commended.

However, the indicators of relevance to and impact on society more generally are mixed. There certainly appears to be an increased recent effort to communicate research to the general pubic (as evidenced by increased publications and demos), and the level of IP generation/protection (e.g., via patents or patent applications) appears to be respectable and stable (e.g., 4-8 patents per year); however, new contract research appears to have declined during the period under review, from a high of €8.2M in 2009 to €3.8M in 2014, dropping as low as €1.8M in 2012. This is balanced by some improvement in "marks of recognition by societal target groups", such as valorisation funding.

The overall picture is therefore somewhat uncertain, and would therefore benefit from more clarity in both strategy and reporting of existing efforts and achievements.

5.4 Viability

At the time of the review, CS research at TU/e appears to be in the midst of a significant and ongoing change. The increase in student numbers, the subsequent changes in teaching loads and the start of a bachelor programme in data sciences next year, appear to have had an observable detrimental impact on the volume, and perhaps consistency of quality, of CS research at TU/e. This appears to have taken its toll on research in terms of both morale of

staff and their productivity. Projections of further increases in student numbers and teaching loads suggest that these are difficulties that may not disappear very soon.

In such a challenging environment (which is not necessarily unique to TU/e), one looks to management for explanations of the past performance and for a strategy for the future. Unfortunately, it appears that current management is also in the midst of changes, with a new Dean (only two months in post at the time of the review). The committee was disappointed that both the past and current management were unable to provide an adequate explanation and reassurance about both past performance and future strategy.

Both the self-evaluation documentation and the discussion during the review visit, led the committee to believe that there appeared to be a strategic vacuum in two areas – scientific vision and recruitment.

The "vision, mission, and objectives" presented to the review committee were lacking in scientific, discipline specific direction, and suggested that these had been formulated substantially from a management and administrative perspective. They were not elaborated nor backed up by management at the review visit, nor reflected by the staff during interviews. This disconnect between management and staff was palpable and deeply concerning.

In terms of recruitment strategy, the committee was unable to see any systematic approach for recruitment except in passing commentaries enumerating some promotions and appointments during the review period. With student numbers continuing to grow, and various research initiatives such as DSC/e expected to strengthen, there was no apparent strategy to identify, target, appoint and support new staff. Without a recruitment strategy in place, and combined with some of the problematic management processes currently in place, the committee was concerned that recruitment at the level and quality required to sustain and improve CS research quality at TU/e is going to be very challenging. This puts significant pressure on the medium to long-term viability of CS research at TU/e.

The committee was of the view that a clear vision about where the CS group is heading with an effective recruitment strategy would be needed, and its formulation requires the active contribution and support of all staff in the group.

5.5 PhD programmes

The graduate school at TU/e oversees the personal development of all university PhD students and prescribes rules for PhD training and quality assurance. Its PROOF programme (PROviding Opportunties For PhD-students) offers courses on personal development and professional skills, such as presentation, scientific writing, planning, communication, scientific integrity, cultural awareness, and career orientation.

The role of the national research schools is well recognised for supporting the advanced disciplinary content of the PhD programme. As a result, students of the CS PhD programme usually enrol in one of the national research schools: ASCI, IPA and SIKS. TU/e CS research

staff make significant contributions to these schools, by providing teaching in selected topics and leadership roles in some schools; e.g. IPA and SIKS.

It appears that PhD students are well embedded and integrated into the teaching and research structure of the department and the graduate school. Nevertheless, the success rate of PhD completion could be improved; for example, about 19% of PhD projects were discontinued during the assessment period. Furthermore, there is room to increase the number of PhD students, and it would be worth exploring how to secure further funding and how to attract more self-funded overseas students.

Overall, the committee was satisfied with the PhD programme. It met with a variety of current students, from diverse backgrounds, at different stages of progression and working in different CS research areas. Although not all the students knew each other, they were aware of the opportunities and mechanisms to communicate with each other and to address any problems or issues that arose (e.g., via a student council). The university's industrial links were cited as an attraction for choosing and joining TU/e, although of course this led to potential delays in publication of industry sensitive data, but this was well supported and managed.

The committee was pleased to see that the increased teaching load of faculty staff in recent years members had not been passed on to or shared with PhD students, and the PhD students that the review committee spoke to did not feel they were overloaded with teaching. Indeed the PhD students indicated that they had regular and sufficient time with their advisors, which again is to be commended.

5.6 Research integrity

The committee was satisfied with the processes in place for ensuring research integrity. As with many universities around the world, the processes and regulations that are in place are no substitute for ensuring a fundamental awareness of research integrity issues, and their embedding in all aspects of research culture. 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 (that could, for example, be mined from data repositories through novel data analytics).

5.7 Summary and recommendations

During the review period, TU/e CS research has had some considerable achievements in challenging circumstances. The committee identified a number of strengths in research upon which the department can build for the future, but also recognised a number of issues that need urgent attention.

Recommendations by the committee:

- The management of CS research is in need of substantive overhaul. With new leadership in place, a serious strategic review and intervention is needed to ensure that there is inclusive scientific research vision that draws on exiting research staff,

the local industrial context, and a complementary recruitment strategy to enable the vision to be implemented;

- The apparent tensions between increasing teaching workloads of staff and the research ambitions need to be addressed. One cannot be sacrificed for the other, and a recognition of the trade offs between them needs to be translated into a workable approach to manage existing staff (including workload planning and effective communication), and new staff again, appointed by following a more systematic recruitment strategy);
- The PhD programme appears to be well thought out and the collaboration between the CS unit and the graduate school seems effective. However, the committee does recommend a more concerted effort to explore the ways of improving the rate of PhD completion and to expand the intake of PhD student from more diverse sources.

6. Assessment of the institute – University of Twente

Assessments:	Research quality:	1
	Relevance to society:	1
	Viability:	2

6.1 Research area

The Department of Computer Science at the University of Twente (UT) is fully embedded in CTIT, the university's research institute coordinating all ICT-related research. In CTIT, engineering and social sciences collaborate to find scientific solutions to the problems of the future.
The department of Computer Science has two research pillars: Dependable Networked Systems and Human Centered Computing. In the field of dependable networked systems the department focuses on wired and wireless communication, distributed data processing and control, reconfigurable hardware design, model-driven design and analysis methods, and quantitative concurrency theory. With regard to human centered computing, the department deals with affective and brain computing, information retrieval, and haptic interfaces.

The department has selected three major societal challenges:

- Safety, Cybersecurity & Privacy
- Energy
- Health & Well-Being.

6.2 Research quality

The committee considers the quality and academic reputation of CTIT excellent. It noticed that researchers in the institute operate at an international level and publish in high impact journals, conferences, and book chapters. Up to now there are only ERC starting grants, but several advanced grant proposals are in the pipeline.

Twente is very active in large-scale European Partnerships and very visible in Brussels. Management has identified a set of faculty members who play the role of an ambassador of Twente for large-scale European PPPs such as the Future Internet PPP. They were a founding member of the prestigious European Institute for Technology and Innovation (EIT Digital) and the current CEO of EIT, headquartered in Brussels, is faculty member of Twente.

The staff has world-leading competencies in the ability to do multi-disciplinary research. To this end, researchers are participating in many European projects. An example is the project "WiBRATE" that connected mechanical engineering and computer science. One of the major outcomes was the ability to sense and analyse the vibration of train wheels for the purpose of predictive maintenance. It is a combination of sensing, energy harvesting, wireless transmission and data analysis. At the same time, also the tracks are monitored, which improves safety. The committee applauds this multidisciplinary approach.

Groups have been also working on model checking, in particular on multi-core computers. The purpose is to parallelise the computationally expensive part; results have been high up in international competitions.

It seems that CTIT is leading in a tenure track system, in which also adjunct professors have full rights in supervising PhD students. The tenure track system is in action, especially now for all retiring full professor positions; an international network is used for headhunting; they also take special care for hiring female faculty. Junior faculty is involved also in strategic

decisions such as research area for new openings, which is great and is rewarded with good morale.

As in other universities, there has been a restructuring of the educational structure of the Bachelor and Master curriculum. This caused a major additional load onto the staff, but it appears that this did not (yet) lead to a major drop in research strength.

Twente has a very good portfolio of external funding (external grants 48% and contracts 18%), but the university provides no incentive for this excellent performance e.g., a top-up of the direct funding proportional to the external funding success. The direct funding the institute receives is only based on the number of students – this is a policy that does not fit with the vision of an entrepreneurial university.

6.3 Relevance to society

During the site visit the management team told to be very proud of the very entrepreneurial spirit at University of Twente. Already 30 years ago, an explicit policy of the President of the university introduced an environment where spin-off companies can emerge and grow. Since then more than 1000 spin-off companies have been created. At the ICT level, there have been about 4 spin-off companies per year in the recent years. There is an established ecosystem of incubators, accelerators, and VC companies at Twente, which seems to be unique in the Netherlands. Reasons are a great support for spin-offs on the university and the department level. The difference in comparison to other universities is that in Twente, one first talks to business developers and not to lawyers. For example, the department has a part-time business developer that helps interested students to enter the world of business. Another aspect is also that the department and the business developer are hunting for ideas.

The committee learned that a couple of world-leading results started from societal (medical and health) challenges: personal coaching systems, and caring home. Some main results show that it is not only possible to provide new technological solutions in this space, but also to test them in cooperation with medical faculty, as well as to bring the results to market. The computer science solutions are based on research in sensor networks, dependability and security/privacy research.

Developing tools is a great achievement of the department, but also a threat in terms of guaranteeing continuous support. The amount of tooling appears to be appropriate, but to valorise on them in a university environment is difficult. Therefore, a major effort is on creating spin-offs and looking for related innovation activities.

The Research Institute CTIT is a great structure in Twente that contains all groups that have a major aspect of their research in the area of ICT. Computer Science is a major part of it. The committee recommends that Twente continues all that it is doing to develop and maintain the culture surrounding CTIT.

Twente is involved directly in the area "Future Internet". Twente feels that they are well represented, especially in terms of subjects due to their broad expertise. On the other hand, representation in terms of research administration could be better.

6.4 Viability

Over the years, in the formula for the redistribution of public money received by the university to the faculty, rewards for external funding have been constantly decreasing. Since some large national funding schemes based on natural gas income will come to the end, the outlook for more external funding is that a plateau has been reached.

The amount of direct funding is directly related to the number of Bachelor and Master students. This fact hits the computer science department to a large extent, and has been in part compensated by creating the educational track on "creative technology". One reason for the stagnation in the core of computer science is that the student reservoir in the geographical region is limited.

In addition, there are difficulties in hiring due to the geographical embedding of the university that is not as attractive as in other universities. This is especially difficult in the typical case of "two body" situations. This all is and needs to be compensated by the reputation of the faculty and the research domains.

There were several discussions at the group level in terms of strategic directions of computer science in Twente. All staff members were asked to provide their opinion on the future strategy. All related questions are discussed including the requirements in teaching. It appears that the department very much reacts to developments in the area by reducing certain areas and developing new lines of research, including the necessary hirings. An example is the new direction "creative technology". The reorganization not only leads to new hires but also to reducing staff to a large extent, partly via laying off permanent staff. The committee is positive about the way the institute manages strategic decisions: pro-active, and problems and solutions are discussed in an open dialogue.

The committee is of the opinion that it is important for the future strategy of Twente, to lead and being involved in large projects with major impacts. What is important in terms of collaborative projects is to have impact in the areas of the "application" partners such as social sciences. Computer science should be considered as the major area where innovation is happening.

6.5 PhD programmes

The committee spoke to a very enthusiastic group of students who told about a healthy, open environment for sharing and collaborating at Twente. The graduate students spoke very highly of the way courses are structured, the openness of the lab and the match between projects and their own interests. It also seemed that the teaching load is not too terribly high. The committee recommends that Twente continues the best practices outlined above that the students do seem to be enjoying.

The main funding of the PhD students the committee met appears to be mostly from European projects. Students would prefer working longer on their own research agendas, though sometimes European projects are well aligned with those interests.

For international students adapting to the Dutch culture is sometimes difficult. Mechanisms should be put in place to ensure that they can get assistance when they need it. There is a Career Center in Twente and a course about life as a postdoc or going to industry.

It is quite common for PhD students to spend some time abroad. For European projects it is inherent due to the project collaboration.

The PhD students only recently joined the university research schools as this mechanism only recently was established. The Twente Graduate school is mainly for general skills where the national research schools are devoted to expanding the fundamentals for research. Many of the guidelines for the PhD students have been recently formalized in order to provide better guidelines. The committee feels that this is a good direction.

Students are being encouraged to finish on time, which the committee commends.

6.6 Research integrity

The committee feels that Twente operates under an extremely high level of research integrity. The research integrity is considered to be much broader than usually considered. In particular, also ethical aspects are getting much more importance and are taking into account seriously, which is important considering the type of societal projects Twente is working on.

6.7 Summary and recommendations

The committee is of the opinion that research quality continues to be very high despite restructuring around new areas. Good mentoring is in place for junior faculty and PhD students mostly get their research interests aligned with projects. The societal relevance of CTIT is impressive. There is a focus on interesting areas of multidisciplinary research. The number of spin-offs is large and greatly supported by the faculty. Twente has a very good portfolio of external funding but the direct funding, based on student numbers, has decreased. The committee feels that the strategies for the future of CTIT are well chosen.

Recommendations by the committee:

- The committee recommends to continue leveraging the international network to find very high quality, transformative faculty members, including the current efforts around attracting world class females;
- The committee recommends to lead and being involved in large projects with major impacts to increase the reputation of the faculty and the research domains.

7. Assessment of the institute – University of Leiden

Assessments:	Research quality:	2
	Relevance to society:	1
	Viability:	2

7.1 Research area

The Leiden Institute of Advanced Computer Science (LIACS) is the Computer Science institute of Leiden University, one of the eight research institutes of the Faculty of Science. Overall research theme of LIACS is data processing and data modelling, which is spread over six research fields:

- Computer systems
- Imagery and media
- Data management
- Software technology
- Algorithms
- Artificial intelligence

LIACS focuses within these fields on four focal areas:

- Embedded Systems and Compiling
- Software Composition and Correctness
- Natural Computing
- Data Mining

LIACS established a matrix organisation that relates the six research fields with the four focal areas. This structure has a very clear application focus on the biosciences.

7.2 Research quality

LIACS has a very distinct research profile that is based on the tight combination of fundamental computer science research with a sound mathematical basis and application-oriented research in the biosciences. All groups in LIACS have been focused on one common research theme, which is “Data Processing and Modelling”. For a relatively small institute a niche strategy with such a clear focus on data analytics for the biosciences is a clear advantage in the global competition for excellence. The committee was also pleased to note that all research groups at LIACS develop a solid mathematical foundation of their work, e.g. dealing with formal specification and verification, model-theoretic semantics and proof theory, complexity theory and graph theory.

During the site visit two professors from the Faculty of Science gave an excellent overview about the scientific programme of LIACS showing both methodological breadth and technical depth. The committee applauds the dual appointment in Computer Science and in Medicine of one of the professors. This helps a lot to establish a close link to clinical research and access to medical data, since the data owners in a hospital are the doctors, who usually share their data only with medical colleagues.

Currently, there are only four full professors at LIACS with a full-time employment level, who don’t have an emeritus status. This is clearly not enough for a full CS department, especially since only full professors can serve as promotors for PhD theses. The committee recommends to create at least four new full professor positions or upgrade some of the best associate professors or tenure-trackers.

An average of 40 journal publications and about 100 peer-reviewed top-level conference papers is a very good research output, given the small size of the scientific staff with only 9.2 FTE. The publication records in the field of compiler optimization are somewhat weaker, because this is currently a less attractive field of computer science. It was good to see, that there is a general trends towards more publications in refereed journals and conferences over the last 5 years at LIACS.

With the MonetDB, LIACS is at least affiliated with a very successful open-source column-oriented database system. The underlying column store technology has found its way into products of all major database vendors. The other systems that are intensively used like Taverna, Archimate and the Mutalyzer have been developed by international teams, in which LIACS was only one of the contributors. This means that the research output in terms of software tools is satisfactory, but needs improvements in the future, since the creation of reusable artefacts is seen a major goal of CS research that goes beyond paper production.

One shared ERC advanced grant and one NWO VIDI grant are good, but in addition ERC starting grants should be acquired by the assistant professors and tenure-trackers.

The committee was surprised that in 2014 only 85K EUR have been invested in the research infrastructure. This is definitely too low for a computer science department, that is competing with the best worldwide.

Unfortunately, the funding portfolio shows a decrease in industrial contracts over the last years from 27% to currently 10%. The committee understands that this is partially caused by the new focus on data analytics for the biosciences, which takes some time in networking for industrial funding. The committee recommends a strong marketing and proposal writing effort to acquire more external funding, with a good leverage factor of the current direct funding (75% direct funding and only 25% external funding is low for a CS department).

7.3 Relevance to society

The impact on societal challenges is excellent, since the research has immediate impact on health and well-being. The clear application focus on biosciences (Bioinformatics, Biopharmacy, Medicine, System Biology, Genomics) has a positive impact on the ageing Dutch society and economic impact on the health industry in the Netherlands. It is clear that data analytics is one of the most important approaches for progress in these areas. LIACS forms the core of the Leiden Centre of Data Science (LCDS) and has strong ties to the Leiden University Medical Center.

The number of joint research projects, joint appointments, and joint PhD candidates with the Leiden University Medical Center is very impressive and a unique selling point of LIACS in comparison to other Dutch CS departments. In particular, there are strong ties with the research groups of epidemiology, bio-semantics and electron microscopy. However, the number of spin-off companies and patents should be increased in the near future, when the data science results can be transformed into smart services for the health system.

7.4 Viability

LIACS has a lean and efficient management structure with a scientific and an education director seconded by an administrative director. LIACS has managed to strengthen its focus considerably: data science for the biosciences. All new recruitments have been aligned with this common goal. The existing staff had either to adapt their research area or they were successfully outplaced to other universities or industry. This was a bold and visionary decision, but the committee believes that with the limited resources available, this was the appropriate strategy to remain a leading computer science department.

It seems that there will be a fierce competition in data science research in the Netherlands, since almost all departments have now founded their own data science centres. However, Leiden has a clear advantage by its clear focus on biomedical issues in close cooperation with a strong University hospital.

The committee applauds that a very strong strategic alliance has been established with CWI integrating three top CWI researchers as part-time LIACS professors. They are a guarantee for excellent basic research and outstanding PhD candidates.

The strategy to increase direct internal funding by increasing the number of students should be re-assessed in a few years, since the higher teaching load may be counterproductive for reaching the ambitious research goals and increase external funding. As soon as the new focus of LIACS is recognised by the funding bodies more broadly, the level of external funding can increase dramatically so that the internal income by more students can be lowered again.

In the SWOT analysis, as stated in the self-evaluation report, it is noted that a specialist focus on data processing and modelling makes the department more vulnerable when interest in this area recedes. The committee agrees that the focusing and niche strategy always comes with the danger. However, in the case of biosciences, we are just at the beginning of a revolution that will continue at least for the next two decades.

A particular risk for industrial exploitation of the results is clearly seen in the long lead-time for innovative products in the medical domain. Thus, the path to a successful product is not only data-intensive, but extremely capital-intensive. Strategic alliances with large and global corporations in the health market are extremely important for the future of LIACS, given its current focus.

7.5 PhD programmes

The committee commends the success of LIACS towards a multidisciplinary PhD programme that is underlined by the fact that 48% of the PhD theses are currently multidisciplinary in nature. This is really an outstanding achievement for a computer science department.

The committee was pleased that all LIACS PhD candidates are members of the Graduate School of Science within Leiden University and thus can take various training courses. The structured PhD programme with a mandatory thesis proposal approved by the supervisor and promoter is a good tool to control progress. Finally, at the end of a PhD there is support

to work on a future career perspective through apposite training courses such as career counselling.

In the interviews with the PhD candidates, the committee was pleased by the satisfaction of all team members with their situation at LIACS. They like the spirit in the department, especially the open-door policy of the faculty members, the interaction among the research groups and the many social meeting spaces. There are many informal discussion groups and meetings with people sharing similar research interests. There is a student council of LIACS that meets with the department's management team to make sure that they have a constant stream of input about specific concerns of the students.

The committee was pleased to see that LIACS is actively involved in two national schools (IPA and ASCI), to which almost all PhD students at LIACS are assigned.

However, the committee recommends that the reasons for the high dropout rate of 20% in the PhD programme is seriously analysed. In addition, the fact that most successful candidates need six years and more to finish their PhD should result in a new effort in restructuring the PhD programme. It may help to allow the candidates in the final phase of their PhD studies (in the fourth year) to work 100% of their time on finishing the thesis, without any teaching or administrative duties.

7.6 Research integrity

At LIACS all scientific staff members have to sign the code of conduct on scientific integrity as issued by the Association of Dutch Universities. Each PhD candidate is responsible that the thesis does not contain fragments copied from other work or other form of plagiarism. There is a formal procedure to deal with the discovery of fraud.

The Committee is pleased that at Leiden a new initiative was launched to ensure that any form of research data will be stored in a sustainable, accessible, transparent and internationally accepted way. In addition, new regulations have been set up that secure amongst others privacy concerns.

The committee commends that LIACS will install its own data management strategy along the general lines issued by the university, and accompany each research project by a data management plan describing how the institute strategy is implemented for this project. This is extremely important for the Leiden Center for Data Science

7.7 Summary and recommendations

In summary, the committee is of the opinion that the research quality at LIACS is very good. The department has very strong focus areas, a very good research output, and close collaboration with the Leiden University Medical Center.

The number of joint research projects, joint appointments, and joint PhD candidates with the Leiden University Medical Center is very impressive and a unique selling point of LIACS. To ensure the future quality of research, LIACS will work hard to maintain its position among the top programmes by continuing to focus on biomedical issues in close cooperation with a

strong University hospital. LIACS has a clear vision for how it wants to progress, how to achieve its goals, and what weaknesses may be evident.

The committee was enthusiastic about the multidisciplinary nature of almost half of the PhD theses. It is of the opinion that the students have clear goals, supervision, evaluation, career development, and research conditions.

The measures to ensure research integrity appear to be well thought and appropriate. The committee was pleased with LIACS' own data management strategy.

Recommendations by the committee:

- The committee recommends that the ambitious programme to perform internationally recognised research on a crisp well-defined set of research areas in computer science, organised within a general theme with an emphasis on foundations and methods should be continued and expanded;
- The committee recommends more carefully developing a strategy to obtain more large international grants, because future financing of research will depend more and more on external funding;
- The committee is of the opinion that LIACS should entertain long-term research collaborations with companies and organisations in the health market;
- The dropout rate of PhD students is too high. It is recommended to carefully analyse the corresponding reasons and to take measures that lead to a substantial decrease.

8. Assessment of the institute –Utrecht University

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

8.1 Research area

The Utrecht Research Institute of Information and Computing Sciences (URICS) is hosted by the Department of Information and Computing Sciences, which is one of the six departments in the Faculty of Science at Utrecht University. The research institute is organised into four divisions, namely artificial intelligence, software systems, interaction technology, and virtual worlds. The vision of URICS is: “the field of computer science evolves through synergy between foundational research and applications-oriented research”. In 2010, URICS decided to focus on game technology as the overarching applications field.

8.2 Research quality

The research quality is on a high standard and covers important fundamental areas. Based on the interviews with the various bodies, the committee is convinced that the research institute conducts good research in average. Some of the research groups conduct very good, internationally highly recognised research. In particular, the functional programming activities are known to be world leading in their domain. Theory in Utrecht is very strong. The academic reputation of the research institute on an international scale can clearly be seen on the high number of refereed journal and conference publications (61 journal/129 conference). It is remarkable that in comparison to previous years, the number of journal publications increased significantly.

The focus on game technology as an overarching field of application appears to be very successful, especially in the Netherlands. Game research has been chosen as one of the eleven university-wide focus areas, and the research institute has a leading role. The academic reputation in this area is further substantiated by the initiation and coordination of the GATE project with many academic and industry partners in the Netherlands. The overarching theme of game technology, in particular serious games, helps to connect the various activities and to foster collaboration in the research institute. Not all research divisions equally contribute to this overarching field of application, some divisions collaborate more with health sciences, industry or with societal partners such as the humanities. The committee welcomes this diversity.

The international academic reputation is visible by the various research events and conferences organised in Utrecht, the ERC consolidator grant as well as several other international signs of recognition as listed in the self-evaluation report.

The research institute has been subject to major re-organisations that lead to a more transparent structure that fosters collaboration and interaction between various research directions. The major change concerns the move from quite independent chairs to research divisions that combine basic research and application-oriented research. Apparently, this change worked well in the recent years in terms of new research lines that emerged. The newly created position in scientific computing makes a lot of sense, given the excellent reputation of the Faculty of Science at Utrecht University.

The committee welcomes the tendency to introduce a flatter hierarchical structure in the divisions. This gives research staff the necessary degree of freedom to follow their own research line and getting independence in research, while still providing the necessary

mentoring and making sure that the various research streams fit well together. It is recommended to continue this development in all divisions in order to increase the international attractiveness of offered assistant professorships with tenure track.

As has been clearly mentioned in the self-evaluation report and also confirmed during the interviews, the research institute has been faced with organisational and financial challenges. This decline in direct funding is apparent from the self-evaluation report: direct funding declined from 26.6 fte in 2009 to 12.6 fte in 2013, there was a certain increase in 2014 to 16.1 fte in 2014.

In addition to this dramatic development, teaching load has increased substantially, going up to 70%. As a consequence, the management took appropriate measures to hire additional teaching staff and to optimise teaching. The atmosphere within the research institute appears to be very good. Processes on distributing teaching load are highly transparent which helps in the overall difficult process. In addition, mechanisms are in place to provide incentives to increase the quality of teaching and research. In particular, individuals are assessed based on their research output and this may lead to a reduction in teaching requirements.

As a necessary and unavoidable consequence, research output has seen a certain decline over the last years. Nevertheless, during the last years there was a great development in the research institute in terms of stabilisation. All groups we have been talking to foresee a period of stability and no further decrease but an increase in funding. But teaching load is still too high even with the additionally hired lecturers.

8.3 Relevance to society

The main application-domain of the research institute is currently the area of (serious) games. This is a prominent possibility to get people involved in influencing their environment and their well-being. Primary examples are serious games for improving communication skills, optimising the energy footprint and being actively involved in improving the personal health. Besides, the social quality of the research institute can be seen in the activities related to the learning environment for high-school algebra, the activities related to analysing legal documents and argumentation, analysing historical texts, and the early detection of outbreaks of avian influenza.

In the gaming area most companies are small companies, but the university-wide focus area helps to connect to them. The amount of external funding is a witness that the investment in developing the corresponding contacts pays off. Prominent “research products” are the interactive domain reasoners for high-school math (100k online service requests), the AMALGAM genetic algorithm (500 downloads), and the Haskell Compiler (10k downloads).

As a further example of the societal use and impact of the research institute, the academic, industrial and governmental partners in agriculture and health for early warning are worth mentioning. The research institute also organises a large consortium SoftwareVOC, which includes several hundred software companies.

There are emerging opportunities in digital humanities due to the recently established digital humanities centre of the university. There are already promising activities in musicology, but new opportunities in historical texts, history of medicine and colonial heritage could be explored.

There are some but not too many spin-off companies that originated from the research institute as the groups are mainly working with open-source software or license models. In addition, there are very strong ties with industry in some of the research areas, in particular software industry, such as KPMG, Rabobank and several smaller companies. There are different models of collaboration in place such as master students that do their thesis in cooperation with industry and the (co-) funding of PhD students by those companies. Highlight areas for cooperation are functional programming and also artificial intelligence.

The self-evaluation report lists several notable outreaching activities related to the focus areas “serious games”, the learning environment for high schools, the music analysis, awards and recognitions and youtube videos with more than a million views.

8.4 Viability

As has been mentioned already, the research unit has been confronted with exceptional challenges in terms of severe financial cuts, sharply increasing student numbers, and a frequent changes in department leadership due to health reasons. In addition, the management of the department had great difficulty to extend contracts and keep the total number of staff positions. It appears to the committee that the management has been successfully guiding the research unit through these difficult times; all groups it talked to foresee a period of stability.

The research institute has several open positions on the senior as well as on the junior level. The worldwide competition in order to hire excellent research staff is fierce and it is of utmost importance to develop a consistent and well-thought hiring strategy. Possible measures to increase the outside attractiveness of these positions must be taken and it must be recognised that the search for talent is a major, if not the most important task for the management of the institute. The flexibility in the composition of research groups based upon strategic considerations of growth, expansion or replacement can be used to broaden the search area at least in the case of assistant professors, and to provide appropriate promotion opportunities for the current research staff.

The hiring of new research staff (4 full professor positions and 11 research staff) is based on a stepwise plan in order not to hire everyone at the same time. While acknowledging the difficult financial situation and the current age-structure of the research institute, the committee recommends to develop a hiring strategy with the clear focus of attracting young researchers on an international scale with a high potential for the future. The research institute could have a leading role in providing a competitive environment for young scientists on an international scale whereas this appears to be difficult for attracting highly established senior professors. Possibly good practice is to offer this young faculty right at the beginning (at a least a small) base funding to start their independent research line. One other major aspect is to activate a clear and internationally compatible tenure track system

including an appropriate degree of formal independence as well as an appropriate base funding. Currently, a tenure track system appears to be available, but not widely used.

Most of the current research strategy in the application-domain is related to serious games and it appears that there is a high identification with this subject in the staff. In addition, there are currently activities underway to get better connected to other areas on the campus and to broaden the application domain. The new initiatives on scientific computing (such as emerging behaviour in physical and biological processes), software engineering, interaction technology and graphics are very welcome. Care should be taken that the new position in gaming is not mainly seen as a fundraising and networking possibility instead of aiming at a major scientific impact.

Coming from a very difficult period in the recent past the URICS is still in a phase of transition. The committee, however, is of the opinion that a turning point has been passed. There is a clear strategy in place, there is competent management and a very motivated staff. Therefore the committee rates the viability as good, with the potential to grow to very good in the period ahead.

8.5 PhD programmes

PhD students appear to be well embedded into the research institute. At the same time, the process towards a successful thesis is well established. Starting point is a joint document that contains a description of the global research topic, the number of hours for supervision (typically 4 hours per week), the percentage of teaching duties expected (typically 15% for PhD students of the first type, but not in the last half year), and a personalised plan of the training to be followed as part of the PhD programme.

Many of the PhD students are international and there is a good communication among them. In general PhD students are well supported and guided through their research.

Due to the problematic situation of the research institute, the teaching load for PhD students appeared to be substantial in some cases. Although the students were compensated, this situation should be avoided by taking appropriate measures, for example by distributing the load more equally.

In terms of PhD education, students need to obtain 20 EC credit points. PhD students make an agreement with their supervisor on how to obtain them via local courses, offerings from the nation-wide research schools or on an individual basis.

In general, the research questions of the PhD students align very well with the (externally funded) research projects they actually work on. Nevertheless, the time for finishing the PhD thesis appears to be too long. It is recommended to carefully analyse the corresponding reasons and to take measures that lead to a substantial shortening.

8.6 Research integrity

As described in the self-evaluation report, research integrity is addressed at the university level, the faculty level, and at the level of the department of Information and Computing

Sciences itself. It appears to the committee, that the measures at the research staff and faculty level are well thought and well developed. This also concerns the important area of "ethics" as in the era of data science and big data, more and more data are collected with the threat of potentially violating the privacy of individuals.

On the level of PhD students, there is not a mandatory course that includes research integrity as a subject. Students are exposed to this subject depending on their choice of courses and/or research schools for obtaining their education requirements. It may be worthwhile to think about some organised way of making the exposure to research integrity compulsory, for example by making it a subject in some compulsory courses, providing corresponding material and/or discussing it in research seminars.

8.7 Summary and recommendations

The research in the research institute is of good quality and well recognised internationally. Some of the research groups are internationally leading. The outreach activities of the research institute complement well the foundational research that is done in the research institute. Some of the main successes are related to the focus area of "game research", but many of them are scattered around other application-oriented activities. The viability of research in the research institute at the University Utrecht appears to be good. The research unit makes responsible strategic decisions and is therefore well equipped for the future. A major focus should be the hiring strategy, including the kind of positions offered, the areas and the breadth of openings, the balance between young and experienced researchers that are looked for, the embedding of new faculty members, the offered start-up package for assistant professors, and the mechanisms to identify the best talents on an international scale. The quality of the PhD programme is appropriate, although the time for finishing the PhD thesis appears to be too long. The measures to ensure research integrity appear to be well thought and appropriate on the faculty and scientific staff level.

Recommendations by the committee:

- The committee recommends to keep and possibly increase the research effort and research quality in fundamental subjects of computer science. They are to a large extent responsible for the reputation of the computer science in Utrecht.
- The committee recommends to take further measures that allow the research staff to spend a substantial amount of their time in research.
- The committee supports the broadening of the current strategic direction in game technology research towards neighbouring areas such as software engineering, scientific computing and interaction.
- While acknowledging the difficult financial situation and the current age-structure of the department, the committee recommends to develop a hiring strategy with the clear focus of attracting young researchers on an international scale with a high potential for the future. To this end, all essential components of a successful hiring strategy should be developed, while taking the local context into account. One major aspect is to activate a clear and internationally compatible tenure track system including an appropriate degree of formal independence as well as an appropriate base funding.

- The time for finishing the PhD thesis appears to be too long. It is recommended to carefully analyse the corresponding reasons and to take measures that lead to a substantial shortening.
- The committee is of the opinion that it is worthwhile to think about some organised way of making the exposure to research integrity and ethics compulsory for PhD students.

9. Assessment of the institute – University of Groningen

Assessments:

JBI:	
Research quality:	2
Relevance to society:	3
Viability:	4
ALICE:	
Research quality:	2
Relevance to society:	3
Viability:	4

9.1 Research area

The Faculty of Mathematics and Natural Sciences is a broad faculty that performs fundamental research in a diverse spectrum of disciplines, including physics, astronomy, mathematics, chemistry, industrial engineering and management, computer science, artificial intelligence, biology and pharmacy. Research is executed in eleven (inter)disciplinary research institutes each headed by a scientific director. Two of these institutes comprise research within the disciplines computer science (CS) and artificial intelligence (AI):

- Johann Bernoulli Institute for Mathematics and Computer Science (JBI)
- Institute for Artificial Intelligence and Cognitive Engineering (ALICE)

Within JBI five research themes are recognised:

- Distributed systems
- Fundamental computing
- Intelligent systems
- Scientific visualization & computer graphics
- Software engineering

The research in ALICE focuses on epistemic logic, multiple agent systems, perceptive systems, machine learning and cognitive modelling. A common research theme is 'Persistent Cognition', implemented in three research programmes:

- Multi-Agent Systems
- Autonomous Perceptive Systems
- Cognitive Modelling

9.2 Research quality

JBI

The research quality at the Computer Science section of JBI is very good overall, demonstrating internationally recognised research. There are also some internationally excellent or leading research activities, particularly in the *Scientific Visualization and Computer Graphics* Group and the *Intelligent Systems* Group.

Staff and PhD students are capable of publishing papers in leading international journals. It is good to see that in the areas of visualization, graphics and pattern recognition, the department has managed to publish a number of papers in leading journals such as *IEEE Transactions on Visualization and Computer Graphics* and *IEEE Transactions on Pattern Analysis and Machine Intelligence*. This is sign of quality and the committee encourages the department to maintain and expand this capability.

There is also internationally recognised research in the *Distributed Systems* Group and the *Software Engineering* Group. These two groups used to be a single group, but were split into two at the beginning of this assessment period. Although there are signs of growth within each, the level of research achievements appears still some way off that from the *Scientific Visualization and Computer Graphics* Group and the *Intelligent Systems* Group. The committee does not fully appreciate the rationales behind the splitting decision, and it urges that this is examined again, especially in the context of the need for critical mass to face

fierce external competition. In this connection, the proposed discontinuation of the *Fundamental Computing* Group and the proposed strengthening of either *Software Engineering* or *Distributed Systems* Group is a positive step in the right direction.

Citation is an important measure of research quality and influence, and the overall performance of the department can be much improved. For a 10-year period (2005-2014), the papers published by CS members received only around 1900 citations in total on the Web of Science according to the self-assessment report. This figure is not high for a department with an average number of publications close to 100 each year. The department should look into this issue closely and explore effective ways of improving its research influence and impact.

ALICE

ALICE conducts internationally recognised research in some areas of Artificial Intelligence and Cognitive Engineering. There are also some internationally excellent research activities, demonstrated by the publication of several papers in leading high-impact journals including *Artificial Intelligence* and *PNAS*.

ALICE has reorganised the structure of research by changing from four in the last assessment period to the present three research programmes. This is a welcome approach for a small department with ten academic staff, making it easy to focus better. The committee would like to see more of the papers published appear in top journals and conferences. There are also clear signs of the department struggling with the number of PhDs, in terms of both current recruitments and completions over the assessment period.

ALICE's aim is "*to span a wide field of Artificial Intelligence and Cognitive Engineering*". This appears to be in conflict with the reality of having a small group of ten academics with heavy teaching load. No doubt hard working and capable as the staff members are, it would be impossible for a small unit to cover the whole spectrum of key research areas in AI and cognitive engineering. It may be more beneficial to focus on selected areas in which ALICE is already strong and that are also strategically important in the future. It may be worth asking which of those three current groups that are more aligned with addressing the major challenges in the modern era and strengthening those whenever there is an opportunity, as part of ALICE's research strategy.

Citation is an important measure of research quality and influence where the performance of ALICE can be much improved. For a department with ten members of academic staff, only one has an H-index over thirty, while four have the index of ten or below. The department should look closely into this issue and explore effective ways of improving its research influence.

9.3 Relevance to society

JBI

Following a set of valorisation indicators defined by the University of Groningen, JBI has adopted the most relevant ones to pursue its work that could lead to important economic, social and cultural impact. JBI has identified the most important stakeholders for its research

as academic peers (40%), secondary schools (20%), non-profit organisations (20%), commercial organisations (10%), and the general public (10%).

There is a special Valorisation Committee within the Faculty of Mathematics and Natural Sciences coordinating the efforts of the research institutes including JBI to find new ways of valorisation in industry, in addition to the support from the Research & Valorisation Office of the University. The primary societal contribution of JBI is identified as the graduation of high-quality PhDs and post-doctoral researchers as well as their contributions to industry, academia and non-profit organisations. Strong connections with secondary schools are also maintained. Research with societal relevance is achieved via diverse means including public engagement, joint projects with industry, outreach activities, patents and spinoffs.

There appears to be a good mechanism in place for promoting and facilitating the knowledge transfer, and the CS section of JBI has been making a good contribution to society in general. However, the committee would be interested in seeing more concrete examples of how its work (algorithms, software etc.) has led to great innovations, financial gains, cost-cutting, life saving, or better society etc. With the great Dutch tradition of successful knowledge transfer from academia to industry in ICT, the committee believes that Groningen has good potential to further strengthen its research impact, existing processes and mechanisms.

ALICE

There is a special Valorisation Committee within the Faculty of Mathematics and Natural Sciences coordinating the efforts of the research institutes including ALICE to find new ways of valorisation in industry, in addition to the support from the Research & Valorisation Office of the University.

Several research products have been highlighted including the trainable Monk system for handwriting recognition and Metalogue, a multimodal dialogue system to train people in negotiation. There are also signs of adopting other approaches to impact: patents, spinoff, industrial collaboration and dissemination, though it is worth pursuing more of these activities.

There appears to be a good mechanism in place for promoting and facilitating the knowledge transfer, and ALICE has been making a good contribution to society in general. However, the committee would be interested in seeing ALICE have more collaboration with industry, and obtain more contract research grants as well as valorisation funding. The committee would also like to see more in-depth examples of how the work (algorithms, software etc.) has led to great innovations, financial gains, cost-cutting, life saving, or better society etc. With the great Dutch tradition of successful knowledge transfer from academia to industry in ICT, the committee believes that Groningen has good potential to further strengthen its research impact, existing processes and mechanisms.

9.4 Viability

The current organisation of computer science research at Groningen appears fragmented and there are challenges of having critical mass and resources at each unit to address their

respective research objectives. Both ALICE and JBI have made clear that their departments are understaffed due to a combination of a period of recruitment freeze, a decreasing amount of direct funding, and an increase in the undergraduate student numbers. This leads to significantly higher teaching load, thereby limiting research ambitions.

Computer Science is co-located with Mathematics in the JBI, while ALICE, a closer subject to Computer Science than Mathematics, is an independent unit. This presents artificial barriers for closer collaborations in Computer Science at Groningen. The committee understands that there are historical rationales for this separation, but fails to see any convincing reason from the scientific point of view. Excellent examples of combining AI and CS successfully in a single unit can be seen in many leading educational institutions, including Edinburgh, MIT and Stanford. Furthermore, both units are so small that there are already signs of difficulties, or deteriorations, in each, whether it is the complete lack of personal grants (CS at JBI), or the dangerously low intake of PhD students (ALICE). There is a clear question regarding the current structure and sustainability of computer science at Groningen.

Furthermore, there are at least a few internationally renowned professors of computational linguistics (CL) at Groningen who have been working in CS research institutes previously. The committee was surprised that they have not been mentioned at all in the self-assessment report, since they may help strengthen the overall scientific reputation of CS in Groningen, even though they work in another faculty.

The committee encourages the management to consider a tight cooperation in research and education between ALICE, JBI and the CL group as well as a serious exploration of moving towards a single, unified CS unit at the university to address the viability issue.

The committee applauds that the Faculty of Mathematics and Natural Sciences to which both ALICE and JBI belong introduced the Rosalind Franklin Fellowships to attract excellent female scientists to join the faculty over ten years ago, although this positive initiative is yet to be translated into important benefit for the two units. The CS section at JBI did not have any female staff member at the time of submission, while ALICE had appointed one such fellow who won a Vidi and an ERC Starting Grant, but unfortunately left the institute in 2011/2012.

In the self-assessment report regarding the future strategy, the CS section of JBI would like to strengthen its core areas of research and actively participate in the university's data science initiative: the new *Data Science and Systems Complexity* (DSSC) Centre, and in particular, emphasise the collaboration with the Mathematics section of JBI. On the other hand, ALICE intends to focus on how to extend their work in AI & Cognitive Engineering by trying to have more industrial collaborations, obtain more grants and have more PhD students. These different focuses give the impression of a lack of joint-up thinking for the future development of computer science at Groningen.

In the era of intense interest in data science and big data worldwide, the committee is concerned about the lack of close coordination and planning between these two units on how to really make the data science programme in Groningen stand out, whether it is innovative joint research and educational programmes, or joint investment in new posts. As

most universities appear to be expanding in this area and there will be fierce competition, the current fragmentation of CS and the lack of close coordination among key units is an obstacle for the growth of CS at Groningen.

9.5 PhD programmes

Here we focus on the provision of PhD programmes in Computer Science as a whole at Groningen, rather than on those individual units. Each of the nine faculties of the university has its own graduate school, and the training of PhD students in ALICE and JBI is embedded in the Graduate School of Science (GSS). While ALICE and JBI are PhD students' scientific home, the GSS provides administrative support, establishing and enforcing rules for PhD training and quality assurance, and providing a high-quality training environment. The GSS offers a broad range of transferable courses, including Publishing in English, Presentation Skills, and Introduction to Teaching.

It appeared that PhD students are well embedded and integrated into the teaching and research structure of the institutes and the GSS. However, none of the six PhD student representatives from ALICE and JBI had attended any national research school, e.g. ASCI, IPA or SIKS, and some students appear not even aware of these valuable resources. Although some managed to participate in selected international summer schools in their field, it would be useful if all the students could have access to those national research schools as well. We have heard plenty of good feedback about these schools from both PhD students and staff of other universities during the interviews.

In general, the research questions of the PhD students align well with the externally funded research projects they work on. Nevertheless, the time for completing a PhD thesis appears to be too long in general and it would be important to carefully analyse the underlying rationales and take corresponding actions. Furthermore, there is room to expand the number of PhD students and it would be worth exploring how to win further funding and how to attract more self-funded overseas students.

9.6 Research integrity

Apart from complying with the behavioural rules of the Association of Universities in the Netherlands, the University of Groningen has its own regulations for the protection of academic integrity, describing which actions to take in the event that academic norms are violated. Questions and complaints about academic integrity can be discussed with a confidential advisor. The integrity issue is also an integral part of the academic performance evaluation. In addition, the GSS course "Mastering your PhD" contains a module on *scientific integrity* that is mandatory for all PhD students enrolled in the school. The issue is also discussed at staff meetings and the research meetings between PhDs and their supervisors. In the rare cases where issues arise, strong actions have been taken to rectify the situations.

9.7 Summary and recommendations

In summary, the computer science department of JBI and ALICE both conduct internationally recognised research, with signs of internationally excellent research in certain areas. There appears to be a good mechanism in place for promoting and facilitating the knowledge

transfer at Groningen, and both units have been making a good contribution to society in general.

There are individual pockets of research excellence in Computer Science at Groningen. Each (ALICE, JBI and CL) has its own independent educational programmes. Although the new Data Science initiative has provided a platform for some of these units to work together, the overall picture of CS research in the university remains fragmented. The committee believes that there is so much more potential that could be unlocked if these units could work much more closely, perhaps towards a single CS unit. This may help with removing barriers, sharing resources, cutting costs, responding to fast-changing landscape of computer science as well as having critical mass in strategically important research areas.

Moving towards a single CS unit was also the recommendation of the last assessment panel, and this committee strongly believes that this now becomes more urgent and recommends that the Groningen management revisit it in light of the latest ICT development since a close integration may lead to not only more options for major interdisciplinary research collaborations, but also innovative new degree courses attracting talented undergraduate and postgraduate students.

The PhD programme appears well thought out and the collaboration between the institutes and the graduate school of science seems effective. However, the committee recommends Groningen to explore the rationales behind the lengthy period of a PhD study, to encourage the students to attend national research schools, and to take actions to expand the cohort of PhD student intake from diverse sources.

The measures to ensure research integrity appear to be well thought out and appropriate. There are internal mechanisms in place for both staff and PhD students.

Recommendations by the committee:

- ALICE and the Computer Science section of JBI should collaborate more closely and gradually move towards a single unit of Computer Science at Groningen, in collaboration with the Computational Linguistics Group;
- The capability of publishing papers in internationally leading journals is commended, but effective ways of improving the influence and impact of these papers should be sought;
- The collaboration with industry and the valorisation activities should be expanded;
- The cohort of PhD student intake needs to be enlarged, and attending national research schools should be encouraged.

10. Assessment of the institute – Radboud University

Assessments:	Research quality:	1
	Relevance to society:	2
	Viability:	1

10.1 Research area

The Institute for Computing and Information Sciences (iCIS) is one of the six research institutes of the Faculty of Science of the Radboud University. Research is focused around three themes: Digital Security, Software Science, and Data Science.

The research mission of the Institute for Computing and Information Sciences (iCIS) is to improve the security and reliability of computer-based systems and algorithms through mathematically founded theories, methods and tools. On the one hand the applicability of the institute's methods and tools is validated by tackling these problems, as encountered in society, industry, and other scientific disciplines. On the other hand, research problems are abstracted from concrete problems encountered in reality.

10.2 Research quality

The iCIS department is an internationally recognised institute. The institute doesn't solely focus their research on doing applications per se, but rather on core CS within the themes of digital security, data science and software science. These research areas appear to be well chosen given the small size of the institute, their core expertise and the academic and industrial communities with which they interact.

It is clear that the department is doing research of very high quality based on the key indicators, such as awards and grants, best paper awards in high quality publication venues, software tool consumption and participation in national and international research programmes.

During this assessment period, there has been an emphasis on publishing in higher impact venues and deeper collaborations with scientists from outside their institute, such as in biology, medicine and financial and security organisations. In terms of numbers and competitiveness of publications, their focus on high quality venues has paid off and several best paper awards have been received in those venues. In addition, iCIS researchers have provided many tools that have been incorporated by outside research groups and industrial partners, and though they don't keep track of downloads per se there is strong evidence that this tool development is having a good impact, both in terms of usage as well as benefitting society.

Similarly, iCIS has been positively aggressive in attracting external research grants, and the data provided shows an increase in this ability over time. In terms of personal grants, iCIS has also been quite successful, with an ERC advanced grant, a VIDI and VENIs and an ERC consolidator grant.

iCIS' organisation is relatively flat and open, they encourage collaboration both within and across disciplines and there is clear evidence that this is working. Hiring is focused on excellence and they have successfully attracted excellent senior talent, including the acceptance of a strong female chair and another, more junior female. Their financial situation is good and communication with university management is clear and timely. They have a good influx of students (which has doubled in number recently) so they should be able to hire staff to ease with the subsequent increased teaching load and balance should be

returned in the next year or so. To offset the teaching load increases, teaching loads have been reduced for new, tenured staff and for grant recipients, so that both groups can focus on and grow their important research areas. The committee applauds this.

10.3 Relevance to society

The committee learned that iCIS and its researchers play an important role in contributions to society on a wide range of topics. iCIS takes the societal relevance of its work as an important aspect of academic research and stimulates staff to be active in that respect.

While iCIS researchers have not kept detailed track of the number of downloads and usage details of their software tools and algorithms' usage, it is clear that these tools and packages are having uptake with research collaborators and moving several fields of science forward in a positive direction for society. Whether in such relevant areas as medical imaging, gene sequencing, cancer detection or the identification of security breaches or faulty code bases, the research products iCIS faculty and staff are working on, are highly relevant to the public today.

There has been an increasing trend in funding PhDs and postdocs through contract research with industry, which has inspired new research projects and directions. Also the funding of part-time professorships from outside organisations has provided good links back to industry and other research partners, again opening new pathways to productive research outputs. iCIS staff members are also supervising externs, industrial PhD students or students from outside the Netherlands, who can then go back to their original homes and take leadership positions there.

Most notable is the work by iCIS' members' efforts in engaging with the public through discourse. Digital security seems to be one such area that has garnered the public's attention in the Netherlands, especially with regard to electronic voting, smart cards, privacy, surveillance and Artificial Intelligence. The high ranking positions held by various researchers in iCIS have obvious related benefits around improving the image of the University, iCIS, the researchers themselves and even the position of ICT in the broader view of government and society, where these debates are also often carried out.

10.4 Viability

The iCIS strengths observed by the committee include their flat and open organisational structure, their growing record in attracting external funding, their strong ties to other disciplines and their solid contacts with government and industrial partners.

In the opinion of the committee, the iCIS faculty and staff are well positioned for the future. They have vetted the SWOT analysis and addressed the previous points raised in their prior assessment thoroughly and critically. In the areas where they recognize that they could still see improvements, such as reducing the teaching load for their staff, they have done what they possibly could, given the lag in funding from the influx of students. This has been realised through providing teaching allowances for new, tenure-track staff and for faculty that have been awarded research grants. Their intention here is to hire additional staff to offset the load thereafter. They can address their teaching imbalance in the future for

mathematically oriented topics as more mathematics PhD students and research partners are attracted to the department.

The previous research assessment of the institute over the period 2002–2008 suggested "that the university grows the department by at least one chair". This has not been followed, but the institute has recently (in 2015) appointed two new chairs in a "dakpan"(tiling) construction as the successors of existing chairs that will soon retire, and it has recently (2015) appointed Marchiori as a personal chair in "Machine Learning For Natural Science". The committee is pleased that it is expected that in the coming five years, the institute will be able to appoint new chairs, because of the continuing increased inflow of students, which enlarges the financial possibilities. As explained, one new chair has been established already, with the support of the university: a chair in Multimedia Information Retrieval, as a joint position with the Centre for Language Studies (CLS) of the faculty of Arts. They have found an excellent female candidate for this position who will start in 2016.

As budget grows in the next few years, internally funded PhD positions should become available for blue-sky research. While the internal career tracks for promising post-doctoral researchers will not materialise in the near future, advisors are coaching the post-docs as to interesting opportunities externally.

With low acceptance rates for computer science research proposals as a whole in the NWO TOP competition, especially for fundamental research with no obvious relationship to applications, iCIS members have demonstrated that they can and most likely will adequately fund research efforts in creative ways.

Finally, iCIS members will continue to try to attract external funding but recognize that, in order to leave ample room for blue-sky research, there may continue to be an imbalance in external funds when core research projects are a priority. iCIS members will need to benefit from their strengths and expanding research collaborations with other disciplines to further grow their institute.

10.5 PhD programmes

The committee commends iCIS members on their attraction of, care, training, advisement and delivery of their PhD students. From inception into the PhD programme, this process seems well considered, nurturing and intellectually sound. The committee found out that there was a good supervising structure both intellectually and procedurally (e.g., the weekly and bi-weekly meetings with supervisors, the annual checkpoints, etc.) and a good process towards career goals.

PhD students told during the site visit they had more than ample ways of helping each other out socially and for interacting with those outside of their research labs. For instance, seminars were open to everyone and announced on institute-wide mailing lists. There is a student council in place for the graduate students across the university. They also have confidential mentors in addition to their main supervisors.

The Committee has spoken to a very enthusiastic group of PhD students, who liked the open door policy with supervisors with a lot of time for them. The teaching load of PhD students is around 10%, as recorded in their contract, but often the teaching involves material that is related to their discipline.

PhD students are encouraged to go to international conferences to present their work and to take courses, internships and master's classes in areas that benefit their training and networking in their area. They also all participate in the national research schools where it makes sense, and this also helps to widen their social network in computer science but also in other research areas.

In summary, the committee agrees with ICIS' own self report that iCIS' policies for the training and guidance of PhD students are well thought-through with various built-in checks (yearly assessments, confidential adviser) and works very well.

10.6 Research integrity

In the self-assessment, it is mentioned that iCIS adheres to the principles of good academic teaching and research as laid down in the Netherlands Code of Conduct for Academic Practice from the Association of Universities in the Netherlands (VSNU). The Radboud University has separate intranet pages to inform employees on scientific integrity, which also discusses cases and dilemmas and best practises. The Radboud University has a confidential adviser on academic integrity and so has every research institute for PhD candidates. Radboud University has a policy for the storage and management of research data that iCIS has followed since 2013. iCIS members are reluctant to enter into Non-Disclosure Agreements (NDAs) and refuse any NDAs that might hamper scientific freedom or undermine academic integrity.

The committee learned that PhD students are provided with a document covering iCIS's policies around research integrity when they are first admitted into the programme. They told us that they have an annual meeting with their PhD coordinator who does career counselling but also covers research integrity issues during this meeting and they are free to discuss any integrity concerns that they might have, including topics as unusual as research "bullying".

The committee feels that iCIS staff members play a leading role in setting the university policies and guidelines on scientific integrity. It values also that Heskes is member of the Advice Council for Academic Integrity and that Vaandrager is a member of the Steering Committee Research Data Management. In short, it appears that the attention and training for and sensitivity to research integrity is well covered by iCIS.

10.7 Summary and recommendations

Research quality of iCIS is excellent based on the key indicators, such as awards and grants, best paper awards in high quality publication venues, software tool consumption and participation in national and international research programmes. iCIS plays an important role in contributions to society on a wide range of topics. The committee applauds the flat and

open organisational structure, the growing record in attracting external funding, the strong ties to other disciplines and the solid contacts with government and industrial partners.

PhD students appear to be extremely positive about the open environment, training and external educational, presentation and networking opportunities that are available to them. The committee commends iCIS on their recruitment of students (diversity-wise) and also on the timeliness incentives for completion of the PhD.

The committee is satisfied with the steps, policies and procedures in place at iCIS to ensure research integrity.

Recommendations by the committee:

- The committee recommends that iCIS continues focusing on publishing in high quality venues and growing new research areas based on interactions with new areas and disciplines, in addition to maintaining their standards of excellence in their core areas of computer science.
- While personal and external funding pressures will continue to grow, it's important that attention to fundamental research will be maintained. iCIS members should continue to reach out to their colleagues in the mathematical sciences in order to ensure that students and staff have a good basis to support their research.
- iCIS members are encouraged to continue searching for external and industrial partners to broaden their research emphasis and opportunities.
- The committee recommends that iCIS members continue to encourage PhD students to explore all educational opportunities that will compliment what is available to them at the Radboud and national research universities. Collaborating more with the mathematical sciences should ensure that PhD students get core mathematic skill training and advice.

11. Assessment of the research schools – General conclusions

The concept of a research school at a national level is a refreshing one. It presents PhD students with an additional resource that would otherwise be unavailable at their host universities. The students are able to learn from some of the best researchers outside of their own universities on selected research topics, and to network with fellow students and staff from other universities in the Netherlands and further afield. In addition to the training courses in specialised areas, the students may also benefit from many other services provided by the schools, including connections with industry, more employment opportunities and national high-performance computing infrastructure such as DAS.

The committee learned that the general /practical courses (eg. presentation, writing) are offered by the universities or local graduate schools, whereas courses on fundamental and advanced aspects of computer science are for the main part organised by the three research schools. According to the committee, this division seems a logical choice and works well in practice.

The committee believes that the three research schools - ASCI, IPA, and SIKS - provide not only an excellent instrument to boost the overall research quality of the PhD programme of a participating university, but also a great opportunity for the networking between senior computer scientists from all over the Netherlands through the interaction of the various faculty members, who are involved as lecturers in these schools. From our interaction with PhD students and staff during the site visits, it is clear that these schools play a very positive role in training PhD students on selected topics and in facilitating collaboration between research units across the country.

There is strong evidence that these schools work very well and fit with the special characteristics of the Dutch Computer Science community. It is a very cost-effective way of enhancing PhD education, since it is based on a lightweight management structure with minimal overhead cost and on lecturers who spend their spare-time for the love of their subject without receiving financial reward.

The committee suggests that the government should consider providing long-term sustainable funding for the three research schools, since we observe that their programmes generate an excellent value for a very small amount of money.

The committee encourages the management of the schools to continue with, and extend, their excellent work in developing these great services that would benefit not only the PhD students in the Netherlands, but also the computing community as a whole since they become excellent vehicles for community building and collaboration.

The committee encourages the management from the three schools to meet frequently to discuss the common challenges and coordinate their activities even better, not only to launch joint conferences or workshops, but also to refine the research scope of each school. At the moment, there appears to be some overlap in a few areas, e.g. pattern recognition, security, and software engineering. This may present selection issues for prospective students.

The committee appreciates the effort of the current school management committees in adapting and introducing new courses that reflect emerging trends and encourages this to continue. In particular, the schools may consider the introduction of the following topics into their programs: collaborative robotics, deep learning technologies, affective computing, wearable computing, crowd computing and others.

The committee recommends that the schools reach out to other relevant communities when considering major strategically important multidisciplinary courses. For example, most (if not all) of the Dutch universities have embarked on the major efforts in the “big data” or “data science” which require much more expertise than what a single school or indeed the computer science community alone can offer. In this connection, it would be desirable to involve other relevant disciplines such as statistics, mathematics and engineering in jointly organising the effective PhD training programs. It is good to see that the three research schools have started working with each other to jointly organise events such as the successful “ICT.OPEN” conferences and “ICT with Industry” workshops, and it would be a natural step forward to extend this collaboration to other communities.

Overall, the committee is impressed with the excellent quality of the services that are provided by the schools. There are many good practices within each individual school and it hopes that these will be shared among all schools. An even closer collaboration between the three schools and other national bodies would move the advanced training of PhDs in the Netherlands to another level and equip the CS community in the country with an excellent platform to address the challenges of the future with confidence.

12. Assessment of the research schools – ASCI

ASCI (Advanced School for Computing and Imaging) initially covered the design, implementation and application of advanced computer systems as well as computer imaging systems, but has gradually evolved into covering a wider range of topics including sensor networks, e-science, visual analytics, big data and security. ASCI has graduated 151 doctorates during 2009-2015 in collaboration with host universities. It not only provides students with an appropriate training programme (a subset of selected courses) that would be most suited for an individual, but also assists the students in, or provides platform for, seeking employment after their PhDs. It is clear that students and their supervisors are capable of publishing high-quality research papers at leading international conferences and journals.

ASCI also makes a unique contribution to the Dutch Computer Science research through its high performance computing infrastructure *DAS*. So far ASCI has coordinated five generations of DAS, each consisting of 4-6 clusters located at different participating universities. It is worth noting that DAS, designed, coordinated and maintained by ASCI, has acted as a national computing infrastructure that has supported the work of over 100 PhDs as well as many collaborative projects among the participating universities in the Netherlands. The committee recommends that national funding should be ensured for continuous upgrading of this important research infrastructure.

The committee is satisfied with the training programmes that are provided at ASCI and the ways they are managed, but urges the school to constantly review the programmes and adapt them to reflect the dynamic evolution of modern CS development. There appears to be a good quality assurance procedure in the school to monitor and ensure the quality of ASCI programme, though ASCI is encouraged to communicate with the corresponding supervision teams at local graduate schools and institutes even more closely to have a full picture of a student's progress and what impact the training courses are having on the student.

It is good to see that ASCI has already started working with other schools and national bodies on jointly organising events such as the successful ICT.OPEN conferences and "ICT with Industry" workshops. Given its unique position with DAS and its current focus areas including big data, ASCI would be well placed to work with other national research schools in CS as well as in other subjects (e.g. statistics) to provide strong training programmes and collaborating opportunities in data science.

13. Assessment of the research schools – IPA

IPA (Institute for Programming research and Algorithmics) initially covered Algorithmics & Complexity, Formal Methods, and Software Technology & Engineering, with the following specific focus areas after a recent review: Real-World Algorithmics and Models, Cyber-Physical Systems, Model-Driven Software Engineering, and Software Analytics. IPA facilitates inter-university cooperation among PhD students and its senior members through the events it organises, and in particular, by subsidising several intra- and inter-university events and activities within the scope of its focus areas. The school is also proactive in assisting students to find appropriate employment after their PhDs.

IPA has actively sought close collaboration with the graduate schools of individual universities where these graduate schools would accept credits earned through the scientific programme of IPA. Starting in 2013, all IPA activities for students have been awarded EC in addition to the certificates students currently already receive after the successful participation of an IPA event. EC enable a more fine-grained quantification of IPA's study workload and facilitate the embedding of IPA's programme in the training programmes of the university graduate schools. Furthermore, IPA has experimented with the offer of its training programme to top MSc students, and introduced a PhD prize awarded annually for the best IPA dissertation, attracting considerable attention to both the winning student and IPA.

The committee is satisfied with the training programmes that are provided at IPA and the ways they are managed, but urges the school to constantly review the programmes on offer and to have an open mind in responding to the fast changing landscape of modern CS research. There appears to be a good quality assurance procedure in the school to monitor and ensure the quality of IPA programme. The committee also noted that IPA has already had close contacts with individual university graduate schools, but the school is still encouraged to communicate even more closely with the corresponding supervision teams at university research institutes and graduate schools, before, during and after attendance at the school, in order to have a full picture of a student's progress and what impact IPA is having on the student.

It is good to see that IPA has already started working with other schools and national bodies on jointly organising events such as the successful ICT.OPEN conferences and "ICT with Industry" workshops. The committee would be interested in seeing its collaboration extended further in providing the timely and strong training programmes in strategically important areas.

14. Assessment of the research schools – SIKS

SIKS (the Netherlands research School for Information and Knowledge Systems) initially covered Artificial Intelligence, Databases & Information Systems, and Software Engineering, with the following specific focus areas after a recent consultation: Knowledge Representation and Reasoning, Computational Intelligence, Agent Technology, Computational Linguistics, Web-based Information Systems, Human-Computer Interaction, Data Management, Storage and Retrieval, Process Mining & Business Process Modeling, and Enterprise Information Systems. SIKS is the largest research school offering diverse training courses and activities. The school is proactive in assisting students to find appropriate employment after their PhDs. During 2009-2014, the school graduated 287 PhDs in collaboration with host universities.

A particular strength of SIKS is its strong ties with national and international organisations and programmes in the *information and knowledge systems* area and in related fields. As a result, SIKS members can participate for free in conferences such as DBDBD, BENELEARN, DIR, EIS and the European Summer School on Multi Agent Systems. SIKS also collaborates with the top conferences that are organised in the Netherlands, such as EASSS, SIGIR, CAiSE, and the next ECAI, allowing the SIKS PhDs to participate in tutorial programmes, workshops or doctoral consortia for free. These are additional benefits for the students in addition to a range of training courses and activities already on offer.

The committee is satisfied with the training programmes and activities that are provided at SIKS and the ways they are managed, but it was somewhat surprised that the VUA does not provide any funding for SIKS, although the other two research schools are supported by their host universities. It is good to see that the school is in the process of revising the curriculum to respond to the fast changing landscape of modern CS research. The school is also encouraged to communicate more closely with the corresponding supervision teams at university research institutes and graduate schools, before, during and after attendance at the school, to have a full picture of a student's progress and what impact SIKS is having on the student.

It is worth noting that SIKS has already started working with other schools and national bodies on jointly organising events such as the successful ICT.OPEN conferences and "ICT with Industry" workshops. The committee would be interested in seeing this collaboration further extended in providing the timely and strong training programmes in strategically important areas such as data science.

Appendix A: Curricula vitae of the Committee members

Gerard van Oortmerssen (chair) is an independent consultant and professor at Tilburg University. Educated at Delft University, he received his PhD in 1970 on computational fluid dynamics. As a researcher, research director and professor he has been involved in many aspects of research and innovation in Information and Communication Technologies. He spent the first part of his career in scientific computing, mainly applied in the maritime field. From 1991 until 2003 he was director of CWI, the national research institute for computer science and mathematics in Amsterdam. During this period he stimulated the generation of many start-up companies based on research results of CWI and founded the incubator CWI Inc. In 2003 he moved to TNO, where he was responsible for the integration of the research laboratory of the telecom operator KPN within the TNO organisation. From 2008 until 2011 he was director of the National Authority for ICT Research and Innovation. During the years 1998-2004 he was president of ERCIM, the European Research Consortium in Informatics and Mathematics. He is a member of the Academy of Technology and Innovation and in 2008 he was President of CAETS, the International Council of Academies of Engineering and Technological Sciences.

Christel Baier is a full professor and head of the chair for Algebraic and Logic Foundations of Computer Science at the Faculty of Computer Science of the Technische Universität Dresden since 2006. From the University of Mannheim she received her Diploma in Mathematics in 1990, her PhD in Computer Science in 1994, and her Habilitation in 1999. She was an associate professor for Theoretical Computer Science at the University of Bonn from 1999 to 2006. She is a member of the DFG review board for computer science since 2012 and co-speaker since 2013. Since 2011 she is a member of Academia Europa. Her expertise is on modelling, specification and verification techniques for reactive systems. In particular, she is interested in algorithms for the quantitative analysis of stochastic systems, probabilistic model checking, verification of infinite-state systems, coordination languages, compatibility of components, temporal and modal logics, and automata over infinite structures.

Mary Czerwinski is a research manager of the Visualization and Interaction (VIBE) Research Group. She received her PhD in 1988 from the Indiana University with a thesis entitled: “Differences between memory and visual search: Implications for models of attention”. Mary’s research focuses primarily on emotion tracking, information worker task management, multitasking, and awareness systems for individuals and groups. Her background is in emotion tracking and awareness, visual attention, and multitasking. She holds a PhD in Cognitive Psychology from Indiana University in Bloomington. Mary was awarded the ACM SIGCHI Lifetime Service Award, was inducted into the CHI Academy, and became an ACM Distinguished Scientist in 2010.

Xiaohui Liu has been a Professor of Computing at Brunel University since 2000. Prior to that, he was a member of academic staff at Birkbeck, University of London (1989-2000) and research staff at Durham and Heriot-Watt Universities (1987-1989). At Brunel, he was Director of Research for the School of Information Systems, Computing and Mathematics (2006-2014) and Doctoral Programme Director for Computer Science (2008-2013). His research interests include the construction of computationally intelligent algorithms, software and systems as well as the integration, analysis and visualisation of large-scale, fast

evolving real-world complex data. Xiaohui has been included in the list of Thomson Reuters Highly Cited Researchers in 2014 and 2015.

Bashar Nuseibah is a Professor of Computing at The Open University (Director of Research. 2002-2008). Previously, he was a Professor of Software Engineering and Chief Scientist at Lero – the Irish Software Engineering Research Centre (2009-2012). He was also an academic member of staff (Reader) in the Department of Computing at Imperial College London and Head of its Software Engineering Laboratory (1990-2001). He continues his association with Imperial College as a Visiting Professor, and maintains strong research links with the Distributed Software Engineering Group. He is also a Visiting Professor at the National Institute of Informatics, Japan. He is holder of a Royal Society-Wolfson Merit Award (2013-2018) and a European Research Council (ERC) Advanced Grant on Adaptive Security and Privacy (2012-2017), and serves as Editor-in-Chief of the IEEE Transaction on Software Engineering (2010-). Previously, he held a Senior Research Fellowship from The Royal Academy of Engineering and The Leverhulme Trust (2005-2007) and served as Editor-in-Chief of the Automated Software Engineering Journal (1995-2008).

Lothar Thiele received his Diplom-Ingenieur and Dr.-Ing. degrees in Electrical Engineering from the Technical University of Munich in 1981 and 1985 respectively. After completing his Habilitation thesis from the Institute of Network Theory and Circuit Design of the Technical University Munich, he joined the Information Systems Laboratory at Stanford University in 1987. In 1988, he took up the chair of microelectronics at the Faculty of Engineering, University of Saarland, Saarbrucken, Germany. He joined ETH Zurich, Switzerland, as a full Professor of Computer Engineering, in 1994. His research interests include models, methods and software tools for the design of embedded systems, embedded software and bioinspired optimization techniques. Lothar Thiele is associate editor of IEEE Transaction on Industrial Informatics, IEEE Transactions on Evolutionary Computation, Journal of Real-Time Systems, Journal of Signal Processing Systems, Journal of Systems Architecture, INTEGRATION, and the ACM Journal on Cyberphysical Systems. In 2004, he joined the German Academy of Sciences Leopoldina. Since 2009 he is a member of the Foundation Board of Hasler Foundation, Switzerland. Since 2010, he is a member of the Academia Europaea. In 2013, he joined the National Research Council of the Swiss National Science Foundation. Lothar Thiele received the "EDAA Lifetime Achievement Award" in 2015.

Wolfgang Wahlster is the Director and CEO of the German Research Center for Artificial Intelligence (DFKI) and a Professor of Computer Science at Saarland University. He has published more than 200 technical papers and 12 books on user modelling, spoken dialog systems, mobile and multimodal user interfaces, the semantic web, as well as the internet of things and services. He is a Fellow of AAAI, ECCAI, and GI. In 2001, the President of Germany presented the German Future Prize to Professor Wahlster for his work on intelligent user interfaces, the highest personal scientific award in Germany. He was elected Foreign Member of the Royal Swedish Nobel Prize Academy of Sciences in Stockholm and Full Member of the German National Academy of Sciences Leopoldina that was founded in 1652. He has been awarded the Federal Cross of Merit, First Class of Germany. He holds honorary doctorates from the universities of Darmstadt, Linkoeping and Maastricht. He serves on the Executive Boards of the International Computer Science Institute at UC Berkeley and EIT Digital. He is the editor of Springer's LNAI series and on the editorial board of various top

international CS journals. In 2013, Wolfgang Wahlster received the IJCAI Donald E. Walker award for his substantial contributions, as well as his extensive service to the field of Artificial Intelligence throughout his career.

Appendix B: Programme of the site visit

Friday 6 November		
Time	Part	Collocutors
19.00 -	Preparation + dinner	Committee only

Saturday 7 November		
Time	Part	Collocutors
09.00 – 11.00	Preparation	Committee only
11.00 – 11.40	Management UvA	Prof. dr. Jan Bergstra, director IvI Dr. Guus Delen Prof. dr. Marcel Worring Prof. dr. ir. Alfons Hoekstra, MT member IvI Prof. dr. Maarten de Rijke
11.40 – 12.10	PhD students UvA	Anne Schuth (ILPS) Mohammad Shafahi (FCN) Amir Massoud Abdol (CSL) Merijn Verstraaten (SNE) Svetlana Kordumova (ISIS) Taco Cohen (AMLAB)
12.10 – 13.10	Lunch	
13.10 – 14.10	Staff UvA	Dr. Mike H. Lees Prof. dr. ir. Cees de Laat Dr. Paola Grosso Dr. Cees Snoek Prof. dr. Theo Gevers Prof. dr. Max Welling Dr. Evangelos Kanoulas Dr. Rick Quax (post doc) Dr. Thomas Mensink (post doc)
14.10 – 14.35	Committee meeting	
14.35 – 14.50	Management UvA	Prof. dr. Jan Bergstra, director IvI, UvA Dr. Guus Delen Prof. dr. Marcel Worring Prof. dr. ir. Alfons Hoekstra, MT member IvI Prof. dr. Maarten de Rijke
14.50 – 15.15	Management UvA/VU	Prof. dr. ir. Karen Maex, dean UVA & VU Prof. dr. Jan Bergstra director IvI, UvA Prof. dr. ir. Alfons Hoekstra, MT member IvI, UvA Prof. dr. Marcel Worring, MT member IvI, UvA Prof. dr. Guus Schreiber, head of department VU Informatics Prof. dr. Frank van Harmelen, MT member VU Informatics Drs. ir. Kris de Jong, department manager, MT member VU Informatics
15.15 – 15.45	Break	
15.45 – 16.25	Management VU	Prof. dr. Karen Maex, dean UvA/VU Prof. dr. Guus Schreiber, head of Department, VU Prof. dr. Frank van Harmelen, director Network Institute, MT member Prof. dr. Wan Fokkink, educational director, MT member Drs. ir. Kris de Jong, department manager, MT member

16.25 – 16.55	PhD students VU	Chris Dijkshoorn Julienka Mollee Dennis Andriesse Fahimeh Alizadeh, Wouter Bek Hamid Bazoubandi Maurits Dijkstra
16.55 – 17.25	Break	
17.25 – 18.25	Staff VU	Prof. dr. Guszti Eiben Prof. dr. ir. Henri Bal Dr. Lora Aroyo Dr. Sanne Abeln Dr. Henrik Leopold Dr. Christiano Giuffrida
18.25 – 18.50	Meeting committee	
18.50 – 19.05	Management VU	Prof. dr. Guus Schreiber, head of department, VU Prof. dr. Frank van Harmelen, director Network Institute, MT member Prof. dr. Wan Fokkink, educational director, MT member
19.30 -	Dinner	Committee only

Sunday 8 November		
Time	Part	Collocutors
09.00 – 09.45	Meeting committee	Committee only
09.45 – 10.00	Break	
10.00 – 10.45	Management TUD	Prof.dr.ir. Rob Fastenau, dean faculty EEMCS Prof.dr.ir. Inald Lagendijk, head dept. INSY Prof. dr. Henk Sips, head dept. SCT Prof.dr.ir. Catholijn Jonker, head Section II Prof. dr. Arie van Deursen, head Section SE Prof.dr.ir. Marcel Reinders, director FGS
10.45 – 11.15	PhD students TUD	Noeska Smit (INSY) Amin Allahyar (INSY) Nicola Pezzotti (INSY) Jie Shen (SCT) Marco Cattani (SCT) Erwin Walraven (SCT)
11.15 – 11.30	Break	
11.30 – 12.30	Staff 1 TUD	Prof. dr. Koen Langendoen Prof. dr. Geert-Jan Houben Dr. Johan Pouwelse Dr. Matthijs de Weerdt Dr. Alberto Bacchelli Dr. Allessandro Bozzon
12.30 – 13.30	Lunch	
13.30 – 14.30	Staff 2 TUD	Prof. dr. Alan Hanjalic Prof. dr. Elmar Eisemann Dr. Hayley Hung Dr. Koen Hindriks Dr. Sicco Verwer Dr. Jeroen de Ridder
14.30 – 14.55	Meeting committee	Committee only

14.55 – 15.15	Management TUD	Prof.dr.ir. Rob Fastenau, dean faculty EEMCS Prof.dr.ir. Inald Lagendijk, head dept. INSY Prof. dr. Henk Sips, head dept. SCT Prof.dr.ir. Catholijn Jonker, head Section II Prof. dr. Arie van Deursen, head Section SE Prof.dr.ir. Marcel Reinders, director FGS
15.15 – 15.30	Break	
15.30 – 16.15	Management TUE	Prof. dr. ir. Wil van der Aalst, director DSC/e Prof. dr. Mark van den Brand, vice dean Prof. dr. Barry Koren, vice dean Prof. dr. Johan Lukkien, director EIRICT Prof. dr. Jakob de Vlieg, dean Prof. dr. ir. Jack van Wijk
16.15 – 16.45	PhD students TUE	Jingyue Cao Paul van den Corput Alok Dixit Arthur van Goethem Julia Kiseleva Ana-Maria Sutii Mahmoud Talebi
16.45 – 17.15	Break	
17.15 – 18.15	Staff TUE	Dr. ir. Pieter Cuijpers Prof. dr. Sandro Etalle Dr. Bas Luttik Dr. Mykola Pechenizkiy Dr. Alexander Serebrenik Dr. Natalia Sidorova Prof. dr. Bettina Speckmann Dr. Michel Westenberg
18.15 – 18.40	Meeting committee	
18.40 – 19.05	Management TUE	Prof. dr. ir. Wil van der Aalst, director DSC/e Prof. dr. Mark van den Brand, vice dean Prof. dr. Barry Koren, vice dean Prof. dr. Johan Lukkien, director EIRICT Prof. dr. Jakob de Vlieg, dean Prof. dr. ir. Jack van Wijk
19.30 -	Dinner	

Monday 9 November		
Time	Part	Collocutors
09.00 – 09.45	Meeting committee	Committee only
09.45 – 10.00	Break	
10.00 – 12.00	Research schools	Prof. dr. ir. Henri E. Bal (VU Amsterdam), scientific director ASCI Prof. dr. Koen G. Langendoen (TU Delft), chairman educational committee ASCI Prof. dr. Mark van den Brand (TUE), scientific director of IPA Dr. Tim Willemse (TUE), managing director of IPA Dr. Richard Starmans (UU), managing director SIKS Prof. dr. Paul de Bra (TUE), scientific director SIKS
12.00 – 13.00	Lunch	
13.00 – 13.45	Management UT	Prof. dr. Peter Apers, dean faculty EWI Prof. dr. ir. M.R. Maarten van Steen, scientific director CTIT Prof. dr. Jaco van de Pol, chair department CS

13.45 – 14.15	PhD students UT	Justyna J. Chromik Kallol Das Robert de Groote Alejandro Moreno Wytse H.M. Oortwijn J. Jair C. De Santanna
14.15 – 14.30	Break	
14.30 – 15.30	Staff UT	Prof. dr. ir. B.R.H.M. (Boudewijn) Haverkort Prof. dr. ing. Paul Havinga Prof. dr. ir. Hermie Hermens Prof. dr. Dirk Heylen Prof. dr. Marieke Huisman Dr. Andreas Peter
15.30 – 15.55	Meeting committee	Committee only
15.55 – 16.15	Management UT	Prof. dr. Peter Apers, dean faculty EWI Prof. dr. ir. M.R. Maarten van Steen, scientific director CTIT Prof. dr. Jaco van de Pol, chair department CS
16.15 – 16.45	Break	
16.45 – 17.30	Management LU	Prof. dr. Joost Kok, scientific director LIACS Prof. dr. Geert de Snoo, dean Faculty of Science Drs. Annemart Berendse, managing director of LIACS
17.30 – 18.00	PhD students LU	Ali Mirsoleimani MSc. Jurriaan C. Rot Dr. Jan van Rijn Msc. Jelena Spasic MSc. Bas van Stein Msc. Hao Wang Msc.
18.00 – 18.15	Break	
18.15 – 19.15	Staff LU	Prof. dr. Thomas Bäck Dr. Marcello Bonsangue Dr. Matthijs van Leeuwen Dr. Michael Lew Prof. dr. Aske Plaat Dr. Todor Stefanov Dr. Katy Wolstencroft
19.15 – 19.40	Meeting committee	Committee only
19.40 – 20.00	Management LU	Prof. dr. Joost Kok, Scientific Director LIACS Prof. dr. Geert de Snoo, dean of Faculty of Science Drs. Annemart Berendse, Managing Director of LIACS
20.00 -	Dinner	

Tuesday 10 November		
Time	Part	Collocutors
09.00 – 09.45	Management UU	Prof. dr. Gerrit van Meer, dean Faculty of Science Prof. dr. ir. Linda van der Gaag, head of Department Information and Computing Sciences Prof. dr. Remco Veltkamp, scientific director till 1 October 2015 Prof. dr. Marc van Kreveld Dr. Marinus Veldhorst, secretary of the board
09.45 – 10.15	PhD students UU	Anna Aljanaki MSc. Jan Dirk Fijnheer MSc. Ruud Koot MSc. Garm Lucassen MSc. Sjoerd Timmer MSc. Wouter van Toll MSc.

10.15 – 10.30	Break	
10.30 – 11.30	Staff UU	Prof. dr. Hans Bodlaender Dr. Fabiano Dalpiaz Dr. ir. Arjan Egges Prof. dr. mr. Henry Prakken Dr. Wouter Swierstra Dr. Anja Volk Dr. Frans Wiering
11.30 – 11.55	Meeting committee	Committee only
11.55 – 12.15	Management UU	Prof. dr. Sjef Smeekens, vice-dean research Faculty of Science Prof. dr. ir. Linda van der Gaag, head of Department Information and Computing Sciences Prof. dr. Remco Veltkamp, Scientific director till 1 October 2015 Prof. dr. Sjaak Brinkkemper, Scientific director Dr. Marinus Veldhorst, secretary of the board
12.15 – 13.00	Lunch	
13.00 – 13.45	Management RUG	Prof. dr. Jasper Knoester - dean FMNS Prof. dr. Jos Roerdink - director JBI Prof. dr. Lambert Schomaker, director ALICE
13.45 – 14.15	PhD students RUG	Frank Blaauw (JBI) Matthew van der Zwan (JBI) Sofia Charalampidou (JBI) Amirhosein Shantia MSc (ALICE) Charlotte Vlek MSc (ALICE) Menno Nijboer MSc (ALICE)
14.15 – 14.30	Break	
14.30 – 15.30	Staff RUG	Prof. dr. Marco Aiello (JBI) Prof. dr. Paris Avgeriou (JBI) Prof. dr. Nicolai Petkov (JBI) Prof. dr. Alex Telea (JBI) Prof. dr. Niels Taatgen (ALICE) Prof. dr. Rineke Verbrugge (ALICE) Dr. Marco Wiering (ALICE) Dr. Bart Verheij (ALICE)
15.30 – 15.55	Meeting committee	
15.55 – 16.15	Management RUG	Prof. dr. Jasper Knoester - dean FMNS Prof. dr. Jos Roerdink - director JBI Prof. dr. Lambert Schomaker, director ALICE
16.15 – 16.45	Break	
16.45 – 17.15	Management RU	Prof. dr. Herman Geuvers, director of iCIS (2015-present) Prof. dr. Tom Heskes, director of iCIS (2009-2014) Dr. Bernadette Smelik, managing director
17.15 – 17.45	PhD students RU	Maaike de Boer M.Sc. Steffen Michels M.Sc. Joshua Moerman M.Sc. Joost Renes M.Sc. Elena Sokolova M.Sc. Bas Westerbaan M.Sc.
17.45 – 18.00	Break	

18.00 – 19.00	Staff RU	Dr. Lejla Batina Prof. dr. Bart Jacobs Dr. Twan van Laarhoven Prof. dr. Peter Lucas Prof. dr. Elena Marchiori Prof. dr. Frits Vaandrager
19.00 – 19.25	Meeting committee	Committee only
19.25 – 20.00	Management RU	Prof. dr. Herman Geuvers, director of iCIS (2015-present) Prof. dr. Stan Gielen, dean of the Faculty of Science Prof. dr. Tom Heskes, director of iCIS (2009-2014) Dr. Bernadette Smelik, managing director
20.00 -	Dinner	

Wednesday 11 November		
Time	Part	Collocutors
09.00 – 12.30	Meeting committee	Committee only
12.30 – 13.30	Lunch	
13.30 – 14.00	Closing session committee	Committee only

Appendix C.1: Quantitative data – University of Amsterdam

Table 1 Research staff

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	38	12.5	37	12.0	37	11.9	35	11.1	36	11.2	36	11.2
Post-docs	33	27.9	26	24.9	26	20.3	33	20.4	34	26.4	26	23.9
PhD students	87	-	80	-	89	-	84	-	88		90	
Total research staff	**158**	**40.4**	**143**	**36.9**	**152**	**32.2**	**152**	**31.5**	**158**	**37.6**	**152**	**35.1**
Support staff	50	29.1	40	28.0	37	33.5	30	27.6	30	24.4	26	20.6
Visiting fellows	35	-	33	-	33	-	27	-	52	-	48	-
Total staff	**243**	**69.5**	**216**	**64.9**	**222**	**65.7**	**209**	**59.1**	**240**	**62.0**	**226**	**55.7**

Table 2 Main categories of research output

	2009	2010	2011	2012	2013	2014
Refereed journals	85	79	96	67	83	88
Peer reviewed conference papers	160	181	166	171	160	185
Books	0	1	0	2	1	1
Book chapters	14	18	21	10	14	5
PhD theses	11	20	19	12	15	21
Software & hardware	0	0	0	0	0	0
Total	**270**	**299**	**302**	**262**	**273**	**300**

Table 3 Funding

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	468	29	49.3	34	32.2	24	38.2	29	41.8	34	46.3	39
Research grants	75.2	47	64.5	44	70.2	51	52.8	41	41.8	34	42.1	35
Contract grants	38.1	24	32.7	22	34.6	25	39.0	30	37.8	31	30.5	26
Other	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Total funding	160.1	100	146.5	100	137.0	100	130.0	100	121.4	100	118.9	100
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	10.0	66	9.0	65	8.2	63	7.9	58	7.7	57	7.7	60
Other Costs	5.1	34	4.8	35	4.7	37	5.7	42	5.8	43	5.2	40
Total expenditure	15.2	100	13.8	100	12.9	100	13.6	100	13.5	100	12.9	100

Table 4 PhD candidates

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	15	1	16	1	6	7	44	10	63	11	69	1	6	4	25
2007	14	4	18	2	11	9	50	11	61	12	67	1	6	5	28
2008	8	2	10	1	10	2	20	5	50	6	60	3	30	1	10
2009	15	1	16	2	13	8	50	10	63	-	-	2	13	4	25
2010	12	5	17	4	24	7	41	-	-	-	-	7	41	3	18
2011	23	3	26	1	4	-	-	-	-	-	-	20	77	5	19
Total	**87**	**16**	**103**	**11**	**11**	**33**	**43**	**36**	**60**	**29**	**66**	**34**	**33**	**22**	**21**

Appendix C.2: Quantitative data – VU University Amsterdam

Table 1 Research staff

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	49	14.5	50	14.9	47	14.4	47	13.5	47	13.3	50	13.4
Post-docs	45	28.4	46	31.4	50	29.9	52	28.9	52	28.4	51	27.1
PhD students	123	-	119	-	119	-	125	-	118	-	113	-
Total research staff	**217**	**45.9**	**215**	**49.2**	**216**	**45.3**	**224**	**44.3**	**217**	**45.0**	**214**	**46.4**
Support staff	18	13.5	18	13.1	17	13.8	25	14.7	20	14.2	14	11.5
Visiting fellows	39	-	50	-	69	-	58	-	43	-	37	-
Total staff	**274**	**59.4**	**283**	**62.2**	**302**	**59.1**	**307**	**59.0**	**280**	**59.2**	**265**	**57.9**

Table 2 Main categories of research output

	2009	2010	2011	2012	2013	2014
Refereed journals	86	75	90	89	82	90
Peer reviewed conference papers	202	194	176	186	221	175
Books	3	6	8	15	17	9
Book chapters	20	20	13	21	20	8
PhD theses	11	22	13	19	11	18
Software & hardware	0	0	0	0	0	0
Total	**322**	**317**	**300**	**330**	**351**	**300**

Table 3 Funding

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	74.0	90	60.2	77	54.7	65	39.3	46	26.1	32	26.0	35
Research grants	6.3	8	13.3	17	20.6	25	32.7	38	33.3	41	26.4	35
Contract grants	1.9	2	4.2	5	8.6	10	14.3	17	21.1	26	22.3	30
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total funding	**82.3**	**100**	**77.7**	**100**	**84.0**	**100**	**86.3**	**100**	**80.4**	**100**	**74.7**	**100**
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	8.7	75	9.1	82	8.7	83	9.1	83	9.	86	8.9	89
Other Costs	2.9	25	2.0	18	1.8	17	1.9	17	1.5	14	1.1	11
Total expenditure	**11.6**	**100**	**11.0**	**100**	**10.5**	**100**	**11.0**	**100**	**10.5**	**100**	**10.0**	**100**

Table 4 PhD candidates

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	15	5	20	3	15	9	45	14	70	16	80	2	10	1	5
2007	15	5	20	2	10	9	45	12	60	14	70	2	10	4	20
2008	14	3	17	1	6	7	41	11	65	13	76	2	12	2	12
2009	14	4	18	2	11	7	39	9	50	-	-	6	33	3	17
2010	9	4	13	1	8	5	38	-	-	-	-	8	62	0	0
2011	21	4	25	1	4	-	-	-	-	-	-	22	88	2	8
Total	**88**	**25**	**113**	**10**	**9**	**37**	**42**	**46**	**61**	**43**	**75**	**42**	**37**	**12**	**11**

Appendix C.3: Quantitative data – TU Delft

Table 1 Research staff INSY

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	24	9.2	25	9.3	26	9.0	29	9.6	31	10.7	30	11.0
Post-docs	18	10.5	19	13.7	19	11.8	24	12.4	24	15.0	26	12.5
PhD students	82	-	68	-	78	-	95	-	100	-	103	-
Total research staff	**124**	**19.7**	**112**	**23.0**	**123**	**20.8**	**148**	**22.0**	**155**	**25.7**	**159**	**23.5**
Support staff	8	5.9	13	7.2	11	8.0	7	4.4	6	4.6	6	4.7
Visiting fellows	1	-	1	-	2	-	2	-	3	-	2	-
Total staff	**133**	**25.6**	**126**	**30.2**	**136**	**28.8**	**157**	**26.4**	**164**	**30.3**	**167**	**28.2**

Table 2 Main categories of research output INSY

	2009	2010	2011	2012	2013	2014
Refereed journals	104	113	102	117	102	120
Peer reviewed conference papers	120	99	77	148	127	101
Books	0	1	1	0	2	1
Book chapters	30	9	4	9	10	10
PhD theses	9	17	9	7	15	18
Software & hardware	0	0	0	0	0	0
Total	**263**	**239**	**193**	**281**	**256**	**250**

Table 3 Funding INSY

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	2.4	39	2.8	52	2.7	46	2.6	39	3.0	41	3.2	39
Research grants	0.5	9	0.4	8	0.6	10	0.7	10	1.2	16	1.4	17
Contract grants	2.5	40	1.3	24	2.1	35	3.0	45	2.5	35	2.9	35
Other	0.7	12	0.9	16	0.5	8	0.4	6	0.6	9	0.8	9
Total funding	**6.2**	**100**	**5.4**	**100**	**5.9**	**100**	**6.7**	**100**	**7.3**	**100**	**8.3**	**100**
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	5.4	86	5.6	90	5.7	92	5. 0	91	5.9	89	6.9	87
Other Costs	0.8	14	0.6	10	0.5	8	0.5	9	0.7	11	1.1	13
Total expenditure	**6.2**	**100**	**6.2**	**100**	**6.2**	**100**	**5.5**	**100**	**6.6**	**100**	**8.0**	**100**

Table 4 Research staff SCT

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	19	6.9	20	7.3	20	7.3	23	6.8	29	8.6	25	9.2
Post-docs	17	9.3	14	11.7	13	7.6	10	5.1	9	4.2	9	6.6
PhD students	73	-	72	-	64	-	61	-	67	-	66	-
Total research staff	**109**	**16.2**	**106**	**19.0**	**97**	**14.9**	**94**	**11.9**	**105**	**12.8**	**100**	**15.8**
Support staff	4	2.6	3	1.9	2	0.9	3	1.4	8	3.7	5	4.3
Visiting fellows	0	-	0	-	1	-	1	-	2	-	2	-
Total staff	**113**	**18.8**	**109**	**20.9**	**100**	**15.8**	**98**	**13.3**	**115**	**16.5**	**107**	**20.1**

Table 5 Main categories of research output SCT

	2009	2010	2011	2012	2013	2014
Refereed journals	37	45	36	43	39	47
Peer reviewed conference papers	108	136	144	144	142	112
Books	4	1	2	6	4	0
Book chapters	11	5	2	4	1	0
PhD theses	7	7	8	8	13	10
Software & hardware	0	0	0	0	0	0
Total	**167**	**194**	**192**	**205**	**199**	**169**

Table 6 Funding SCT

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	2.5	56	2.4	53	2.4	52	2.7	44	3.0	45	3.1	46
Research grants	0.9	20	0.9	18	0.6	12	0.2	4	1.3	19	0.9	13
Contract grants	0.8	18	1.1	23	1.5	31	3.1	50	2.0	30	1.8	28
Other	0.3	6	0.3	6	0.2	5	0.1	2	0.4	6	0.9	13
Total funding	**4.5**	**100**	**4.7**	**100**	**4.7**	**100**	**6.1**	**100**	**6.7**	**100**	**6.7**	**100**
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	4.3	84	4.6	90	4.8	92	4.6	92	4.6	92	5.0	95
Other Costs	0.8	16	0.5	10	0.4	8	0.4	8	0.4	8	0.3	5
Total expenditure	**5.1**	**100**	**5.1**	**100**	**5.2**	**100**	**5.0**	**100**	**5.0**	**100**	**5.3**	**100**

Table 7 PhD candidates

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	26	4	30	3	10	18	60	19	63	21	70	2	7	7	23
2007	15	1	16	4	25	9	56	11	69	12	75	2	13	2	13
2008	24	8	32	0	0	17	53	21	66	24	75	4	13	4	13
2009	22	8	30	2	7	20	67	23	77	-	-	4	13	3	10
2010	25	8	33	0	0	19	58	-	-	-	-	11	33	3	9
2011	17	8	25	0	0	-	-	-	-	-	-	22	88	3	12
Total	**129**	**37**	**166**	**9**	**5**	**83**	**59**	**74**	**69**	**57**	**73**	**45**	**27**	**22**	**13**

Appendix C.4: Quantitative data – TU Eindhoven

Table 1 Research staff

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	46	13.1	45	13.9	51	15.8	50	15.0	51	15.1	53	15.3
Post-docs	24	14.8	29	16.2	26	14.0	21	15.7	20	10.5	27	14.0
PhD students	59	-	64	-	72	-	69	-	61	-	75	-
Total research staff	129	27.9	138	30.1	149	29.8	140	30.7	132	25.6	155	29.3
Support staff	5	3.5	6	3.8	8	4.5	6	4.4	6	4.5	7	4.0
Visiting fellows	0	-	0	-	0	-	0	-	0	-	0	-
Total staff	134	31.4	144	33.9	157	34.3	146	35.1	138	30.1	162	33.2

Table 2 Main categories of research output

	2009	2010	2011	2012	2013	2014
Refereed journals	95	78	84	64	69	65
Peer reviewed conference papers	202	183	181	170	191	154
Books	1	1	3	1	1	2
Book chapters	26	23	10	17	21	7
PhD theses	11	6	16	15	8	13
Software & hardware	0	0	0	0	0	0
Total	**335**	**291**	**294**	**267**	**290**	**241**

Table 3 Funding

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	24.1	36	25.8	36	31.7	41	27.5	38	24.1	38	23.5	32
Research grants	18.7	28	18.9	26	16.2	21	16.0	22	15.7	25	18.3	25
Contract grants	18.3	27	21.6	30	23.3	30	24.6	34	19.1	30	22.7	31
Other	6.2	9	5.5	8	5.7	7	3.5	5	5.1	8	9.2	12
Total funding	**67.2**	**100**	**71.7**	**100**	**76.9**	**100**	**71.5**	**100**	**64.1**	**100**	**73.7**	**100**
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	10.5	88	11.0	83	10.6	89	10.1	88	10.4	88	11.1	88
Other Costs	1.5	12	2.3	17	1.3	11	1.4	12	1.4	12	1.6	12
Total expenditure	**12.0**	**100**	**13.3**	**100**	**11.9**	**100**	**11.5**	**100**	**11.7**	**100**	**12.7**	**100**

Table 4 PhD candidates

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	4	2	6	0	0	5	83	5	83	5	83	0	0	1	17
2007	10	4	14	1	7	13	93	13	93	13	93	0	0	1	7
2008	16	3	19	3	16	13	68	13	68	14	74	1	5	3	16
2009	11	2	13	1	8	8	62	8	62	-	-	0	0	5	38
2010	10	3	13	1	8	8	62	-	-	-	-	1	8	4	31
2011	11	1	12	2	17	-	-	-	-	-	-	9	75	1	8
Total	**62**	**15**	**77**	**8**	**10**	**47**	**72**	**39**	**75**	**32**	**82**	**11**	**14**	**15**	**19**

Appendix C.5: Quantitative data – University of Twente

Table 1 Research staff

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	62	19.6	65	20.4	65	20.6	57	17.4	56	16.7	52	15.4
Post-docs	62	33.0	67	43.5	58	33.8	57	29.0	48	25.0	59	30.6
PhD students	156	-	147	-	155	-	151	-	165	-	157	-
Total research staff	**280**	**52.6**	**279**	**63.8**	**278**	**54.4**	**265**	**46.4**	**269**	**41.7**	**268**	**46.0**
Support staff	22	14.1	21	15.1	20	14.3	18	13.0	18	12.7	16	12.0
Visiting fellows	1	-	6	-	9	-	12	-	9	-	11	-
Total staff	**303**	**66.7**	**306**	**78.9**	**307**	**68.7**	**295**	**59.4**	**296**	**54.3**	**295**	**58.0**

Table 2 Main categories of research output

	2009	2010	2011	2012	2013	2014
Refereed journals	94	103	94	89	111	94
Peer reviewed conference papers	302	303	293	290	274	242
Books	3	3	3	0	0	1
Book chapters	31	21	26	21	7	24
PhD theses	25	30	25	19	28	35
Software & hardware	3	2	4	5	11	7
Total	**458**	**462**	**445**	**424**	**431**	**403**

Table 3 Funding

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	82.8	59	96.6	64	81.3	58	73.2	53	62.0	47	42.3	34
Research grants	30.9	22	27.5	18	34.3	24	38.3	28	46.3	35	59.9	48
Contract grants	27.6	20	27.8	18	25.6	18	26.9	19	24.0	18	22.8	18
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total funding	141.3	100	152.0	100	141.2	100	138.5	100	132.2	100	125.0	100
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	12.4	78	13.4	80	13.2	80	13.2	82	12.4	79	11.7	79
Other Costs	3.5	22	3.4	20	3.4	20	2.9	18	3.4	21	3.2	21
Total expenditure	**16.0**	**100**	**16.9**	**100**	**16.5**	**100**	**16.1**	**100**	**15.7**	**100**	**14.9**	**100**

Table 4 PhD candidates

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	17	8	25	2	8	13	52	17	68	19	76	1	4	4	16
2007	15	5	20	5	25	14	70	16	80	16	80	0	0	2	10
2008	18	3	21	4	19	13	62	16	76	17	81	2	10	1	5
2009	28	2	30	2	7	18	60	19	63	-	-	7	23	3	10
2010	22	7	29	1	3	17	59	-	-	-	-	11	38	1	3
2011	23	4	27	0	0	-	-	-	-	-	-	27	100	0	0
Total	**123**	**29**	**152**	**14**	**9**	**75**	**60**	**68**	**71**	**52**	**79**	**48**	**32**	**11**	**7**

Appendix C.6: Quantitative data – University of Leiden

Table 1 Research staff

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	28	6.4	25	6.9	30	8.1	31	7.5	33	6.8	43	9.2
Post-docs	10	2.8	13	3.4	6	3.2	3	1.4	2	0.9	4	2.7
PhD students	62	-	61	-	61	-	69	-	63	-	60	-
Total research staff	**100**	**9.2**	**99**	**10.3**	**97**	**11.3**	**103**	**8.9**	**98**	**7.7**	**107**	**11.9**
Support staff	22	12.3	21	11.9	23	15.1	23	13.1	28	14.3	24	11.5
Visiting fellows	0	-	0	-	0	-	0	-	2	-	0	-
Total staff	**122**	**21.5**	**120**	**22.2**	**120**	**26.4**	**126**	**22.0**	**128**	**22.0**	**131**	**23.4**

Table 2 Main categories of research output

	2009	2010	2011	2012	2013	2014
Refereed journals	25	36	35	42	52	41
Peer reviewed conference papers	75	89	109	115	105	85
Books	13	11	6	18	18	8
Book chapters	8	12	10	6	11	10
PhD theses	8	9	11	11	9	10
Software & hardware	2	3	3	2	2	2
Total	**131**	**160**	**174**	**194**	**197**	**156**

Table 3 Funding

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	33.7	53	31.3	46	26.8	45	27.8	51	30.8	59	41.3	75
Research grants	13.4	21	18.6	27	16.6	28	15.6	29	13.0	25	8.8	16
Contract grants	16.4	26	18.1	27	15.8	27	11.0	20	8.1	16	5.3	10
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total funding	**63.5**	**100**	**68.0**	**100**	**59.2**	**100**	**54.4**	**100**	**51.9**	**100**	**55.4**	**100**
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	4	77	4.5	84	4.3	84	4.1	87	4.4	82	4.5	84
Other Costs	1.2	23	0.9	16	0.8	16	0.6	13	0.9	18	0.8	16
Total expenditure	**5.2**	**100**	**5.4**	**100**	**5.1**	**100**	**4.7**	**100**	**5.3**	**100**	**5.4**	**100**

Table 4 PhD candidates

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	8	5	13	1	8	4	31	9	69	10	77	0	0	3	23
2007	8	3	11	1	9	2	18	7	64	7	64	3	27	1	9
2008	8	1	9	1	11	4	44	8	89	8	89	1	11	0	0
2009	13	2	15	3	20	6	40	11	73	-	-	1	7	3	20
2010	18	3	21	4	19	8	38	-	-	-	-	10	48	3	14
2011	7	3	10	1	10	-	-	-	-	-	-	7	70	2	20
Total	**62**	**17**	**79**	**11**	**14**	**24**	**35**	**35**	**73**	**25**	**76**	**22**	**28**	**12**	**15**

Appendix C.7: Quantitative data – Utrecht University

Table 1 Research staff

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	48	13.1	52	14.7	47	13.9	40	12.4	42	12.0	42	14.2
Post-docs	18	7.0	20	11.7	20	11.7	16	10.9	16	8.8	16	6.9
PhD students	57	-	54	-	58	-	55	-	45	-	46	-
Total research staff	123	20.1	126	26.4	125	25.6	111	23.3	103	20.8	104	21.1
Support staff	5	1.9	3	1.7	2	2.0	4	2.8	2	1.6	4	1.8
Visiting fellows	0	-	0	-	0	-	0	-	0	-	0	-
Total staff	128	22.0	129	28.1	127	27.6	115	26.1	105	22.4	108	22.9

Table 2 Main categories of research output

	2009	2010	2011	2012	2013	2014
Refereed journals	61	76	69	95	55	61
Peer reviewed conference papers	185	172	185	152	143	129
Books	0	0	0	1	3	0
Book chapters	30	7	14	17	25	22
PhD theses	14	6	14	14	10	9
Software & hardware	-	-	-	-	-	-
Total	**290**	**261**	**282**	**279**	**236**	**221**

Table 3 Funding

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	26.56	44.2	23.06	39.9	16.73	30.7	14	27.4	12.62	26.4	16.13	33.6
Research grants	15.28	25.4	11.31	19.6	15.26	28	22.56	44.2	21.03	44	17.56	36.6
Contract grants	18.27	30.4	23.48	40.6	22.54	41.3	14.52	28.4	14.16	29.6	14.33	29.8
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total funding	**60.11**	**100**	**57.85**	**100**	**54.53**	**100**	**51.08**	**100**	**47.81**	**100**	**48.02**	**100**
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	4.19	81.3	3.74	77.7	4.13	90.1	3.54	89.6	3.52	88.7	3.65	89.7
Other Costs	0.96	18.7	10.8	22.3	0.45	9.9	0.41	10.4	0.45	11.3	0.42	10.3
Total expenditure	**5.16**	**100**	**4.81**	**100**	**4.59**	**100**	**3.95**	**100**	**3.97**	**100**	**4.07**	**100**

Table 4 PhD candidates

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	4	2	6	0	0	3	50	6	100	6	100	0	0	0	0
2007	15	1	16	1	6	11	69	12	69	12	75	2	13	2	13
2008	7	2	9	0	0	4	44	6	67	6	67	1	11	2	22
2009	4	2	6	2	33	2	33	3	50	3	50	2	33	1	17
2010	8	4	12	1	8	5	42	5	42	-	-	6	50	2	8
2011	9	1	10	1	10	1	10	-	-	-	-	8	80	1	10
Total	**47**	**12**	**59**	**5**	**8**	**26**	**44**	**31**	**53**	**27**	**46**	**19**	**32**	**8**	**14**

Appendix C.8: Quantitative data – University of Groningen

Table 1 Research staff JBI

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	12	4.6	13	4.8	13	4.6	13	4.5	13	4.7	14	5.2
Post-docs	2	1.2	2	1.4	3	1.0	4	3.4	4	2.0	3	2.2
PhD students	31	-	33	-	40	-	42	-	47	-	51	-
Total research staff	**45**	**5.8**	**48**	**6.2**	**56**	**5.6**	**59**	**7.9**	**64**	**6.7**	**68**	**7.4**
Support staff	2	1.3	2	1.3	2	1.3	2	1.3	2	1.2	1	0.3
Visiting fellows	0	-	0	-	0	-	1	-	0	-	1	-
Total staff	**47**	**7.1**	**50**	**7.5**	**58**	**6.9**	**62**	**9.2**	**66**	**7.9**	**70**	**7.7**

Table 2 Main categories of research output JBI

	2009	2010	2011	2012	2013	2014
Refereed journals	21	32	48	32	42	37
Peer reviewed conference papers	45	82	56	36	39	33
Books	0	3	3	2	2	1
Book chapters	6	13	3	3	3	6
PhD theses	3	5	7	5	8	7
Software & hardware	0	0	0	0	0	0
Total	**75**	**135**	**117**	**78**	**94**	**84**

Table 3 Funding JBI

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	20.0	53	20.5	49	17.7	41	17.2	37	14.8	37	16.4	44
Research grants	4.0	11	5.0	12	3.8	9	2.7	6	1.8	5	0	0
Contract grants	6.8	18	5.3	13	5.9	13	6.5	14	4.7	12	4.2	11
Other	6.9	18	11.0	26	15.8	37	19.9	43	18.5	46	16.8	45
Total funding	**37.7**	**100**	**41.8**	**100**	**43.2**	**100**	**46.3**	**100**	**39.8**	**100**	**37.4**	**100**
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	1.60	77	1.59	76	1.35	74	1.76	81	1.82	71	1.74	86
Other Costs	0.47	23	0.49	24	0.48	26	0.43	19	0.73	29	0.29	14
Total expenditure	**2.07**	**100**	**2.08**	**100**	**1.84**	**100**	**2.19**	**100**	**2.54**	**100**	**2.02**	**100**

Table 4 Research staff ALICE

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	10	3.3	10	3.5	11	4.1	10	3.8	10	4.0	10	4.0
Post-docs	6	4.3	5	3.0	9	7.8	7	4.9	6	2.4	4	2.2
PhD students	18	-	16	-	15	-	14	-	15	-	14	-
Total research staff	**34**	**7.6**	**31**	**6.5**	**35**	**11.9**	**31**	**8.7**	**31**	**6.4**	**28**	**6.2**
Support staff	5	1.6	6	2.6	6	2.7	5	4.6	4	2.3	4	2.3
Visiting fellows	0	-	0	-	1	-	2	-	2	-	3	-
Total staff	**39**	**9.2**	**37**	**9.0**	**42**	**14.5**	**38**	**13.3**	**37**	**8.7**	**35**	**8.5**

Table 5 Main categories of research output ALICE

	2009	2010	2011	2012	2013	2014
Refereed journals	17	29	34	25	28	37
Peer reviewed conference papers	36	16	31	18	37	23
Books	2	2	2	5	1	2
Book chapters	15	8	3	5	3	6
PhD theses	1	4	1	3	1	2
Software & hardware	0	0	0	0	0	0
Total	**71**	**59**	**71**	**56**	**70**	**70**

Table 6 Funding ALICE

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	10.9	50	12.4	62	13.4	51	13.0	52	13.6	53	12.1	51
Research grants	8.5	39	6.0	30	10.0	38	5.5	22	6.0	23	4.5	19
Contract grants	2.5	11	1.0	5	2.0	8	4.8	19	4.3	17	5.2	22
Other	0.0	0	0.5	3	1.0	4	1.6	6	2.0	8	2.1	9
Total funding	**21.9**	**100**	**19.9**	**100**	**26.4**	**100**	**24.9**	**100**	**25.9**	**100**	**23.9**	**100**
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	1.4	89	1.4	86	1.7	88	1.6	86	1.8	83	1.6	85
Other Costs	0.17	11	0.21	14	0.23	12	0.25	14	0.35	17	0.30	15
Total expenditure	**1.6**	**100**	**1.6**	**100**	**2.0**	**100**	**1.8**	**100**	**2.1**	**100**	**1.9**	**100**

Table 6 PhD candidates RUG

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	6	4	10	0	0	4	40	8	80	8	80	1	10	1	10
2007	4	3	7	1	14	3	43	5	71	5	71	0	0	2	29
2008	8	1	9	0	0	5	56	6	67	6	67	1	11	2	22
2009	9	2	11	2	18	8	73	8	73	-	-	2	18	1	9
2010	12	0	12	2	17	2	17	-	-	-	-	8	67	0	0
2011	13	3	16	4	25	-	-	-	-	-	-	11	69	1	6
Total	**52**	**13**	**65**	**9**	**14**	**22**	**34**	**27**	**73**	**19**	**73**	23	**35**	**7**	**11**

Appendix C.9: Quantitative data – Radboud University

Table 1 Research staff

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Scientific staff	30	10.1	30	10.0	30	9.6	30	9.7	29	8.9	27	8.9
Post-docs	23	12.5	24	16.6	27	17.1	28	15.4	30	11.9	30	14.1
PhD students	26	-	29	-	35	-	36	-	42	-	44	-
Total research staff	**79**	**22.6**	**83**	**26.6**	**92**	**26.7**	**94**	**25.1**	**101**	**20.8**	**101**	**23.0**
Support staff	18	11.9	17	11.8	14	9,6	10	7.7	9	7.5	9	7.3
Visiting fellows	1	-	0	-	0	-	0	-	0	-	2	-
Total staff	**98**	**34.5**	**100**	**38.4**	**106**	**36.3**	**104**	**32.8**	**110**	**28.3**	**112**	**30.3**

Table 2 Main categories of research output

	2009	2010	2011	2012	2013	2014
Refereed journals	47	60	57	52	82	73
Peer reviewed conference papers	99	137	143	112	137	123
Books	2	9	9	8	8	5
Book chapters	4	14	16	22	19	20
PhD theses	9	6	7	9	13	12
Software & hardware	0	0	2	1	1	0
Total	**161**	**226**	**234**	**204**	**260**	**233**

Table 3 Funding

	2009		2010		2011		2012		2013		2014	
Funding:	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	37.5	50	37.4	44	38.1	45	34.8	43	33.6	45	31.7	45
Research grants	26.9	36	32.6	38	32.0	38	31.6	39	27.5	36	25.4	36
Contract grants	10.8	14	15.1	18	14.7	17	14.0	17	14.3	19	13.6	19
Other	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Total funding	75.1	100	85.1	100	84.9	100	80.3	100	75.4	100	70.7	100
Expenditure:	M€	%	M€	%	M€	%	M€	%	M€	%	M€	%
Personnel costs	4.94	78	5.50	81	5.53	85	5.53	83	5.06	81	5.27	87
Other Costs	1.41	22	1.29	19	0.98	15	1.17	17	1.19	19	0.77	13
Total expenditure	6.35	100	6.80	100	6.51	100	6.70	100	6.26	100	6.05	100

Table 4 PhD candidates

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	8	0	8	4	50	6	75	7	88	7	88	0	0	1	13
2007	7	3	10	5	50	7	70	10	100	10	100	0	0	0	0
2008	12	3	15	10	67	12	80	13	87	14	93	0	0	1	7
2009	7	2	9	4	44	7	78	7	78	-	-	1	11	1	11
2010	11	4	15	8	53	12	80	-	-	-	-	2	13	1	7
2011	10	1	11	5	45	-	-	-	-	-	-	6	55	0	0
Total	55	13	68	36	53	44	77	37	88	31	94	9	13	4	6

Appendix C.10: Quantitative data – Research schools

Table 1 Research staff ASCI

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Tenured staff	95	28.5	95	28.5	93	27.9	90	27	88	26.4	83	24.9
Non-tenured staff	14	4.2	14	4.2	12	3.6	7	2.1	9	2.7	8	2.4
PhD students	171		166		141		144		145		152	

Table 2 PhD candidates ASCI

	Enrolment			Success rates (graduations. cumulative)										
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006			42	7	17	23	55	31	74	33	79	2	5	5	12
2007			34	2	6	17	50	19	56	23	68	4	12	6	18
2008			38	6	16	19	50	26	68	28	74	3	8	6	16
2009			35	7	20	21	60	25	71	25	71	4	11	6	17
2010			37	7	19	22	59	22	59	22	59	12	32	3	8
2011			51	1	2	4	8	4	8	4	8	44	86	3	6

Table 3 Research staff IPA

	2009		2010		2011		2012		2013		2014	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Tenured staff	58	27	56	24	61	25	58	26	55	26	56	24
Non-tenured staff	59	27	66	29	60	24	53	23	37	17	50	21
PhD students	98	46	107	47	124	51	118	51	120	57	130	55

Table 4 PhD candidates IPA

	Enrolment			Success rates (graduations. cumulative)										
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	%
2006	19	4	23	9	39	20	87	21	91	21	91	0	0	1	5
2007	19	6	25	14	56	21	84	24	96	24	96	0	0	1	4
2008	32	4	36	18	50	26	72	29	81			3	8	4	11
2009	24	6	30	10	33	20	67					6	20	4	13
2010	26	4	30	12	40			-	-	-	-	15	40	1	3
2011						-	-	-	-	-	-				

Table 5 PhD candidates SIKS

	Enrolment			Success rates (graduations. cumulative)											
Starting year	Enrolment (male/ female)		Total (M+F)	Graduated in year 4 or earlier		Graduated in year 5 or earlier		Graduated in year 6 or earlier		Graduated in year 7 or earlier		Not yet finished		Discontinued	
	#	#		#	%	#	%	#	%	#	%	#	%	#	
2006			60	23	38	48	80	49	82	49	82	1	2	7	11
2007			49	14	29	31	63	42	86	43	87	0	0	6	13
2008			52	14	26	27	52	45	86	45	88	2	4	4	8
2009			68	9	13	36	53	49	72	51	75	13	19	4	6
2010			48	16	34	27	56	27	56	27	56	19	40	2	4
2011			64	11	17	31	48	31	48	31	48	30	47	3	5

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