

Research review according to the
Strategy Evaluation Protocol 2021-2027

Mathematics 2022



UNIVERSITY OF AMSTERDAM



Radboud
University
Nijmegen



Utrecht
University



Universiteit
Leiden
The Netherlands

TU/e EINDHOVEN
UNIVERSITY OF
TECHNOLOGY

VU  **VRIJE
UNIVERSITEIT
AMSTERDAM**

 **WAGENINGEN**
UNIVERSITY & RESEARCH

**UNIVERSITY
OF TWENTE.**



E-Mail: meg@megvanbogaert.nl
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This report was finalised on 6 July 2022

Preface

The present report concerns the evaluation of the mathematics research over the period 2015-2020 of eight Dutch universities according to the Strategy Evaluation Protocol 2021-2027. The assessment was performed by an evaluation committee consisting of eight - mostly foreign - members. Essentially all research areas in mathematics were covered by the expertise of the committee members.

Information on the modus operandi of the committee can be found in Chapter 1 of this report. The core of the work were the interviews with numerous representatives of the departments, ranking from the (administrative) board to PhD candidates, which took place in Utrecht during the last week of March 2022. Many of these interviews were very informal and inspiring and added value to the self-evaluation reports previously prepared by the departments. The interviews also helped the committee to identify some critical issues of general nature which concern essentially all departments and a list of best practices (Chapter 2).

The committee has an extremely positive impression of the state of the art of mathematics research in the Netherlands. The overall quality of research and teaching is very high. Mostly due to the sectorplan investment, mathematics in the Netherlands has become substantially stronger during the evaluation period.

I deeply thank the committee members Irene Bouw, Claudia Klüppelberg, Yukihiro Murakami, Britta Peis, Mark Roest, Henrik Schlichtkrull and Stefan Vandewalle for their great professionalism and spirit of collaboration. On behalf of all committee members, I express my special thanks to the project manager Meg van Bogaert for her excellent guidance, great experience and the tremendous amount of work she performed.

Professor Michiel Bertsch
Committee chair
6 July 2022

I. Introduction

Scope of the assessment

In 2021 the Executive Boards of the University of Twente, Utrecht University, University of Amsterdam, Eindhoven University of Technology, Vrije Universiteit Amsterdam, Wageningen University & Research, Leiden University and Radboud University commissioned a review of the Mathematics research conducted at their institutes in the 2015-2020 period. The review is part of the regular six-year quality assurance cycle of the universities; it is intended to monitor and suggest improvements to the quality of research and fulfil the duty of accountability towards government and society. The quality evaluation contained in this report follows the Strategy Evaluation Protocol for Public Research Organisations 2021-2027, drawn up by the Universities of the Netherlands, the Netherlands Organisation for Scientific Research (NWO) and the Royal Netherlands Academy of Arts and Sciences (KNAW).

The review committee

The Executive Boards of the participating universities appointed a review committee (hereafter: committee) of eight external peers, including a mid-career researcher, a (recently graduated) PhD candidate and a representative from industry. The committee consisted of:

- Prof. dr. Michiel Bertsch (chair), University of Rome Tor Vergata, Italy;
- Prof. dr. Irene Bouw, University Ulm, Germany;
- Prof. dr. Claudia Klüppelberg, Technical University of Munich, Germany;
- Dr. Yukihiro Murakami, TU Delft, the Netherlands;
- Prof. dr. Britta Peis, RWTH Aachen, Germany;
- Dr. Mark Roest, VORtech, the Netherlands;
- Prof. dr. Henrik Schlichtkrull, University of Copenhagen, Denmark;
- Prof. dr. Stefan Vandewalle, KU Leuven, Belgium.

Dr. Meg van Bogaert was appointed as

independent secretary to the committee. Members of the committee signed a declaration and disclosure form to the effect that they would judge without bias, personal preference, or personal interest, and their judgment would be made without undue influence from the universities, the departments, or other stakeholders. Any existing professional relationships between committee members and departments under review were disclosed. The committee concluded that there was no risk in terms of bias or undue influence.

Assessment criteria

The Strategy Evaluation Protocol 2021-2027 (SEP) was the starting point for the committee's review. This protocol describes the aims and methods used to assess publicly funded research in the Netherlands.

SEP identifies three main evaluation criteria: (1) research quality, (2) relevance to society and (3) viability. Furthermore, SEP asks committees to take four specific aspects into account when evaluating the three central criteria. These are: (1) Open Science, (2) PhD Policy and Training, (3) Academic Culture and (4) Human Resources Policy.

In addition to the guidelines and criteria suggested by the Strategy Evaluation Protocol, the



committee considered the Terms of Reference issued by the boards of the participating institutes. In this document, the committee was specifically requested to assess:

1. the Dutch landscape in Mathematics in relation to its international position
2. the extent to which the implementation of the *sectorplan* invigorates Mathematics in the Netherlands and how it prepares Dutch Mathematics for the future.

Documentation

The committee received detailed documentation consisting of:

- Self-evaluation reports 2015-2020, including appendices;
- Strategy Evaluation Protocol 2021-2027;
- Documents related to the *sectorplan*.

Working method

The site visit took place in Utrecht from 27 March 2022 to 1 April 2022. Before the site visit, the committee members were asked to read the documents provided and formulate questions for the interviews. In an online kick-off meeting, approximately four weeks prior to the start of the site visit, the committee agreed upon procedural matters. At the start of the site visit the committee discussed its preliminary findings. Delegations of all eight universities came to Utrecht to talk to the committee. The schedule for the site visit is included in appendix 2. During its final meeting on 1 April 2022, the committee discussed its findings based on the documents and the site visit. To conclude the visit, the committee chair presented the main preliminary conclusions to the departments and universities.

After the site visit, the chair and the secretary drafted a first version of the committee report, based on the evaluations drawn up by the committee members. This draft report was circulated to the committee for all members to comment on. Subsequently, the draft report was presented to the participating universities for

factual corrections and comments. After considering the feedback in close consultation with the chair and other committee members, the secretary finalised the report. The final version of the report was provided to the departments and universities. The report was completed on 6 July 2022.

A note on the report

In this report, the committee presents its findings, conclusions, and recommendations, both at the level of the individual departments and at the overarching level. The committee set out to assess each department in light of its own aims and strategy, while taking the international context of the disciplines into consideration. No attempts were made to quantitatively compare or rank the participating research units. However, the committee did discuss the separate units in relation to each other. It did so in order to arrive at a well-rounded evaluation that is supported by the committee as a whole. The committee hopes that this joint report will make it easier to identify and share best practices across the eight departments, thus benefiting the disciplines of mathematics.

In accordance with the SEP, the committee details its evaluations on strategy and targets, research quality, societal relevance, viability, and the associated specific aspects in separate chapters for all eight participating departments. The report starts with a chapter that contains overarching observations and recommendations for the Dutch discipline of Mathematics as a whole.

In the evaluation of the research units, the committee will often use the term *department*, even if mathematics is part of a larger unit.

II. General findings

Introduction

In this general chapter the committee provides its input, observations and recommendations that are relevant for the mathematical community at national level. These include ongoing developments, common challenges, best practices and other observations that might be relevant to the departments, faculties and universities involved.

Mathematics research in the Netherlands

The (high) quality of mathematical research in the Netherlands has, among science policy makers, traditionally gone unseen or has not been prioritized as it has been in other countries like Germany and the United States. Fortunately this is changing, mainly due to the rapidly increasing power of computational tools. Nowadays, the crucial importance of a great amount of mathematically trained people in society is generally recognised. This requires new strategies and investments for the universities and the government. In this context the committee's general impression of the evolution of the Dutch mathematical landscape in 2015-2020 is extremely positive. Without any doubt the international position of mathematical sciences was reinforced in this period. The committee also recognises the crucial role of the *sectorplan*.

For several reasons, doing research in the Netherlands is attractive, e.g., permanent contracts for researchers, the often informal and international atmosphere, the high quality of research, good network and connections abroad and small distances to other research groups in the Netherlands. Less attractive in the Netherlands are the difficulties for senior scientists to obtain basic national (NWO) funding, the rigid financial rules of many universities and the fact that assistant professors do not have *ius promovendi*. This makes it hard to compete with the US and some European countries to attract and keep top talents, in particular (but not only) in

those emerging research fields where competition for such talents is tough. The overall level of mathematical research in the Netherlands is very good, although according to the committee, the number of truly outstanding and excellent mathematicians in the country could be even higher if universities were financially more competitive at an international level.

The mathematical community in the Netherlands is well organized, e.g., PWN, the clusters and MasterMath. This made it possible to formulate a convincing *sectorplan* and use its investment in an optimal manner.

The clusters have been very important since 2005 for the entire field of mathematics in the Netherlands. They led to many PhD projects and hirings. In 2018 the mathematics clusters were evaluated as excellent. Nevertheless, in 2022 the financial position of clusters will change significantly. Part of their function is now taken over by the *sectorplan* and direct funding for the clusters has significantly been reduced, this will particularly have impact on the number of PhD positions that are funded. According to the committee the clusters are very important for mathematics and the recent budget cuts are harmful. In the past, the clusters played a major role in collaborations. All departments mentioned to the committee that the clusters still have a future and that they remain important tools for stimulating national coordination and network activities. There is an initiative to revitalize the clusters, in particular with the task to bring Dutch researchers together, e.g., in Summer Schools.

Unlike in other sciences, mathematicians do not naturally work in larger groups within one specialization. So if budget cuts are inevitable, the committee believes that the future mathematics clusters should be considered a vital infrastructure, as they bring together the very dispersed group of mathematics researchers in the Netherlands.

Execution of the sectorplan

Seven of the eight departments considered by the committee were involved in the *sectorplan*. The

sectorplan led to multiple new positions in most departments and as a result radically changed the Dutch mathematical landscape during the evaluation period. Each mathematics department has proven to be able to write convincing proposals, with good but often nontrivial choices between various fields in the single departments. To do so, the departments used the excellent level of coordination already existing between them, for example through the Platform Wiskunde Nederland. The increase in research staff as a result of the *sectorplan* is impressive, important, and clearly a major success for mathematics research in the Netherlands.

The departments have also been able to use the *sectorplan* optimally, not only in spreading the different disciplines but also with full attention to quality, and diversity (gender, international, age). Small departments have gained more than critical mass, entire new groups were created from scratch (mostly in applied mathematics, statistics, and emerging fields), and, where necessary, existing groups were consolidated or strengthened.

Optimal planning and execution of the *sectorplan* budget clearly made a difference for all departments involved and subsequently for Dutch mathematics as a whole. It is appreciated that the departments agreed on topics to focus on, which leads to broad coverage of mathematics in the country. The committee is strongly in favour of continuation of the structural funding from the *sectorplan*. It clearly led to more, broader, and better research in the entire country. It is an important opportunity to further raise the quality of mathematics within the Netherlands and will be decisive in the near future. The Netherlands should be seen as an attractive country for outstanding mathematicians and a second considerable investment is needed to reinforce its competitive position in the world-wide landscape.

Funding

During the site visits various funding issues were brought to the attention of the committee. First of all, senior staff suffers from extremely low success rates when applying for NWO projects, for

example for PhD positions. The committee agrees with national funding policies which give more possibilities to junior staff, but a basic level of funding for scientifically active senior staff should be available. Some departments solved this problem by creating a revolving fund for PhD positions or for hiring good juniors, which helps to avoid missing opportunities. Such a fund can also be created from small remainders of grants, projects, and contracts. Other departments are prohibited to use first stream funding for hiring PhD candidates, which puts them at a disadvantage.

Secondly, there seems to be a specific national funding issue for mathematics. It is in the nature of mathematics that it is less organized in large consortia than other disciplines and performed in a small context rather than large research groups that are more typical of other disciplines. Thus, the current trend in the Netherlands towards a focus on applications (often interpreted as concrete industrial collaborations) and towards large grant opportunities as opposed to small-scale funding is a particular problem for mathematicians. Apart from ERC funding, EU-funding follows the same trend. In many surrounding countries (Germany, France) this problem is overcome by specific funding actions at national level. In these countries the global reputation of the field of mathematics is valued more broadly, also higher, which is reflected in higher funding for fundamental research in mathematics. Higher funding of applied mathematics due to its growing societal relevance is natural, but it should not penalize more fundamental research, which remains the pillar of mathematical research.

Thirdly, in reviewing the different departments, the committee noticed differences in local funding policies, both at university and faculty level, especially the balance between funding streams. In all departments increasing student numbers lead to more direct funding (also to higher workload). Some departments were very successful in second stream funding, while others have more difficulty in acquiring grants. Contract funding was more difficult to assess, partly

because – according to some departments in this review - the tables did not always reflect the actual situation.

Research quality and societal relevance

Organisational structures vary between the departments. Some are more hierarchical than others and/or have a more structured organisation. Nevertheless, all research staff has academic freedom which leads to very good and in some cases excellent research output. The present SEP makes it difficult to really go into depth assessing the quality of all research in a department. Nevertheless, the committee was impressed.

The committee noticed that all departments are searching for ‘their’ optimal balance between fundamental and applied mathematics. This optimum differs between universities, depending on the research staff and the strategy. It is clear that all departments, even those who focus more on fundamental mathematics, pay attention to societal impact. The definition of impact, or societal relevance seems to differ between universities, e.g., the way a contribution of mathematical research to other disciplines as well as industry and society is valued.

The societal relevance of mathematics and quantitative methods is rapidly growing, and the Netherlands has a growing need for mathematically trained people. Societal relevance through contributions to other sciences is still insufficiently recognized by funding agencies and some of the universities. The route from fundamental discovery to application is not always direct, however, funding agencies often emphasize direct links between the two. As the committee stressed before, for a healthy mathematics landscape in the Netherlands, both fundamental work and more applied work should be rewarded.

In several departments the committee encountered good practices concerning societal relevance and impact:

- An alumni-council is useful to maintain natural links with industry that are not

dependent on specific persons (who may leave). These alumni can also provide material for bachelor and master assignments, to let students work on realistic problems.

- An outreach committee with some form of professional support (e.g., from the university’s communication department) is useful to ‘sell’ the expertise of the department both to potential students and PhD-candidates and to potential partners.
- It is important to team up with other disciplines to enhance opportunities and visibilities.

In the context of societal relevance, a very special role in the Dutch mathematical landscape is played by Biometris in Wageningen, which strongly stimulates the use and development of quantitative methods in life sciences through concrete collaborations with specific stakeholders. This department definitely enriches the Dutch mathematical landscape, but according to the committee this fact does not seem to be fully recognised by the national mathematical community. In particular the Wageningen department did not participate in the *sectorplan*. More intensive relations between Wageningen and the other departments could be most fruitful: many departments have research projects in the context of life sciences, and Wageningen may offer interesting teaching-contributions, for example in the context of MasterMath.

Career development

The committee understands that there is a nationwide discussion about the tenure track system, with the intention to minimize or eliminate the period to get tenure and to focus more on the upgrade from assistant to associate professor. All departments are working on further development of the tenure and development track with the aim of providing more security to junior and mid-career researchers and a level playing field for all talented researchers. This is being stimulated by changes in the labour agreement regulations for Dutch universities. According to the committee, career plans should

always be transparent during the hiring procedures, and criteria, the process of feedback and evaluation for both tenure and development should be well defined and transparent.

The committee understands that not all departments follow the same procedures for the upgrade from associate professor to full professor: some of them use transparent and clear criteria for internal candidates to grow towards the full professorship, while others prefer to keep the right to use a world-wide call of interest (open to local candidates but not exclusively). Both options are legitimate. Obviously the second possibility has the advantage that the department is more competitive in the international market and that it can set research priorities according to the needs of the department.

An appropriate workload is of vital importance. In particular for young talents, it is important to provide a decent work-life balance. If a new task is added, then another task should be reduced. Female research staff, being underrepresented, are asked more frequently to participate in various tasks. The committee acknowledges that people have to learn to say no, but departments should also have an eye on this. The committee recommends to the management to be aware of who is doing what and to make sure there is balance and compensation.

The Recognition and Rewards programme is related to this but is, in most places, still a work in progress. Some departments already have taken the next step and include a wide variety of aspects into their assessment criteria, like teaching, valorisation, teamwork etc.

Diversity

Diversity, in particular gender diversity, is a challenge at all departments. Most are well aware of this challenge and are working on strategies and policies to improve the situation. At the level of assistant professors, an increase in female research staff is visible over the period of this review. However, at the level of PhD candidates the developments are less impressive. Also, at the senior and management level most departments

require major improvements. It is not merely a pipeline issue; diversity also requires cultural changes and a different way of thinking. Actions taken by some departments that have a positive impact on diversity were observed:

- It helps to have female members in appointment committees. More specifically, of the external experts who evaluate the candidates at least one should be female.
- The small number of female researchers are expected to serve on many committees. Therefore, some compensation should be given. This compensation should be discussed with the female staff member and granted in a flexible way (money, teaching reduction, selection of courses, or reduction of other committee tasks etc.).

Open Science

Open access publications are clearly the norm; contracts with publishers and funding in grants to cover publication costs are taking away the barriers, and requirements in NWO-grants exert additional pressure where needed. All departments took major steps in the evaluation period. By using repositories and the university wide contract with major publishers, open access publications should be up to 100% very soon.

Open (FAIR) data and properly publishing research software is mostly work in progress. It is best to formalize these issues in a course for PhD candidates and make this course mandatory where applicable. The attention given to open data and code differs between departments. Training of bachelor and master students on these topics will also help to make open data the norm.

PhD training and supervision

All departments increasingly work on formalizing a structure to guide and supervise PhD candidates. The committee observed some best practices, like a buddy system, a just-in-time master your PhD course, diligent monitoring of PhD duration by a coordinator.

- Buddy system: by connecting new PhD candidates with more senior ones, the

onboarding process and start of the project will be smoothed out. This system does require administrative effort to make it work, but it is worth the effort.

- Exempt PhD candidates from teaching in the final period (e.g., last year) of the contract to support thesis writing.
- Hire graduating PhD candidates as lecturers, in case their thesis has not been finished. This provides financial support for the PhD candidates, but also alleviates teaching duties from other faculty members.
- PhD council: by providing some administrative and financial support, a PhD council can be initiated. This way, PhD candidates can organize both scientific and social events themselves and the PhD council can act as a forum to represent the body of PhD candidates. The larger university body (e.g., faculties) often already have a PhD council in place. In such cases, it is important

to make sure that there is at least one representative from the Mathematical department.

- The 'Mastering your PhD' course from the UvA gives necessary start-up information to PhD candidates in a realistically 'time-spread' manner. Instead of bombarding new students with too much information, the sessions are spread into a 7-week 2-hour a week structure.
- Diligent monitoring of PhD duration by a PhD coordinator seems to work at several universities to reduce later-than-expected completion rates.
- Mandatory courses, not only in academic integrity but also on data management, seem to have a positive effect on PhD performance. Courses (support) for first-time PhD supervisors are considered valuable by the committee.

III. Vrije Universiteit Amsterdam

Strategy and targets

The Department of Mathematics advances mathematics and its applications in the broadest sense. A strong fundamental component is combined with a genuine interest in applications. According to the self-evaluation report, the central strength of the department, and core to its strategy, is the intertwining of fundamentals and applications. The academic culture is such that the entire spectrum is valued and appreciated.

The mission of the research programme is two-tiered: to perform world-leading mathematical research resulting in outstanding publications, as well as to carry out applied mathematical research which is highly relevant to other disciplines and/or society. The two main pillars of the research programme are dynamical systems and stochastics, accompanied by thriving research activity in topology, geometry, and algebra. The strategy of the department is to hire excellent researchers and give them full freedom to develop their research programme. The idea is that choosing one's own research topics leads to the highest quality and stimulates new internal collaborations.

The committee establishes that such strategy is working well. Hiring good researchers and stimulating collaboration will lead to excellent research. All groups the committee interviewed were very happy with this structure, collaborations take place and very good research output is the result.

Furthermore, the committee is positive about the many collaborations of individual researchers, both within the department and with stakeholders outside mathematics. The high degree of freedom within the department is praiseworthy and fruitful regarding the happiness of researchers and the quality of the research. According to the committee, however, the chosen

structure does require an explicit strategy on how to acquire funding, since there is the risk that the department misses funding opportunities, in particular the funding of large consortia. A more theme-driven approach combined with careful planning could create more participation in funding opportunities for large projects. Most likely, it would already suffice if the structures and foci that already exist would be more emphasized.

Of the seven focus areas described in the *sectorplan*, the VU links to four areas: Networks, Statistical learning, Dynamical data, and Geometric & Stochastic evolution. The department was able to establish five new positions. The *sectorplan* positions clearly provided a boost to the department. The committee agrees with the department that, in planning in which fields to expand, it is important to keep the balance in group sizes.

Organisation

The department aims for a flat hierarchical structure. Most responsibilities related to day-to-day work lie with the staff members. Academic freedom for every staff member to choose their own research topics is prominently visible. The chair of department takes decisions in consultation with the management team and the larger department. Changes in policy are initially discussed with the full professors and in staff meetings. The emphasis lies on policies that are enabling rather than restricting. The size of the department allows for taking individual circumstances into consideration in the decision-making process. Communication is described as open and essential information is actively spread through emails, in staff meetings and informally at the lunch table.

According to the committee, although research groups are in place to organise the research (e.g., seminars), the flat structure that is aimed for is indeed visible throughout the department. Full professors have a role in strategy and policy development, while an informal way of communication includes the entire department in the decision-making process. The size of the department allows for this informal structure,

since the chair of the department knows all research staff. Significant growth of the department in the upcoming period might change this and the impact of this growth should be considered. The committee recommends looking for implementation of more formal structures for clear, transparent vertical communication and consultation in addition to the informal structure. This way, the department makes sure—also in case of further growth—that all status groups are included in discussions on strategy, involved in planning and decision making and that important information reaches everyone.

Academic culture and HRM

As mentioned above, the culture in the department is to work in a collegial fashion. The division of labour is primarily based on consultation and consent. Annual consultation meetings are held with all staff members. A recent development in these meetings is that assessment scores are eliminated to allow for more open reflection. The small size of the department allows the chair to keep an overview of individual development opportunities. The committee was impressed by the open and stimulating atmosphere it encountered in the interviews. The flat hierarchy is felt and experienced at all levels. This and the open-door policy stimulate frequent interactions, which subsequently might lead to collaboration in research.

Well-being of the staff is considered important, including access to confidential mediators at faculty and university level. Furthermore, staff members in leadership roles follow a training (An eye for (social) safety). The bi-weekly General Mathematics Colloquium is well attended. Integrity in research and decision making is expected without exception. By moving to the new NU building, all staff is housed on a single floor, unifying the department.

The committee learned that the administrative burden is increasing. It encourages the department to continue with its plans to hire a full-time department manager. New junior research staff has a reduced teaching load in the first year, although it still remains high. The

numbers of students have increased enormously in the evaluation period, with up to one hundred new bachelor students each year.

Tenure and development track

The Recognition & Rewards policy increasingly allows for more opportunities for individual career paths. This is in line with the ambitions and strategy of the department, to provide an environment in which staff can develop their strengths and grow into leadership roles. The Tenure Track (TT) policy, Associate Professor policy and Full Professor policy describe the requirements for advancing from one level to the next and a general, holistic view is part of the decision making. Conditions for the TT policy include the development of a successful research line, positive teaching evaluations, obtaining a UTQ, a well-appraised grant proposal and being involved in the guidance of a PhD project. After five years the decision is made to provide a permanent contract and discussed at annual consultation meetings. The TT policy at faculty level allows an implementation that suits the mathematics department and make it feasible for tenure track assistant professors to fulfil requirements and get permanent contracts. Central policies (including criteria) were developed for progressing to associate and full professor level. This allows for a transparent career development system.

Currently, decisions on tenure and promotion might depend a bit too much on individuals, like the direct supervisor and management team. In recent years, much progress has been made towards formulating transparent criteria for tenure and promotions on all levels. The committee considers that the changed criteria and requirements to get tenure are clear on paper and tailored to the department. Tenure trackers obtain an individual list of criteria with appointment. This is good, as it allows for individual career paths.

The professional development progress of all staff is recorded and monitored based on an annual meeting with the advisor ('Goed gesprek'). Even though all TT-candidates get tenure, they are

nervous at times. This is one of the reasons why the department advocates not having a five-year period before tenure, but to reduce it to two years. By doing so, they would follow the trend in many other universities. Several TT candidates informed the committee to have an academic supervisor and a coach. According to the committee all candidates should have a coach. Although there is a very positive atmosphere in the department, it should be guaranteed that no TT candidate is dependent on merely one advisor/full professor. Also, it could be made even more transparent who takes decisions about tenure and promotions, to allow and encourage candidates to develop their own profile.

Senior positions

In the upcoming period, four full professors will retire. Talent within the department is stimulated and prepared to take over. If internal candidates are not available, the department looks for external candidates. According to the committee there is quite a lot of interaction and openness in the discussion on how to fill the vacancies. Directions for new positions are defined in consultation with the departmental staff. Often a broad description of a position is made to attract a wide variety of candidates. The committee thinks that this fits in with the strategy of the department.

Diversity

Diversity, in particular in terms of gender balance, shows a positive development. Instrumental in this was the 'female first' hiring policy for some of the *sectorplan* positions. Furthermore, the department is actively working on creating a pleasant professional environment for all staff members to allow junior staff members to grow into more senior roles. Parental leave and finding a good work-life balance are important aspects.

The committee confirms the increase of female and international staff in the period under consideration. Women are represented at most levels and training opportunities, for example on leadership, are provided at university level. On the senior level, female professors are still very much underrepresented, though there are some

promising female researchers on lower career levels. The committee noticed that diversity does not seem to be explicitly included in the discussion on replacing retiring full professors. The reason might be that current female research staff is not (yet) at the level of becoming a full professor. Nevertheless, the committee stimulates the department to more explicitly include diversity in this discussion.

PhD policy and training

PhD positions are broadly advertised in order to stimulate diversity. PhD candidates receive individual mentoring, and all have a second advisor who is either involved directly or takes a supervising role in the background. The daily supervisor meets weekly with the PhD candidate to discuss scientific progress. Junior PhD supervisors follow the courses *Supervising PhD candidates*, and the Faculty has published a *Golden Rules for PhD supervision* document. The mandatory course on PhD supervision for junior research staff is applauded by the committee.

PhD candidate and supervisor set-up a Training and Supervision Plan, primarily on research-related activities and on the 30 EC of training, a course on scientific integrity is mandatory. All PhD candidates assist in teaching (up to 15%) and are engaged in other tasks according to their wish. A survey on teaching was conducted, which showed that not all students were satisfied with the overall experience, and also since it took more than 15% of the contracted time. The PhD coordinator is aware of this issue. PhD candidates as a group run their own seminar and are part of the Faculty wide PhD council. There are two confidential PhD mediators in the department. PhD candidates are stimulated to attend the biweekly colloquia.

At the departmental level, a PhD coordinator is in charge of organisational matters. PhD candidates are encouraged to build a network, undertake at least one longer international research visit and think about their career perspective. A bench fee of 5.000 EUR is available for travel, more if needed. Points of attention, in particular in the weekly meetings between supervisor and PhD

candidate, include the mental health of the PhD candidate, the speed of progress and delineation of teaching activities. In the recent past, the PhD coordinator became more proactive and frequently meets with the group of PhD candidates to discuss general topics and follow-up action where needed.

The number of PhD candidates fluctuates due to the number of successful grant applications. In addition to PhD candidates on grant funding projects, both PhD-junior lecturer positions and *sectorplan* positions and external PhD candidates leads to a stable, slightly increasing total number of PhD candidates. Drop-out rates are low, though the duration of a PhD is more than four years. In particular, the writing down of results is postponed more than necessary. Internal processes are being improved to reduce delays that can be prevented. There are developments in place to stimulate PhD's to graduate on time. The idea is to centralize the process. The committee stimulates the department to continue working on guidelines to ensure that PhD's write down their results in a timely manner and have something on paper at the two-year mark.

There is no strict requirement for graduation (e.g., number of papers), the requirements depend on the discipline. Students feel this is reasonable and the committee agrees. Goals and expectations are discussed in annual meetings with the daily supervisors. The PhD candidates have good opportunities to get into contact with industry (e.g., career day) and information about possible career paths outside academia. The committee considers it a missed opportunity that the connection of PhD candidates in the networks of research staff (supervisor) seems limited, which is related to the recommendation to give attention to more structured support in career planning for PhD candidates. Both aspects seem to strongly depend on the supervisor.

The PhD's overall appreciate the fact that all research staff is located on the same floor, stimulating interactions. The noise level for the PhD's in the open floor office space was mentioned. PhD candidates are given noise-

cancelling headphones, but perhaps this is not an ideal long-term solution. The flat hierarchical structure and culture was seen throughout the VU department – also students felt comfortable approaching the confidential advisors, though they could also address common issues with the coordinator. The PhD candidates the committee interviewed seemed very happy at the VU. They all very much appreciated the availability of their direct supervisor and the management team.

Research quality

The strategic aims of the department in the period of the review were to strengthen the research in two broad directions: computational mathematics and mathematical data science. Also, the balance between applied and fundamental research was guarded, and the breadth of the teaching programme was to be guaranteed. Researchers get full freedom in developing their own research programme, which led to research on the crossroads of fundamental mathematical results and practical questions.

The research in the department spans a broad range of fields and is aimed at developing mathematical theory and understanding. Many of the results also have impact in other disciplines, like systems biology, neuroscience, oncology, and ambulance planning. The department advocates that research and teaching should go hand in hand, leading to several master courses being closely connected to the research. From the interviews, the committee learned that the department is struggling to differentiate and find a balance between fundamental and applied research. Funding is more easily obtained for applied research, while maintaining sufficient possibilities for curiosity driven research is also important. According to the committee, the balance between fundamental and applied mathematics now leans towards the applied side, and both analysis and algebra have a rather small mass, which makes it challenging to maintain the mission of combining the applications with a strong fundamental component, and to keep the necessary basis for both research and education.

The department has a large group in dynamical

systems and stochastics. The *sectorplan* has been used partially for positions within the focus areas, namely applications of dynamical systems and mathematical statistics, and partially for a position in applied topology. The research is very good, in particular in these areas, but also outside of the focus areas. The emphasis on applications in life sciences, apart from the focus areas, is worthy of praise.

According to the committee a lot of very good to excellent research takes place, based on spontaneous interactions and collaborations. This strategy of spontaneous interaction leading to quality is really embedded in the department.

Funding

The committee learned that it is not easy to find external funding for PhD positions (on average a 10% success rate), in particular for more senior research staff the grant opportunities are limited. The committee appreciates the fact that the department occasionally funds a PhD candidate, e.g., to get a TT candidate started. As mentioned above, the boost given to the mathematics discipline by the sector plan positions is impressive. Unfortunately, due to the cuts in the funding for clusters, a major contributor to PhD positions has disappeared. This leads to a disbalance between numbers of tenured staff and PhD positions that should be solved in the upcoming years.

The self-evaluation report mentions some frustration on the low success rate in grants, in particular large EU-grants. The limited recognition of the importance of fundamental mathematical fields in comparison to 'hot topics' like AI and data science limits the funding opportunities. To improve on the acquisition of funding, the committee suggests investing more into the formation or participation in interdisciplinary clusters with focus on societal-relevant topics, bringing together researchers from various fields.

Open Science

The policy in the department is to have all papers published under open access, either through one of the deals with publishers or by publishing

preprint and the author accepted version on the repository. Accompanying computer code is made available on the webpage of the journal, a personal page, or (increasingly) GitHub. When relevant, data are also made available.

According to the committee, open access is well organized and also publication of code and data seems to be organized and supported. The VU department is ahead of several other departments in this respect.

Relevance to society

Societal relevance is considered of pivotal importance to the department. Staff members have complete freedom to work on fundamental and/or applied problems, though research with impact in other disciplines and society is explicitly valued on equal footing with more fundamental research. A shift is observed towards applications and emerging fields. This might be why computational mathematics and mathematical data science are in the *sectorplan* proposals. Senior staff emphasized in the interview that application is important, but investment in very fundamental research also is and remains important.

The committee learned about several interesting collaborations with society, e.g., the Forensic Institute and legal firms. Furthermore, endowed professors and co-funding of PhD candidates (e.g., in health care or the hotel business) are increasingly part of the research portfolio. The main challenge the department has, is that most contacts with external parties are on a personal base. This is valuable and seems to be working well, but also includes a potential risk. By considering formalizing these contacts further and setting up something like an advisory board, these valuable contacts might become less person dependent.

Outreach to industrial partners is actively pursued in research collaborations, e.g., by way of funding PhD positions in fields like health care, emergency and safety services, logistics and traffic management. In these collaborations, new mathematical models are developed, validated in

pilots, and implemented in real life by the companies. The committee applauds the initiatives around PR and outreach, with a PR-committee and involving a professional PR-employee from the university. The committee would encourage the department to go further into marketing their expertise and position. The 'label' that is being considered might help the department to be(come) more visible to external partners and show what kind of partner the department can be.

Viability

The department believes it is of the utmost importance for the future of Dutch mathematics that young talent is attracted, trained, and advised. With the department becoming more diverse, some customs will need to be adjusted, e.g., the difference between assistant, associate, and full professors in terms of involvement in departmental policy making.

To create a collaborative environment for good policy making and supporting of new initiatives, the department aims at an open dialogue, combined with clear roles and responsibilities. By streamlining processes, making expectations explicit, and communicating transparently about decisions, management is supporting the strategy to continue giving full freedom to staff members to choose their research projects. By stimulating a collaborative academic culture and stimulating collaborations, both excellent research and societal impact are expected.

The department aims at contributing to the rapid developments in the broad areas of computational mathematics and mathematical data science. Past developments and appointments will be continued. The department furthermore aims at continuation of the intertwining of fundamental and applied mathematical research, leading to strong societal impact.

In view of the quality of the department and the

results obtained in the past six years, the committee considers the viability of future plans to be very good. The focus on computational mathematics and mathematical data science is a convincing strategic choice. The flat and informal organisational structure seems to work extremely well, but the department is advised to consider some minor formal adjustments to offer maximal protection to more vulnerable groups, such as PhD candidates.

Conclusion and recommendations

Overall, the committee has a positive impression of the Mathematics Department at the VU. During the assessment period, the department became significantly stronger, also due to an optimal use of the sectorplan investments. Very pleasant atmosphere, with a lot of freedom for the researchers and very good quality of the research. The department also has a convincing level of viability for future plans, with clear ideas. The committee did not come across major issues, merely issues that need to be tweaked. The committee has the following recommendations:

- Without sacrificing the chosen strategy of freedom for the researchers, the committee suggests to the department to look for a way to participate in funding opportunities of large projects.
- The flat hierarchy and informal structure and communication work well, due to the limited size of the department. Future growth might change this and impact on the organisational structure should be carefully considered.
- The outreach activities are appreciated. By creating a 'label' and formalizing the valuable (but often personal) contacts with industry, structural partnerships can be put in place.
- The PhD coordinator is working on providing more structure. The committee suggests to also include more structured support in career planning and connection to the networks of supervisors and senior staff.

III. Eindhoven University of Technology

Strategy and targets

The Department of Mathematics and Computer Science (M&CS) of Eindhoven University of Technology (TU/e) aims at contributing to mathematics by performing pioneering, fundamental mathematical research that enables to tackle societal problems. M&CS brings together motivated students, lecturers, and researchers, and as part of the Brainport collaborative partnerships with companies and government. The mission is to make a difference in solutions to scientific and societal challenges, through ground-breaking scientific research in fundamental mathematics, educating top students, and transferring results to industry and society.

M&CS is committed to pursuing curiosity-driven fundamental mathematics, drawing upon pure and applied mathematics in search of mutual synergy. Central in the strategy is to keep a good balance between pure and applied research, and to further develop cross-disciplinary research themes in TU/e institutes. Three research themes (Health, Energy and Smart Mobility) offer opportunities for collaborations in institutes. The strategy was improved since 2018 in order to keep up with external factors and be able to react quickly and dynamically to societal needs.

Organisation

M&CS developed from two sub-departments into three domains: Computer Science, Data Science and Mathematics. The research unit in Mathematics consists of four clusters:

- Applied Differential Geometry (ADG)
- Center for Analysis, Scientific Computing and Applications (CASA)
- Discrete Mathematics (DM)
- Statistics, Probability and Operations Research (SPOR)

Each cluster consists of several PIs with a group of

PhD candidates, postdocs and possibly other assistant and associate professors. The department increased in size in the period of evaluation, resulting from an increase in student numbers and *sectorplan* funding. The department furthermore has five research pillars, four are coupled to TU/e institutes, while the fifth pillar is aligned with the Gravitation programme NETWORKS. According to the committee the department has a strong formal structure, with the various clusters as the main units in which research is organised. The organisation seems flexible, but complex at the same time with sub-departments, clusters, pillars, and institutes.

The growth in student numbers led not only to an increase in direct funding, but also to a strong increase in educational workload. By introducing PhD-TA's this has been resolved to a certain extent. However, due to Covid-19, teaching load has remained high. The committee stimulates the department to continue dealing with the teaching load.

Concerning the governance and management structure, there are regular meetings where staff members meet to discuss strategic developments. The impression the committee got from the management team and the senior staff was very positive, with many positive developments taking place. The top-down, hierarchical structure in which the management takes decisions, is evolving towards a situation in which PI's are increasingly involved in the decision-making process. The developments and new structure are beneficial, members from the associate professor level feel more involved in the decision process as in previous years.

The committee considers the change from the very hierarchical structure to a more permeable and flatter governance structure positive. Although decisions are still made at the full professor level, everybody is invited to contribute and meetings with all PI's are organized. However, the recent positive changes and developments within the department have not yet fully reached down to the assistant professor level. The committee learned that the actual involvement of

more junior PI's depend on the research group leader, and that some procedures do not (yet) work as planned. This is understandable since changes take time. The committee stimulates the department to continue paying attention to improve and to find a transparent way of dealing with procedures and strategy in the upcoming period. This includes the implementation of a good and transparent vertical communication line throughout the different hierarchical levels when it comes to decision making processes.

Academic culture and HRM

Effort is put into involving all staff and allowing for a fair and open academic culture in which researchers flourish. Within clusters, colloquia are held regularly and social events are organized. In so-called Department Dialogues, the whole M&CS department is involved, providing a platform for open discussions on general topics, e.g., plans, collaborations across clusters and didactic developments. The department is informed on decisions and strategies via the board newsletter. In all interviews with TU/e delegations it was mentioned that academic culture and openness has changed for the better over the past years. Management was aware that changes were required, and action was taken. Still, not yet do researchers at all levels consider that the system is sufficiently transparent. Thus, further increasing transparency remains an important goal for the upcoming years.

Tenure and development track

The course of an individual's career depends on the experience and competences at the time of joining and on past development. To be able to attract and develop talent, the university wants to offer clear prospects. In response to several talented researchers leaving the department, external recruitment was increased, and the department set up explicit personal development and promotion plans. In 2020 the department implemented a document on appointment and promotion procedures for academic staff. Assistant professors are often appointed in a development track, with the aim of becoming an associate professor within 6-8 years. Halfway

through the development track, a positive evaluation leads to a permanent contract. Alternatively, candidates at the assistant professor level can get an appointment for two years after which tenure is given (with positive evaluation after one year) without the expectation to grow towards an associate professorship. TU/e is in the process of reshaping its current recognition and reward system, to also consider the importance of good academic citizenship and teamwork besides research quality. The department is also looking for differentiation in career paths, e.g., in education or with more emphasis on valorisation.

Decision on tenure is independent from the decision for promotion. An interdepartmental committee provides a recommendation on the decisions. The development from associate to full professor is more strategic and involves decision making at university level. The committee appreciates the active mentoring of young talent, and young women in particular, towards leadership positions. In line with developments in governance and organisational structure, the committee observes progress in the transparency about criteria and procedures concerning tenure and promotion decisions. Criteria are based on multiple aspects, like PhD supervision, teaching, valorisation, grant acquisition etc. The committee is positive that in recent appointments, clear and individual goals are discussed between candidates and supervisor, including how to reach them. There is support for assistant professors in a tenure track, for example a PhD position is provided.

Despite clear and transparent criteria on paper, in practice tenure and promotion decisions seem to still strongly depend on the supervisor. Transparency and perceived support seem to differ between senior and mid-career research staff and there seem to be differences between clusters in the way that they deal with the criteria. The leading role given to HR, in order to make the development track transparent, does not seem to work properly for junior and mid-career research staff that was appointed prior to implementation of these changes.

Senior positions

The department is looking into a period in which several full professors will retire. There is a clear strategy in place, in some cases with a rooftop construction. Also, the *sectorplan* positions are used in a strategic way to take decisions and move toward new developments. The committee emphasizes the importance of including diversity (in particular gender diversity) in the replacement of these retiring professors.

Diversity

TU/e strives for a diverse staff and open culture. Despite efforts for many years to increase the percentage of female research staff, results are limited. In 2019 an Irene Curie Fellowship programme was initiated, which led to a significant increase. At departmental level, a Diversity and Inclusion committee was established, which is improving appointment procedures for managerial positions and reviewing promotion criteria. Policies are in place to become aware of implicit bias. The fact that TU/e takes membership of these committees into consideration when assigning teaching and administrative tasks is considered very positive by the committee and important in furthering diversity and the position of female research staff. A clear increase in gender diversity in the department is observed in 2020, in particular at the assistant and associate professor level. This is a promising development, although further steps are still required, also at the level of PhD and tenure track candidates. Concerning internationalization, a diverse population is observed, especially at the early career phase.

It is clear to the committee that the gender issue is taken seriously and is actively being dealt with. There are several excellent female researchers on the assistant and associate professor level. Moreover, the university is putting a lot of effort into hiring more female staff members and results are (slowly) becoming visible. The drawback of the high load on committee work for women is compensated by e.g., reduction of the teaching load, which is good.

PhD policy and training

The PhD programme is embedded into the TU/e Graduate Programme. The training programme PROOF (PROviding Opportunities For PhD candidates) ensures support in the personal, direct supervision of PhD candidates. The funding for most PhD projects comes from grants from funding organisations and industry. Positions are open for internal and external candidates. Nearing the end of the first year, a PhD candidate is formally evaluated, and a go/no-go decision is taken. The number of PhD candidates has increased in the period of evaluation (from 67 to 79). Most PhD candidates manage to finish within time. Extensions are extremely exceptional, and supervisors urge PhD candidates to start in time with writing down their thesis. From the interview, the committee learned that there is emphasis from supervisors to finish the PhD within the agreed upon contract period. Expectations are frequently discussed with supervisors. Teaching obligations are scrapped in the fourth year to promote thesis writing.

PhD candidates have at least one promotor, one co-promotor and one or two daily supervisors. At the start of the project the candidate and supervisors jointly write a Training and Supervision Plan (TSP). In the annual evaluations the progress is formally discussed. Educational activities and the following of courses are tailor made for each PhD candidate. Apart from the mandatory Scientific Integrity course, the PhD's take courses from the PROOF programme (graduate school) tailored to their needs. Some transferable courses (e.g., 'How to be more resilient', 'How to deal with work pressure' and 'Taking charge of your PhD project') have been mentioned to be very beneficial. The fact that only one course is mandatory means, according to the committee, that the role and input by the supervisor is pivotal, since he/she has an important role in recommending on what courses should be followed. Most PhD candidates spend about 10% on teaching related activities. PhD-TA's have a five-year contract and spend % on teaching activities.

Career planning is also part of the annual

evaluations. In addition, the PhD candidates can make use of the TU/e Career Academy, which offers individual career coaching, workshops, and other support. Technificent helps candidates prepare for interviews and assessments towards the labour market. This structured way of providing career advice is appreciated by the committee.

The committee met with a group of PhD candidates who seemed happy and confident. They do not think everything is perfect, but feel free to discuss any issue with and propose changes to supervisors and management. Most PhD candidates enjoyed a smooth onboarding process upon joining the university, though this was made more difficult through the pandemic. In case of problems, students are aware of psychological counselling opportunities and HR counselling members. Students feel comfortable approaching the senior faculty members to discuss any personal issues. Social events for PhD's are organized by the PhD council; they as well bring to the management team's attention some issues the PhD's face.

Research quality

Within the topics of the research clusters, the department strives for a balance between fundamental and applied research, with activities driven by technological relevance, curiosity, and societal relevance. Five pillars are identified where the three sub-departments join forces. These are 1) Data Science & AI, 2) High-tech systems, 3) Computational Science, 4) Cybersecurity, and 5) Complex Networks. Furthermore, Mathematics is also active within the TU/e strategic sectors Energy and Health.

According to the committee, the quality of the research and output of the department is excellent. The TU/e gives a wonderful example on how interdisciplinary research and cooperation between the fields of mathematics, computer science, data science and industry lead to outstanding, important, and societal relevant research output. The reputation of mathematics at TU/e is very high and deservedly so. The members demonstrate scientific leadership in

many ways: writing books, publishing relevant articles in excellent journals, acting as journal/book editors, organizing conferences etc. Furthermore, the department manages to attract excellent researchers from all over the world. Unfortunately, retaining these talents is a challenge. This is unfortunately the price of excellence. The committee appreciates that the department is willing to pay it.

From the paragraphs under *Relevance to Society* the impressive connection with industry, it becomes clear that impact and valorisation are particular strengths of TU/e. Nevertheless, the department emphasizes the combination of applied research with actively supporting fundamental mathematics that is curiosity driven on in situ practical issues. The committee thinks that this approach is exemplary.

Funding

The amount of funding acquired is impressive. The financial situations seems very healthy with a stable mix of various incomes. In addition to the increase in direct funding (resulting from *sectorplan* and increased student numbers) the department continued to be successful in acquiring second stream funding via national and European funding agencies. Furthermore, the high-tech companies in the Brainport region offer excellent opportunities for collaboration. In the Covid-19 period the connection to industry was more difficult, so third-stream funding slightly decreased. The management is aware of this dip and is keeping an eye on developments. From the interviews it was clear that grant acquisition is stimulated and supported by an excellent support office, leading to success in for example the NWO gravitation programme.

Compared to other mathematics departments in the Netherlands, TU/e relatively has a large number of PhD candidates per faculty member. Not only does the department manage to obtain many grants for PhD projects, but there are also PhD-TA positions, and all tenure track candidates are provided with a PhD position. The latter is possible since the cluster gets part of the funding of personal grants that tenured staff acquires. Finally, the department also has joint PhD

positions with industry.

Open Science

In the period of evaluation, the department worked on open access publications, data and software. Both by way of agreements with major publishers (Gold) and by making use of the TU/e repository, an increase in open access is achieved. Furthermore, data stewards provide support with research data management topics (e.g., FAIR principles, GDPR and ethics). Several clusters maintain software packages that are freely available to researchers and other users.

From the interviews the committee learned that the availability of a data steward is not generally known at all levels. Standardizing and embedding the open data and open-source software procedures in the daily work seems to be a work in progress. Collaboration with industrial partners might put a strain on open source (e.g., software). The committee recommends to carefully guard the trade-off between open science on the one hand and keeping things confidential because of the collaboration with industry on the other hand.

Relevance to society

Historically, the Eindhoven Brainport region stands out for its connection to industry. Indeed, the research seems well embedded in industry and collaboration is used in a strategic manner. Research staff have to write a valorisation plan, which can include collaboration with industry as well as with government institutes. At the same time, there is attention for keeping the balance with fundamental mathematics research.

According to the committee, collaboration with industry is excellent and organized professionally. As such, TU Eindhoven stands out as an example for other universities even as a wonderful context like the Brainport region is not present everywhere. The committee strongly appreciates that collaboration with industry is explicitly rewarded in the tenure and promotion contracts with an eye for the various forms (actual collaboration or contribution to standardization organisation) and that industry is involved in the training of master students. Efforts related to

societal relevance are rewarded. For example, cooperation (e.g., with industry) leads to a reduced teaching load. This makes it worth the effort and makes a (structural collaboration) valuable which will then become even more structural.

Viability

For the future strategy, an important goal is to maintain and expand the current strengths. The five research pillars are adequate in the current academic landscape and TU/e research institutes ensure lasting collaborations with other departments. Strong ties with industry are maintained, e.g., by part-time professors and active participation in interdisciplinary conferences. Attracting new talent is important to keep up the quality of the research.

The department anticipates several strategic goals: 1) to attract and facilitate excellent researchers, 2) aim for (large) personal grant proposals to keep consistent long-term research lines, 3) create and maintain close ties with industry, 4) act in alliances/programmes with other universities, 5) stimulate collaboration and increase impact and visibility, 6) disseminate via multi-media the high societal relevance of the research, and 7) continuously improve and consolidate support systems.

In the self-evaluation report a point for improvement is the interaction with computer science. By aiming for AI and data science, this connection is expected to develop in the upcoming period, e.g., by appointing people on the interface. Another point for attention is the high teaching load. By hiring of new staff this can be addressed, although it will remain a point of attention.

According to the committee, the future plans are convincing and reflect the experience and success (in terms of scientific output, prestigious research grants, collaboration with industry, diversity of research themes, etc.) of a relatively large and well-organized department. Viability is excellent although the department should not underestimate possible weaknesses in the

organisational structure, internal communication, and transparency. Transparency refers in particular to the actual realization of career plans, where the committee noticed certain frictions and even mistrust. Given the smooth organisation of the department, these imperfections should be easy to overcome, provided that the management and senior staff are fully aware of clear signals from younger staff members.

Conclusion and recommendations

The combination of doing applied research (as a technical university) with fundamental, curiosity driven research has led to impressive, high quality research output and impact and valorisation. The department has a clear view on its strengths, which is visible in its strategy and viability. In the organisation and governance, the development towards a less hierarchical structure was started. The committee agrees with the research staff it talked to during the site visit that this is a positive development and should be continued. The recommendations by the committee are the following:

- The shift towards a situation in which PI's are increasingly involved in the decision-making process is positive, but it requires attention to make sure that all (junior) PIs are involved. Currently, their involvement depends too

much on group leaders and not all PI's feel involved at the level they are supposed to. Attention is required to further enhance transparency of the development, procedures, and decision-making process, with specific attention to vertical communication.

- The lack of a good gender balance is taken seriously and actively being dealt with. The committee encourages the department to continue with its proactive approach.
- Important steps have been taken to improve the transparency, definition of criteria and decision making on tenure and promotion. This is already visible in the most recent hirings. The committee points out that the group of mid-career researchers that was hired prior to the implementation of these improvements, does not seem to profit. It urges the department to make sure to include all research staff in the ongoing increase of transparency.
- Policy on open science aspects is in place. The committee recommends working on implementation and awareness of these policies, including the availability of a data steward. Furthermore, the department should continuously guard the boundary between open science and confidentiality as the result of collaboration with industry.

IV. Leiden University

Strategy and targets

The mission of the Mathematical Institute (MI) is to push the frontiers of scientific knowledge by developing and applying high quality mathematics, while offering a wide range of mathematical training in a friendly but challenging environment. Investments in individual researchers are essential to achieve this mission, so the institute aims at attracting high-quality mathematicians, who are given freedom to pursue their own research interest. This implies that long-term research strategies and perspectives are shaped through hiring decisions. Cooperation with strategic partners is essential to maximize impact of the research contributions. The MI therefore encourages collaborative projects with partners from industry and society as well as partners in mathematics and other scientific fields.

The strategy consists of six key aims: 1) build a strong and balanced research team, 2) broaden scope and impact through mathematical partnerships, 3) connect to other scientific fields, industry, and society, 4) provide an inspiring institutional atmosphere, 5) train a new generation of mathematicians, and 6) operate from a position of financial strength. The committee is of the opinion that these aims are clearly defined, and the overall strategy reflects very well the mission of the MI.

Organisation

The MI is part of the Faculty of Science of Leiden University. Although the organisational structure at the MI is rather loose, there are three main sections with many crossovers:

- Algebra, geometry, and number theory;
- Analysis and dynamical systems;
- Stochastics.

The governance and decision-making process went through changes during the evaluation period that are still ongoing. In the old situation,

the Scientific Board, consisting of all full professors, made decisions based on consensus but without clear recordkeeping. Lack of transparency, in particular with regard to career policy, led to the implementation of changes. Since 2019 steps are taken to reform the management structure, aiming at a more transparent decision-making process. The Management Team (MT) is responsible for budget, HR policies and strategy, and an institute council (consisting of max twelve elected staff members and students) gives the scientific director solicited and unsolicited advice. Also, the Scientific Board is expanded to include all assistant and associate professors along with the full professors.

Academic culture

The MI aims for a welcoming environment where staff members feel respected and valued, where researchers are free to develop research lines and pursue opportunities for collaboration and funding with institutional support. In the interview, PhD's and postdocs confirmed the open-door policy, stimulating climate and support in their development. To ensure that this atmosphere is experienced at all levels, the organisational structure was adapted, and measures have been implemented, such as new lines of communication. Initiatives like weekly 'corona hour' sessions and a newsletter were introduced. The aim is to create an open culture in which independent and critical pursuit of science is made possible.

Both from the interviews and the self-evaluation report, it was clear to the committee that the MI went through a few turbulent years. The aim to be transparent, with a clear structure, procedures and criteria for tenure and promotions is fully supported by the committee, including setting up a consultation team and advisory council to allow for involvement of all MI status groups in strategic decision making. In particular, the implementation of an advisory council seems a very good strategic move. Regular meetings will facilitate decision making processes and result in jointly working on aligned goals. The committee furthermore appreciates the priority that is given to these

developments, both by the MI and the Dean. At the level of senior research staff, the impact of the measures was clearly recognised, and the increased involvement of staff was appreciated. At the level of associate and assistant professors, the impact of the changes was, although acknowledged, not yet fully visible. This group was not yet convinced of their changing role and future impact. The committee encourages the MI to continue with the implementation of the changes and pay specific attention to the communication with and involvement of the mid-career research staff.

The committee is very positive about the recently installed member of the MT who is responsible for career and personnel issues regarding PhD candidates and postdocs. This member can be individually contacted in case of e.g., problems with the direct supervisor. Also the new consultation structure in which all status groups are represented could help to further improve the trust of the mid-career research staff.

HRM

The MI has grown significantly during the evaluation period, which is primarily visible at the assistant professor level. This is – among others – the result from the *sectorplan*. Further growth is expected in the upcoming years. Workload is high, in particular the supervision of an increasing number of BSc and MSc theses requires a significant time investment. Administrative and managerial duties also add to the workload. Since 2017, the support team has nearly doubled in size and is expected to continue to grow.

Tenure and development track

New researchers are often recruited on a temporary contract at the assistant professor level. The previous committee recommended to resolve the distinction between tenure track researchers and temporary assistant professors. In response to this, many of the contracts have been converted into permanent positions and for all new hirings a general policy is adhered to with a clearly-defined path towards a permanent position. An ad-hoc committee was formed to

identify issues that required attention when updating the career policy. This led to a number of concrete proposals that are being implemented. The MI aims to create a level playing field for all staff members, based upon clear procedures and criteria that are weighed by a representative group that is broader than the scientific director and supervisor involved. Faculty wide performance indicators cover research, earning power, education, supervision, leadership, management, and societal contributions. In annual performance and development interviews, the general criteria are translated into individual career path-criteria. Staff is provided with resources and facilities, allowing them to focus on their research and development of their network.

The committee thinks that the clearly formulated criteria for obtaining tenure, or a promotion are a major improvement, including the use of a consultation team and clear description of the process. The diversification of the performance indicators for promotion is important to enable more individual and diverse career paths. It would be good to accompany this diversification by a flexible and transparent policy on maternity and paternity leave. In addition to transparency issues on strategic decision making the group of mid-career research staff is challenged by the work-life balance in which a demanding job must be combined with family. A way to deal with part of this work pressure, is to reward activities like participating in committees with a reduction in teaching load.

Senior positions

The MI has a significant number of professors who will retire in the upcoming evaluation period. Replacement of these positions is being discussed and the advisory council and scientific board are part of the strategic discussions. Subgroups who need new professors are also included in the discussions. According to the committee, the strategy is well thought out though it emphasizes the importance of clear communication and involvement of relevant staff members.

Diversity

Inclusion and cultural diversity are prominent

topics; an inclusion trajectory was set up with the support of the university diversity officer and an external expert. Staff and students discuss cultural differences, and bottlenecks and sensitivities. The MI aims for a diverse and inclusive environment. However, like all mathematics departments in the Netherlands, the gender balance is not good. Effort was made to attract female talent to the institute. This led to 50% of the appointments being female, which is visible in the percentage of female assistant professors. The committee strongly encourages the institute to continue this trajectory and focus on the associate and full professor level. The committee found that the MI is aware of the diversity challenge (in particular the gender balance), but not a clear strategy or additional support for female researchers.

PhD policy and training

All PhD candidates enrol in the faculty Graduate School of Science (GSS). The GSS takes care for formalities, organizes courses on academic and transferable skills. The university has guidelines and procedures for PhD trajectories, like drawing up an Education and Supervision Plan by PhD candidate and supervising team of at least two members. Yearly evaluations of the activities of the PhD candidate and discussion of the upcoming period allow for room to discuss future career paths. PhD candidates are supported with regard to traveling, e.g., to international conferences. Additional training is flexible and adapted to the skills and ambitions of the PhD candidate. PhD candidates are expected to spend part of their time on training and education, by contributing to BSc and MSc courses. Support for teaching works well, especially during the lockdown it was well-organized. PhD candidates and postdocs were given tablets and walk-throughs on technical issues for a smooth teach-from-home situation.

The MI aims for PhD candidates to complete their theses within the four-year duration of a PhD contract. On case-by-case basis extensions are possible and were applied liberally during the corona pandemic. Approximately two-thirds manages to obtain a PhD within five years. Expectations for a successful thesis, and the PhD completion rate are discussed on a fairly regular

basis (though this depends on the supervisor). Nevertheless, the PhD completion rate within 5 years remains low. Financial support is typically possible (extension) for a year. Close monitoring of PhD candidates will be in place soon, by the fourth member of the MT. The committee encourages the MI to make sure this is actually implemented.

Social cohesion is important for the PhD population. Regular social events are organized by and for PhD's, typically in the form of lectures by speakers and social activities. There is some non-transparency in the bench fee provided for conferences / summer schools / research visits. PhD candidates and postdocs seem happy, with approachable supervisors and an open atmosphere. Communication between supervisors and PhD's happens on a weekly basis (not necessarily scheduled). In case of problems, a trust person (*vertrouwenspersoon*) can be approached, but not everyone knew who they were. A course on academic integrity is mandatory for all PhD candidates; otherwise, there are no mandatory courses.

The cotutelle programme ALGANT, in collaboration with prestigious international universities, gives opportunities for international PhD-candidates. Onboarding for international staff (including PhD students) could be improved. Such procedures should not just depend on the individual working group.

Research quality

According to the committee the research output of the MI is very good to excellent. This is reflected in the reputation of the institute as well as by an abundant output of strong scientific papers and the presence of several first-class mathematicians. The number of prestigious grants is impressive, and the MI made optimal strategic use of the *sectorplan* and van Meenen funding. Joint appointments with other disciplines (e.g., with biology) are important strategically for high-level interdisciplinary research.

Due to the ending of some larger grants and funding for PhD projects, the MI invested in

institute-wide hiring rounds for junior researchers, resulting in ten PhD positions in 2020/21 and an additional twenty postdocs and PhD candidates starting in 2021/22. Nearly 50% of the PhD defences in the period of evaluation involved external partners. In particular the cotutelle programme was part of this success. To broaden the scope and impact through mathematical partnerships, the MI stimulated involvement in national and international networks and collaborations.

Funding

First stream funding provides the majority of income to the MI and has increased in the period of evaluation. This steady source of income allows the MI with financial flexibility to pursue strategic investments, such as the funding of PhD candidates. The MI was successful in the acquisition of NWO grants, providing a steady source of income. Second stream funding from international grants shows a dip in 2019-20 due to the ending of two ERC Advanced Grants. In 2021, this decrease was turned around. Third stream funding provides the smallest chunk of total funding. However, the committee notices developments in this respect as well, e.g., with KWF and oncology research.

Obtaining external funding for PhD candidates is challenging and time consuming. This is a national issue, in particular for research staff at the full professor level. The committee appreciates the way that the MI allows first stream funding to pay for PhD projects, for proposals that are rated excellent but are not granted, first stream funding is available. This leads to a good balance between the number of PhD's/post-docs on the one hand and tenured research staff on the other hand.

Open Science

The vast majority of research results are publicly available. Papers are usually posted as pre-print and published in open access journals. In addition, the MI members contribute to open-source mathematics software.

According to the committee, open science is very much embedded in the culture within the MI,

with open access publications being the norm and with significant contributions to open-source software. However, awareness about procedures around open data is not found at all levels. This may be because it is not relevant for those who the committee interviewed, but it was not possible to establish whether things will turn out to be in place where it is needed. Please make sure that the proper mechanisms are in place to ensure the actual implementation of the policy.

Relevance to society

The MI was stimulated by the previous committee to be more proactive in exploiting the mathematics that is developed. By involvement in joint projects with other fields (e.g., biology, ecology, linguistics, pharmacology) the number of collaborations has grown, providing increased opportunities to exploit research results. By joint appointments with other institutes, collaborations are further stimulated. Other examples of research leading to societal impact is the training of secondary school teachers and a number of outreach activities to the general public. This is an important contribution to society, as well as the valuable projects with developing countries. In some fields (e.g., medical statistics) the institute is directly involved in participative research, where stakeholders are involved in designing the research projects. Outreach activities are stimulated by the MI, to promote mathematics to the general public. By including outreach in the performance indicators for promotions, these activities are supported and acknowledged by the institute. Not all fields of mathematics at the MI are suitable for application (in the short term) and interdisciplinary cooperation. According to the institute this does not diminish their importance to the institute or to society in general. These topics of research can lead to unforeseeable developments in science and technology. The committee fully agrees with this statement.

The committee is of the opinion that the MI does well on aspects related to societal relevance. The institute is connected via many collaborations (e.g., LUMC) and a promising crypto- and quantum development along with involvement in AI, data science and machine learning. The

committee is very positive about the fact that PhD-candidates are obliged to do a three-month internship in industry as part of the Network programme, to raise awareness of industrial needs. An opportunity could be the establishment of an alumni network (e.g., as an upgrade of the educational council) to make the connections between the department and societal stakeholders less person dependent. The plans on outreach activities and the outreach assistant are good, although the full professors were not aware of the plans to hire an outreach officer. It would be good to involve all staff in the outreach activities and to reward such activities.

Viability

For the upcoming years, the MI has identified several strategic priorities: 1) to exploit the financial resources of the MI to fill new positions in strategic areas, 2) to develop and implement a new management and communication structure, 3) to formulate a transparent and robust career policy, 4) to increase number of support staff, and 5) to consolidate the financial strength of the institute. According to the committee, the strategic aims are clearly formulated and form an excellent starting point for the next period. Recent hirings were used to expand MI's profile in a more applied direction, including Data Science and Machine Learning, and (Quantum) Cryptography. This is supplemented by hiring researchers from other institutes on part-time positions and joint hirings. The initiative to reduce administrative duties by hiring more administrative staff is good. The MI should make sure that not only the full professors benefit from this.

The committee is of the opinion that the viability is very good. The strong scientific and financial position of the MI is a solid basis for the future plans. The MI relies on its reputation as a top mathematics institute for attracting strong researchers. This reputation relies partially on former staff. The institute is aware of the need to appoint some excellent full professors in strategic areas. The MI is also aware of the need to

radically change and improve the management structure, transparency, and internal communication. The new plans are certainly convincing, though the institute should not underestimate the time and continuous efforts required to include all staff members and convince them of the fact that improvements are substantial and visible in the daily life.

Conclusion and recommendations

The research quality and societal relevance of the research are very good, and the MI has an impressive academic reputation. Strategy and plans on improvements are welcomed by the committee and appear to be solid. The main challenge is to implement the plans and gain the trust of all research staff on a new direction taken. To help in this, the committee has the following recommendations:

- The MI should continue to improve on the changes already implemented, including involvement of all levels of research staff in decision making. Communicating with all levels about changes, improvements, inclusion, and strategies should get continuous attention.
- Developments on establishing and documenting the process of tenure and development tracks are promising. Policy, criteria, and procedures become clearer and more transparent. The committee encourages the MI to continue along this path and include clear communication (not dependent on the supervisor) and more diverse and flexible assessment criteria.
- Like all mathematics departments, the MI has a diversity issue. Despite acknowledgment of the issue and a proactive search for candidates, a clear strategy for attracting and retaining female staff members and other underrepresented minorities seems required.
- Awareness about procedures around open data could be improved. Proper mechanisms should be in place to ensure the actual implementation of the well-defined policy.

V. University of Twente

Strategy and targets

The mission of the Department of Applied Mathematics at University of Twente (DAMUT) is based on the conviction that the interaction between mathematics and its application domains in academia and society is key for both. The mission is to be an internationally leading institute for mathematical sciences and applied mathematics, covering the full spectrum from fundamental research to applications of societal relevance. The strategy to achieve this mission is to engage actively in collaborative projects within and across the faculty. Research institutes at UT stimulate these activities, e.g., DSI, MESA+ and TechMed. In addition to collaborative projects, the department performs research in the mathematics of computational science, operations research, and data science.

The committee appreciates the modern vision of interaction between mathematics, applications, and society, driven by data, models, algorithms and AI. There are many collaborative projects in various application domains and the strong link to medicine is remarkable (with a master track AI4Health). The Theme-Team-Call is an excellent strategic method for young researchers to broaden their perspective and step out of their comfort zones.

Organisation

DAMUT is one of three departments in the Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS). Until 2018 DAMUT research was organised in two clusters, SACS (Systems Analysis and Computational Science) and MOR (Mathematics of Operations Research). Since 2018, the formation of a new group in statistics with a new chair in modern statistics is an invaluable asset to strengthen fundamental research in data science, which led to a new cluster on mathematics and data science.

Monthly meetings with all full professors in the department are used to discuss major (strategic)

decisions. From the interviews the committee learned that the decision-making structure is one of agreement. The clusters organize meetings (sometimes including PhD candidates) to discuss issues and developments. Yearly group meetings are organized in which different topics are discussed in a collaborative manner. Furthermore, yearly strategy meetings are organized, including all permanent staff members. According to the research staff the committee talked to, influencing policy decisions are possible, also for assistant and associate professors.

The EEMCS as a whole is growing and working on joint strategic themes. One result of the growth is that more autonomy is given to the departments on strategic and financial decision making. This results in the role of the head of the department being redefined, with increasing responsibility for the department's financial health. This puts the department more into the position to develop its own strategy. All staff mentioned the role, involvement, and approachability of the department head. His role appears essential in making everyone feel included in the decision-making process. The upcoming retirement of the department head will therefore require careful attention.

Academic culture

The UT stimulates an environment within which responsible research practices are encouraged. As of 2020, the UT has an integrated programme, covering academic, social and corporate integrity. This programme includes training for all PhD candidates, mandatory ethical assessments for all research, and a data management policy. During the review period, the ethics protocol was put to the test in one case and seemed to work well.

Work pressure is high. With a significant increase in student numbers university wide, service teaching has increased as well as the teaching load towards mathematics students. By systematically monitoring all educational activities, a good overview of the division of teaching work is obtained. This led to the conclusion that the actual hours to teach were not fully represented in the earlier overview, and

a change was therefore made in the hours calculated to teach. Part of the solution to deal with the high workload is attracting additional junior staff members and teaching staff. The committee appreciates that the department systematically monitors all activities related to teaching duties.

Various activities are organized at departmental level, aimed at community building and aligning the research direction of individual staff members in the department's strategy. These activities include a bi-weekly departmental colloquium followed by drinks, weekly seminars organised by the clusters, and reading groups on various topics. Based on the interviews, the committee concludes that the atmosphere at the department is good and despite a rather formal decision-making structure, all staff feels involved in the discussions on strategy and other relevant topics.

HRM

In annual meetings the chair-holders discuss the functioning of all staff members, guaranteeing equal treatment. Promising junior faculty is identified, and appropriate growth paths are determined. The committee appreciates the opportunities young parents have in this department. Parental leave is important when it comes to a healthy work-life balance. Teaching load for young staff members is reduced from 50% to 33% in the first three years of employment. Female researchers appear overloaded with committee work (also at other universities). The committee suggests establishing rewards in case of relatively large amounts of committee work. If a reduction of teaching load is not possible, then other means for compensation should be thought of.

Tenure and development track

The current policy is to provide a one-year contract after which tenure can be given. There are also tenure track positions, in which case a six year temporary contract is given. In addition, a development track is in place with clear structure and guidelines on what has to be achieved for promotion from assistant to associate professor.

Criteria for promotion are tailored to the specifics of the mathematics department. According to the mid-career research staff the perspectives are clear, and so are the criteria on how to get tenure and promotion. They also mentioned that it is becoming easier to rise to the level of associate professor than it was several years ago. The department chair is actively supporting candidates to also be promoted to the level of full professor by clearly showing the dean the ambition of the department. However, this final step is not solely in the hands of the faculty and an appointment committee is always part of the decision. Young mathematical talent is invested in, e.g., by coaching them in writing research proposals. In the evaluation period this has led to highly ranked proposals, invitations for personal interviews, and in several cases to an honouring of the grant. This allows them to focus on their research line. Other support measures are training for time management and a supervision training (e.g., PhD candidates).

DAMUT has demonstrated to be able to attract outstanding, young talents. However, both in the self-evaluation report and during the interviews, it was mentioned that there is also the risk that these talents get offers from elsewhere and leave. The committee is positive about the twofold way by which the department is dealing with this challenge. First, the department is made more attractive by the creation of a realistic track to full professorship in the foreseeable future, supported by the Dean, by establishing a starter package for all new staff members, and by supporting talent in a variety of ways. Second, the department as a whole became a more attractive place to do research by the establishment of the statistics group.

Senior positions

In the near future, a significant number of full professors is retiring. The department is actively thinking about and working on a strategy to replace these researchers. This strategy includes promoting both talented associate professors and hiring external candidates. The committee appreciates this balance, and emphasizes the importance of transparent procedures in this

process.

Diversity

The 2025 target of the EEMCS faculty for the number of female employees at various levels has not yet been achieved, although the faculty comes close at the level of assistant professors. However, at the level of DAMUT the percentages are not impressive in the period of evaluation. The faculty is looking into possibilities to prioritise female applications. Concerning one of the other diversity aspects, international staff, DAMUT is doing well with 40% international staff members at assistant, associate, and full professor level.

According to the committee, the gender balance needs to be improved at all levels. This is similar to many mathematics departments in the Netherlands and the department appears well-aware of the challenge. In 2020, the department already hired two female assistant professors, and it has set itself firm goals for future hirings.

PhD policy and training

All PhD candidates are registered in the Twente Graduate School (TGS), with uniform procedures and rules. This includes central registration of all PhD candidates, the writing of a Training and Supervision Plan (TSP), and a formal go/no-go decision during the first year. The TSP contains a summary of the research plan, the supervision plan, and the educational programme (30EC) to be followed, half of the credits are obtained with content related to research topic, and the other half with transferable skills (presentations, academic integrity, etc.). The educational programme includes university wide courses, but also courses from national research schools, summer schools etc. Much of this information, and more, is clearly laid out in the 'PhD charter' document.

Increasing emphasis is put on PhD wellbeing, for example by way of an exit questionnaire. From the interview with PhD candidates, the committee concluded that overall, the PhD candidates and postdocs feel happy. A mentor is assigned upon arrival, to whom questions may be directed. A 'vertrouwenspersoon' is in place in case of

confidential issues. Expectations for a successful thesis are communicated by the promotor and the daily supervisor on an annual basis, based on a continual modification and update of the TSP plan from the first year. Conferences and research visits are encouraged by PI's. As for teaching, students have freedom in deciding whether they want to give exercise classes or lectures (depending on possibilities).

The flat hierarchical and open structure was clear to the committee. Further social cohesion - though this is already at a very nice level - can perhaps be promoted via a seminar for and by PhD candidates.

Research quality

The overall research quality in the department is very good. This is demonstrated by the publication rate in high-quality journals and conferences. The list of publications, in particular that of 12 selected 'top publications', shows that the department has a high level activity in a great variety of research themes. In addition the department is particularly active in public software development. The individual faculty members have many international contacts and collaborations, and visibility through, e.g., editorships of international journals and leadership positions in the scientific community. There is a strong national embedding in the NWO clusters, an active participation in graduate schools and in the UT research institutes. The department is clearly able to cope with its ambitious mission, and offers a healthy mix between fundamental and multidisciplinary application-oriented research.

The department was substantially reinforced, both qualitatively and quantitatively, by the *sectorplan* and other investments. Many promising young staff were hired and a new group in statistics was created, of crucial importance given the increased focus on data science.

One of the recommendations by the previous committee was the continuation of interdisciplinary cooperation. The department worked on this by extending activities on smart

energy systems, and by building a group on geometric deep learning with focus on medical imaging. Also, activities on healthcare logistics were continued.

Funding

The EEMCS and department have taken measures to professionalize the development and support of new research project and grant proposal writing. Participation in consortia and multidisciplinary proposals is one of the ambitions, and support is given by the strategic business development department. The allocation model for direct funding within EEMCS is expected to change, leading to an increase in direct funding for DAMUT. The department plans to use this increase in direct funding to support talent and fundamental research.

Concerning contract funding, the department mentions health care & statistics, as well as energy to be large areas in which collaboration with industry takes place.

The committee has learned that in the Netherlands it is not easy to find external funding for PhD positions (on average a 10% success rate). In particular for more senior research staff the grant opportunities appear to be limited. At DAMUT the relatively large amount of talented younger research staff that have obtained European and national grants makes this less of a problem. However, it was confirmed by the senior research staff that getting research grants becomes increasingly more difficult. Easier than obtaining a research grant, is to get PhD projects funded in collaboration with industry.

Open Science

Open science and research-data policy constitute an important topic at UT. The university aims for 100% open access publications by 2023. One of the tools to support researchers is the Open Access website. In 2020, only 45% of the publications were open access, which was less than the 72% in 2018. Important in achieving the 100% target is the resources to finance open access publications.

At UT level a university wide data-management policy serves as starting point for tailored data policies. At the level of the EEMCS Faculty, this tailored policy was established. Several individual groups have further refined the policy into practical guidelines and workflows. The Twente Graduate School offers a compulsory course on Research Data Management for all PhD candidates. Part of this training is the writing of a data management plan (DMP). A point of attention that is mentioned by the department is the long-term storage of data generated by PhD candidates. A faculty-wide data science initiative was pushed, resulting in a close collaboration between various chairs, and the offering of several data science seminars.

According to the committee it is great that the department has a (mandatory) course on data-management (and software-management) in the Graduate School, that PhD candidates have to make a data management plan and that PhD candidates are encouraged to publish software. In that aspect, the department is ahead of some of the other departments the committee spoke to. The procedures and awareness around open access publications seem to be a work in progress. The committee strongly encourages the department to make these procedures generally known and adhered to (where that is not yet the case).

Relevance to society

As part of being a technical university, UT has strong ties with industry. In the energy domain long-term collaborations are in place (jointly with the computer science department). According to the senior research staff, these connections are now starting to pay off in several successful projects. The committee appreciates the approach taken, which is based on a long-term investment in setting up a network and in building trust with industry. Although the contracts are project based, there are cooperation agreements and communication with fixed people in the companies. In the domain of health, most collaborations are currently at the level of PhD projects. It is more difficult to establish long-term network contacts in this domain, partly due to a

relatively large turnover of contacts. Nevertheless, the department is actively working on trust and a stable and long-term network in this domain. In particular, the impact of health care imaging was major in the previous years, which led to a growing role of mathematicians.

According to the committee, DAMUT has a clear vision on investing in societally relevant research directions. This is a strong point even if there is always a risk of betting on the wrong horse: no guts no glory. The committee compliments the department for their strong and structural collaborations in health and energy.

From the self-evaluation report the outreach activities seemed limited. From the interviews, however, the committee learned that in practice more outreach is taking place, for example towards secondary school mathematics teachers, and via public presentations. This is good, since technical universities in particular have an important role in the connection of academia to industry and society.

Viability

For the future strategy, the *sectorplan* funding allowed the department to realize a major strategic goal, which was building a group in statistics. The integration of this group with other departmental research activities anticipates on data science and related future developments. It is foreseen that the statistics group will be the heart of a newly formed cluster for the mathematics of data science. The committee appreciates the statement that the clusters are not meant to strictly separate research domains, and that large overlaps amongst the clusters is aimed for.

As the description of the future strategies in the self-evaluation report was not exhaustive, useful additional information was provided during the site visit. In particular it was explained how DAMUT deals with the important threat that 'Faculty members are constantly offered positions at other universities, and it remains a challenge to avoid a quick outflow of staff': a mechanism of proactive talent scouting, both inside (through

career planning) and outside (through attractive offers) the department, should guarantee the presence of excellent senior staff. This makes the department attractive for younger staff members. Several very recent and concrete results in this direction are most convincing. More general, the viability of future plans is excellent. The committee sees evidence of this in the very good results achieved in 2021 and 2022, which gives further confidence in a healthy future. All in all, the committee has great confidence in the future of the department, where the quality of research will at least remain at the very good level of the past period.

Conclusion and recommendations

Based on the information in the self-evaluation report and from the interviews, the committee has a very positive impression of the functioning and quality of DAMUT. There are challenges, but the department is well aware of these, and actively striving for solutions. Based on the conclusion that the department is successful and properly organized, the committee has some minor suggestions:

- The current head of department plays a pivotal role in the department, which is evident from his good approachability and the pleasant atmosphere. His upcoming retirement will therefore have an impact on the department. The proper positioning of a replacement requires much attention, not only within the department, but also from the faculty.
- A lot of attention is given to talent development, which is great. In addition, the committee emphasizes the importance of leadership development. With a large number of retirements in the upcoming evaluation period, it is crucial to prepare mid-career researchers to take up leadership positions.
- Overall, PhD training and supervision are well organised. One suggestion by the PhD candidates themselves was to be clustered with other mathematics PhDs in general courses. A second suggestion, from the

committee, is to have the PhD candidates themselves organize more social and professional events. This is – among other advantages – important for the integration of international PhD candidates. The

department could provide financial support for this.

- According to the committee, the gender balance needs to be improved at all levels.

VI. University of Amsterdam

Strategy and targets

The Korteweg - de Vries Institute for Mathematics (KdVI) at the Faculty of Science (FWNI) of the University of Amsterdam strives to be an inspiring centre at the forefront of the mathematical endeavour, fostering talent and ambitions. The strategic aims that were in place are 1) Create an optimal research environment; 2) Connect to society; 3) Connect to other disciplines, 4) Strive towards a better representation; 5) Offer challenging educational programmes; 6) Reach out to society and 7) Protect the mathematical cultural heritage.

Sectorplan investments were used by the KdVI on new positions to further improve the research profile in geometry, mathematical physics, discrete mathematics, and quantum information, and to make a transition in the Statistics group. Another important aim was to invest in interdisciplinary collaborations and to build research coalitions with public and private partners. In addition to focusing on the connection to society, the KdVI aims at interconnections with other disciplines (e.g., QuSoft, NETWORKS, Physics).

Organisation

The KdVI is organised in four coherent research programmes:

- Algebra, Geometry, Mathematical Physics;
- Analysis;
- Stochastics;
- Discrete Mathematics and Quantum Information.

In addition, some research is performed on blended learning and the history of mathematics. Each research programme informally consists of several 'focus groups,' sharing a common interest in research and education. The programmes furthermore play an organisational role, each one is represented in the management team (MT).

However, the research programmes are not intended to (nor do) hamper research initiatives and interactions across programmes.

Transparency of the decision-making process is considered important by KdVI. The director of the institute appoints an advisory MT consisting of the four programme leaders, the programme directors of the educational programmes and the institute manager. In monthly meetings strategic issues and organisational matters are discussed. Every two months staff meetings are organised in which the MT informs and consults with the different status groups of staff. Ad-hoc committees are in place for complex policy discussions.

Academic culture

The KdVI stimulates an open atmosphere and informal contacts by – for example – an open-door policy and daily teatime. New staff is welcomed in welcoming sessions. Regular communication through a weekly newsletter and staff meetings aim at a transparent communication. Covid-19 restrictions hampered informal communication, leading to a difficult start for newly hired personnel. Measures will be taken to deal with this in the upcoming period, e.g., by the introduction of a 'buddy' system and (social) activities organised by the PhD council. A proactive strategy to identify potential social safety issues will be implemented.

All staff members appear to be open and approachable. The junior as well as mid-career researchers that the committee interviewed felt that they take part in the decision-making process and that they are listened to. The director is present in very a positive manner; everybody knows him and can talk to him. During the interviews he was often referred to on a first name basis.

Despite the fact that staff feels involved, the decision-making process related to new hirings, new strategic initiatives or more general departmental policies was not clear from the documents. The programme leaders play a central role in providing key information to junior and mid-career staff. Not all programme leaders have

a similar interpretation of their role in this communication nor do they structurally organize staff meetings. The MT is aware of the risk of the current informal communication pathways and has initiated the publication of the agenda and minutes of MT meetings in MS Teams. Although no problems were identified in the interviews, the committee agrees that a more formal procedure should be installed to guarantee that everyone gets all relevant information.

In the self-evaluation report the high work-pressure and risk of burnout are mentioned. Although these are not unique to the KdVI, it is important to deal with the perceived workload and requirements in combining research and education, as well as outreach activities and managerial tasks. By allowing staff members to individually balance out their tasks and by rewarding committee work, the institute as a whole will benefit of the strengths of each individual and work pressure can overall be controlled.

HRM

The past evaluation period was one of growth and transition for KdVI. The *sectorplan* allowed the institute to appoint six new staff members and subsequently the opportunity to improve the research environment, gender balance and ability to connect to society and other disciplines.

Goals for the period 2015-2020 were (i) creating an environment where a great diversity of employees are being stimulated to grow and (ii) developing a strategy aimed at attracting and retaining top talent. More specifically, the KdVI worked on promoting diversity and inclusiveness, consolidating the tenure track system, offering an extensive training programme at all levels, providing career support through a system of annual consultations, ensuring a socially safe environment for everyone by, among others, transparent decision making and open communication, and paying attention to work pressure issues.

Tenure and development track

New junior staff members were by default hired

on tenure track (TT) contracts, which are flexible agreements that are carefully monitored. Currently, other contracts are in also place. Decisions on tenure of the staff member are made by the dean based on the advice of a promotion committee and the research director.

In 2019, FNWI implemented updated appointment and promotion criteria for scientific staff. This led to a more transparent policy on promotions, with clearly formulated criteria. These criteria have recently been adapted to be more specific towards mathematics, which is a good development. In the interviews, the committee learned that in practice, the criteria are less strict than on paper. For example, requirements on grant acquisition seem very strict and fixed, but in practice having an excellent but not (yet) honoured proposal might suffice. This could be communicated more clearly. In this respect, it might help to assign TT staff with a mentor. The committee is very positive about the fact that there is a committee taking all decisions on tenure or promotions, this provides transparency and an independent decision making. Individual researchers discuss their ambitions at an annual review, and advice is given by their supervisor, for example on participation in leadership workshops.

At the time of the site visit, a change is being made towards more continuous career paths. These changes are aimed to deal with the negatively experienced effects of the tenure track system, e.g. unnecessary stress and uncertainty, but without losing the positives. The plan is to have two distinct pathways for young talent. The first is a tenure track like position in which the researcher builds up his/her own research line. The candidate gets a starter-package, consisting of a PhD student and travel money, and after two to three years a tenure decision is made. Subsequently, criteria are set for the promotion to the associate professor level. Another pathway is a tenured position as assistant professor with different criteria and support being provided, resulting in a less fast track up. The committee strongly suggests that either all assistant professorships have the same value or a clear

distinction between the two pathways is made (e.g., research oriented versus teaching oriented appointments).

Diversity

The KdVI has successfully participated in three rounds of the FNWI-MacGillavry programme and used the *sectorplan* opportunities to improve its gender balance.

According to the committee, significant progress was made in hiring more female staff at the assistant professor level. However, on the full professor and associate professor level, there is still only one female professor (and one female professor by special appointment). Also, at the PhD candidate level, the gender balance is not very good. The focus and attention on gender diversity did initially not include the hiring policy at PhD level. The KdVI has set up a diversity committee, which will try to stimulate diversity at all levels. This committee has a very positive effect on hiring policies to ensure a more diverse staff. A scholarship programme for students of the Anton de Kom University in Paramaribo will be started. This development will increase the international diversity of the institute.

PhD policy and training

The emphasis of the PhD programme lies on training candidates to become independent researchers in all aspects outside and inside academia. The programme comprises topic-specific knowledge and research skills, teaching skills and didactic and personal skills. PhD candidates are offered the 'Mastering your PhD course', with emphasis on developing various skills in the beginning of the first year and on career planning in the final year. This course also addresses cultural differences and the Dutch system. The course on integrity is mandatory, and apart from this, students can choose their own courses. The FNWI PhD council oversees the orientation activities and deals with topics related to PhD supervision, supplementary courses, and housing. In addition, the KdVI established its own PhD council.

Progress of PhD candidates is evaluated by two

formal assessments during the first 18 months, followed by annual reviews. In practice, weekly meetings between PhD candidate and supervisor take place in addition to group seminars. Approximately 60% of PhD candidates finish within nominal time, 90% do so within five years. Covid-19 will most likely result into more delays, therefore extensions up to three months will be granted. PhD candidates informed the committee that the teaching load is doable. They appreciate the fact that they have no teaching tasks in their final year.

The PhD success rate at UvA is high. The KdVI director is monitoring the progress. It is also made clear to both daily supervisors and second supervisors that active involvement towards graduating in time is important. The graduate programme includes the 'Mastering your PhD' course, which is nicely spread out over time. This course also discusses further steps in the career, putting emphasis in year three on what to do afterwards.

According to the committee, having a PhD council is very good, both for social activities and as an outlet for common issues towards management. The buddy system is also a nice initiative from the student council. PhD candidates mentioned that it really helped them with the onboarding process at the KdVI. The PhD candidates seem to feel happy at the institute, and they feel comfortable approaching the KdVI director. At the level of postdocs, there is less structure. It might be a good idea to also assign a mentor to each postdoc. Also, the onboarding process, especially for newly hired international assistant professors and postdocs, could be improved.

Research quality

According to the committee, the research quality of the KdVI is excellent. Each of the four research programmes has published in excellent journals, and the institute was successful in the acquisition of many personal and prestigious research grants. The department is strongly embedded in the Dutch mathematical landscape, and its members take up leadership roles in a variety of interdisciplinary collaborations and public-private

projects. According to the committee, the importance of teaming up with other disciplines and institutes to enhance both opportunities and visibility, is demonstrated convincingly by the NETWORKS initiative and by QuSoft, the Dutch Research Center for quantum software and technology. Both initiatives are impressive examples of long term collaboration leading to outstanding research.

The KdVI made optimal use of the *sectorplan* to substantially reinforce the institute, for example with the setting up of a new statistics group, crucial for new developments in data science and machine learning, and with the start of a new research program in Discrete Mathematics and Quantum Information. Furthermore, existing research areas, such as algebra, geometry and mathematical physics were strengthened.

The KdVI has a strong tradition in doing pure mathematics research but is clearly opening up to applications and emerging fields. This conscious direction of fundamental mathematics research combined with spin-offs to concrete problems is paying off. According to the committee, the research equilibrium and interactions between pure, fundamental research and applied mathematics are excellent.

Funding

The KdVI was successful in obtaining grants, both from national and European agencies. According to the mid-career research staff, there is a lot of support when writing grant-proposals. In the interview with management, it was mentioned that increasingly large consortia are funded by NWO. For the mathematicians at the KdVI this is not optimal as they prefer smaller projects and open calls. However, the institute is confident to continue being able attracting funding, e.g., in developing areas like quantum research.

The committee learned that it is not easy to find external funding for PhD positions. In particular for more senior research staff the grant opportunities are limited. This is a nationwide challenge.

Open Science

Open science is formulated as ‘the practicing of science in a sustainable manner which gives other the opportunity to work with, contribute to and make use of the scientific process’. Three main topics are identified, 1) open access, 2) FAIR data and 3) Scientific integrity.

Open Access is clearly in the culture of the KdVI and will become fully implemented as contracts with publishers are established and funding for publications is available in grants. The committee would encourage the institute to make the data-management and software-management more embedded in the procedures. Awareness of the best practices is done through a document that was sent around and was discussed in a staff meeting. The committee stimulates the KdVI to continue pointing out this document and the awareness for open access. The committee does compliment the institute on having an outreach committee, recognizing efforts for outreach and valorisation, and for developing web classes. Such web classes are a wonderful form of outreach.

Relevance to society

The KdVI expects that the *sectorplan* investments will result in more extensive collaborations with societal partners. Already, the institute engages in many national and international partnerships and collaborations. A strong presence of the financial industry in the Amsterdam region and the KdVI has several partnerships with this industry, both in research and education. Several of the full professors have a special appointment and play an important role in strengthening the network with societal partners. Furthermore, external PhD candidates enrich the network of connections to societal partners.

KdVI traditionally pays a lot of attention to service teaching to kindle the interest in mathematics. The committee did notice that many expensive educational programmes form a financial risk for the KdVI. There does not yet seem to be a good strategy dealing with this risk in the future.

The KdVI has major initiatives around societally relevant themes like quantum, finance, statistics,

and networks, including lots of collaboration, even though the committee feels that actual valorisation is mostly indirect. Still, it is strong that the institute has these structurally organized collaborations. There are also collaborations that are on a more personal level (e.g., forensics, CBS) which might fall away if the involved researcher leaves. If such a collaboration is considered to be essential, the institute is asked to consider organising it in a more structural (less personal) way. In general, the committee encourages the plan for an industrial advisory board to have a more permanent broad connection to industry. The committee stimulates the institute to continue with its plans to improve the connection to alumni.

Viability

The strategic aims in the past evaluation period remain important for the upcoming years. The fruitful interplay and good balance between fundamental and applied aspects of mathematics is a key value and serves as important guideline. Main ingredients for upcoming years are 1) emerging fields, 2) research programmes, 3) connecting science, 4) diversity, 5) NETWORKS follow-up, 6) Financial Mathematics, 7) HR-policy, and 8) Open Science.

According to the committee, the KdVI has an excellent strategy for keeping up the current positive development in the upcoming period. The institute made excellent use of the possibilities in the *sectorplan* to strategically enlarge the mass on topics already covered. Despite the fact that the viability is decidedly very good, the KdVI – like other mathematics departments the committee reviewed – has a number of challenges. The committee is convinced that the MT is well aware of these challenges, and in combination with the open and pleasant atmosphere, a bright future lies ahead. The strong research position of the institute makes the viability of future plans very good. The strategies are very detailed and described well. Being both challenging and realistic at the same time, they are particularly convincing. As an example, the committee appreciates the strategy that is addressing the problems for research directions not favoured by

the *sectorplan* such as analysis.

Conclusion and recommendations

Overall, the committee is very positive about the KdVI. Research output is outstanding, an increase in the combination of fundamental and applied mathematics is observed, grant acquisition is impressive, and the PhD council and diversity committee are good practices. Based on the conclusion that the department is doing well and is properly prepared for the upcoming period, the committee has some minor suggestions:

- A point for improvement already identified by the KdVI itself is the introduction and embedding of clear and structured communication lines. Dependence on the programme leaders for clear communication entails a risk of research staff being excluded from strategic developments and decision making.
- Despite the existence of a PhD- and postdoc council, the onboarding and coaching of postdocs requires attention.
- Despite clear improvements, gender diversity remains an issue. The diversity committee is a very promising development to support improving gender balance at the senior level as well as at PhD level.
- Concerning the difficulties to obtain national funding for PhD projects, in particular for senior staff, the KdVI should intensify its efforts to use direct funding for very good candidates in excellent PhD projects.

VII. Radboud University

Strategy and targets

The mission of the mathematics department is to conduct research in pure and applied mathematics at the highest scientific level, to provide excellent education, training, and supervision in mathematics at all academic levels, and to contribute to society by engaging in collaborations and interactions with partners both within and outside academia. More specifically, strategic aims in the period of evaluation were creating an optimal research climate, increasing diversity, establishing a group in Applied Mathematics, reinforcing pure mathematics, and reinforcing mathematical physics.

Forming a group in Applied Mathematics was done with the help of the *sectorplan* and hiring opportunities, resulting in building a new group of 5 FTE by 2020. Parallel, the *sectorplan* also allowed the department to reinforce the pure mathematics research group as well as mathematical physics.

According to the committee, the strategy of the department is visionary. For example, the choice of Derived Geometry and Higher Structures as target area for the *sectorplan* recruitments in pure mathematics is closely attached to important recent developments in mathematics. Also, the emphasis on applied mathematics in the use of the *sectorplan* has been a benefit for the department.

Aiming at a critical mass to be competitive in international research, three focus areas have been formulated: Geometry, Applied Mathematics, and Mathematical Physics. The committee welcomes the new focus in Applied Mathematics, which has been announced in 2015, and still is considered an excellent complement to fulfil the department's well formulated strategy. As the department values both research and education equally important, it is consequential to plan to hire new staff.

The Nijmegen department in Mathematics is the

smallest in this review and deserves a compliment on how it has been working on many issues, challenges, and aspects of its research. In all interviews a congruent picture was painted on recent changes and developments that significantly improved the situation. With the support of the *sectorplan* positions, which were used very effectively, the department managed to grow and overcome the threat of insufficient critical mass.

Organisation

Mathematics is one of three departments that constitute the Institute for Mathematics, Astrophysics and Particle Physics (IMAPP), which is one of eight research institutes at the Faculty of Science at Radboud University. The departments are not independent of IMAPP, the Board of IMAPP consists of a director, a managing director, three heads of department, a PhD representative and support. The Head of the Department of Mathematics is supported by an Advisory Board, consisting of six-seven members of the department representing all career stages.

In the past most decisions were in the hands of full professors and/or coordinators of educational programmes. Information was exchanged on an ad hoc basis, and department-wide meetings were organized irregularly. In the past years, the need was felt to change the governance and information structure, which subsequently led to improving inclusion and transparency. Currently, bi-weekly (often online) lunch meetings for the department are organized and provide a platform for discussions. In addition, the department has a wiki-page, providing information about local affairs. The most important change, however, was the setting up of a new Advisory Board, consisting of several members representing all career stages (including PhD candidates and postdocs). This Advisory Board acts as a sounding board for the Head of Department.

Academic culture

The general atmosphere in the department is open. Information is exchanged during weekly lunch meetings. As mentioned in the organisation

paragraph, all levels of research staff are represented in the Advisory Board. The committee considers this a good practice. Involvement and influence on strategic decisions by junior and mid-career staff is informally present in several institutions evaluated by the committee, here it is actually formalised.

It is important for the inclusion of the international employees to maintain a high level of information also about matters of Dutch society (health care etc).

HRM

With the increase in size of the department and the hiring of many new research staff, personal development and integration into the department are given a lot of attention. In addition to practical information and trying to give new staff members a role in activities, resources were used to provide new research staff with a PhD candidate. Furthermore, new research staff has a (temporary) reduced teaching load.

Understaffing of the department in the past led to an explicit goal to increase staff numbers, to reduce teaching load and allowing more research time. In addition to support from the Faculty Board, the *sectorplan* had major impact. Five positions were obtained in three focus areas.

From the interviews the committee concludes that workload is very high. This is not unlike other mathematics departments in the Netherlands, but the small size of the department makes it more vulnerable in Nijmegen as teaching load has to be covered by a smaller staff size. The committee is very pleased that the *sectorplan* positions led to a significant growth of the department, which has now sufficient critical mass. With the worst threat and highest workload behind it, the department must now work on backlogs in other areas. The committee is thinking of housing, secretarial and administrative support.

In the period of evaluation, several outstanding researchers left the department. According to the committee, the department was able to replace these researchers with new talent, and in addition

set up a new group in Applied Mathematics.

Tenure and development track

The HR policy has significantly changed, with the department now being able to offer tenure track contracts with clear and realistic targets. During the first three years of employment, tenure trackers have a 50% teaching reduction, which helps them building up a research line. The tenure track officially takes six years, though many get tenure during the first three years of employment.

Individual career tracks are formulated with clear criteria for promotion to the next academic level. These tracks are reviewed by a small Faculty committee before being approved by the Dean. Promotions are based on an evaluation by an advisory committee that includes external experts.

The committee learned that being a small department makes it not easy to stay attractive for talented researchers. Already, the mid-term evaluation is often used to grant tenure. In accordance with new labour agreement regulations for Dutch universities, the tenure track appointments will be turned into permanent positions as assistant professor (after a short testing period) and the Faculty will further implement career track procedures for promotion. The committee appreciates the developments taking place, though wonders if one year is sufficient to get an insight into the functioning of the candidates.

Promotion from assistant professor to associate professor is based on conditions, which are clear, and tailor made for the researcher. In order to keep track of further possible promotions, plans are to define a track to becoming associate and full professor. More experienced researchers were appointed on a permanent contract, usually with requirements to be fulfilled within three years (e.g., obtaining a BKO).

According to the committee, the criteria for tenure are wonderfully transparent and very reasonable. Moreover, all recently appointed staff members get a PhD student to establish their area

of research within the department. The committee suggests that the department also considers compensation for work that is not research or teaching. By taking all activities into consideration, transparency to staff members is provided. Still, there is some responsibility of an individual researcher to say 'no' when committees and administrative tasks become too much. This will in particular help assistant professors and female research staff in managing their workload and performing outstanding research.

Diversity

An important aspect of increasing (gender) balance is the awareness for diversity issues. Policies were implemented on the composition and diversity training of the Hiring Committee as well as actively encouraging talented female researchers to apply. The department made use of the Faculty's Mohrmann programme to attract female candidates. All measures led to an improvement in the gender balance up to 25%. The future aim includes further improving gender balance and diversity, in particular in senior positions and among PhD students and postdocs. The department also improved with respect to international diversity.

In the self-evaluation report the department emphasizes the importance of an open and inclusive research environment, career opportunities and clear governance structures as having strong impact on the department.

The committee welcomes the openness of the department to address the lack of (senior) female staff members. Measures have already been taken, e.g., a member of the department represents it in the diversity committee of the faculty of science. Also, by using the Faculty of Science's Mohrmann programme for female researchers, a female professor was hired (first in tenure track and meanwhile tenured). Also, the Applied Mathematics group has already hired three female TT professors. Yet, gender balance still needs to be improved on all levels. The department appears well aware of this, as it is explicitly mentioned as a strategy. Promising was the announcement during the interview that a

female professor in Statistics had very recently been hired.

PhD policy and training

PhD provision, supervision and training was reviewed, culminating in the establishment of a formal Graduate School in Mathematics in September 2021. In addition to a promotor and daily supervisor for each PhD candidate, there are confidential counsellors at IMAPP level and a mathematics PhD coordinator. The department also introduced a buddy-system, in which a more senior PhD candidate helps with the orientation. According to the committee, this initiative is good, but onboarding can be improved by a functional buddy system. The committee is impressed by the reformed provision, supervision and training that is organised in the new Graduate School.

PhD candidates draft a Training and Development Plan (TSP) at the start of their project, which is being reviewed annually. A wide range of training is offered, including technical mathematics courses, (compulsory) didactics training and skills training. There appear to be no other mandatory courses, but a wide variety of courses is offered (didactic / presentation / supervision skills). It was nice to see social events organized university-wide through the PhD council as well as within IMAPP (colloquia, seminars, BBQs).

PhD supervisors can follow trainings on PhD supervision organised by the Mathematics Department. All PhD candidates are offered the opportunity to interact with industry through an annual Modelling Camp, bringing industry into the department. PhD candidates are encouraged by their supervisors to visit conferences and summer schools, though a fixed amount of funding is not given.

The PhD coordinator is aware of the longer-than-expected PhD duration. Further developments of the recently introduced Graduate School seem like the right first step in remedying the situation: plans for more centralized administration are in place. Furthermore, compulsory courses will be introduced for PhD candidate for transferable skills (academic integrity, etc.).

PhD candidates are represented in the management committee of the Graduate School, on the Advisory Board for Mathematics and in the IMAPP board. Biweekly lunch meetings offer roundtable discussions between all members of the department, including PhD's; this further promotes the open-door policy exhibited by management and staff. It was nice to see a solid representation of PhD candidates and postdocs within the advisory board.

Research quality

The quality of the research in this relatively small department is overall very good. The size requires that choices be made, but this is something the department is well aware of. During the evaluation period the mathematics department has made a truly impressive progress, both qualitatively and quantitatively. The *sectorplan* and other investments were optimally used to further the research quality. In particular an entirely new group of Applied Mathematics was created, with a full professor now leading a diversified group of promising younger staff members. Also, traditionally strong research areas in pure mathematics and mathematical physics were reinforced. The very good research quality is also confirmed by the amount of grants which were obtained. The activities and policy during the assessment period fully reflects the department's mission.

Funding

From the information in the self-evaluation report, the committee noticed a decrease in number of research grants. However, according to the department this is within normal fluctuations. Recent developments of the department on funding include contracts with industry, e.g., Alliander will fund several PhD candidates. This – and possibly other contracts – will provide a good balance in funding from the three streams.

Open Science

There is strong support in the department for Open Access, the majority of the work is made available on ArXiv, and appropriate research code is available online. It is good that publishing on

ArXiv is the standard, though the ambition should be towards gold open access. Open science is clearly embedded in the culture, and the committee appreciates that the department has a training on data management. The committee would recommend including software management in this training as well.

The committee welcomes the establishment of a PR-committee and would encourage the department to really make it work. Please do not only focus on attracting students but consider outreach as a broader activity. The committee also appreciates that outreach activities are considered in employee evaluations.

Relevance to society

Mathematics is considered fundamental for all the sciences and lies at the core of many technical innovations important to society. According to the department, the contribution to society by the department starts with training bachelor, master and doctoral graduates. Teaching is research informed and provides a bridge to industry and wider society. Furthermore, societal impact is achieved by connections to wider areas of societal interest, e.g., by the initiation of a statistical helpdesk.

The committee is charmed by the statistical helpdesk as a wonderful mechanism to connect to other disciplines. The committee furthermore applauds the signing of a contract with Alliander and would encourage the department to establish similar structural long-term collaboration on departmental level, perhaps building on existing contacts with TenneT. The modelling camp and modelling assignments as part of the education are excellent initiatives to connect (PhD-)students to relevant applications of their knowledge.

Viability

The strategy for the upcoming period includes issues identified in the SWOT analysis. The department aims to further improve gender balance and diversity in a broader sense. Furthermore, recent improvements in governance, HR-policy and PhD policy will

stimulate academic culture in order to maintain the high quality of research, making resources available and supporting staff.

The department will develop local cross-disciplinary activities to include joint projects with the other IMAPP departments, the Donders Institute, the Institute for Computing and Information Sciences and other institutes. Also, at national and international level, the department intends to build and strengthen its networks and subsequently its funding opportunities and societal relevance.

The future plans aim at confirming and continuing the very positive developments during the evaluation period. The viability of each of the plans by itself is very good, but it will be a major challenge to work them all out successfully. In particular, further improvements of gender balance, research funding and the intention to increase the number of PhD candidates and postdocs will require continuous attention and perseverance.

The department is ambitious, this is reflected in the aim to double the overall number of PhD candidates and postdocs in the upcoming period. The committee agrees that the size of the department is relatively small, even after the increase as a result of the *sectorplan*. Further enlargement, if possible, will be helpful. Not only will it further decrease the relatively high teaching loads, but it will also improve the balance between the three departments in the institute.

Conclusion and recommendations

From the information in the self-evaluation report and the interviews, the committee concludes that the mathematics department is doing very well,

e.g., the small department used the *sectorplan* positions well. The management of the department, IMAPP and Faculty are well aware of the challenges it faces and the opportunities that present themselves. Measures are taken accordingly, and the committee is positive about the many initiatives. In this positive perspective, the committee has several minor suggestions:

- With all the initiatives and ambitions, the committee considers it to be important that the department clearly prioritizes. It can then make sure that plans are executed properly and the results are of good quality.
- The committee is impressed by the steps that are currently being taken regarding gender diversity. The open attitude and awareness of the issues led to actions that subsequently led to some success. The committee encourages the department to continue on this path.
- More structural contacts with industry are recommended, with a good example being the alliance with Alliander. There are clear connections (Janssen Pharmaceutical and TenneT), the next step is to make these connections less ad-hoc and more structural and formalized.
- The initiation of the Graduate School is a positive development. It was primarily about establishing a new practice. Now, the next step can be taken, in which the reduction of the duration of doctoral programmes is an important point of attention. Specific focus is requested for the functioning of the buddy system.
- Workload remains high, even though the growth of the department has led to some reduction. Continuous effort should be made to alleviate the workload.

VIII. Utrecht University

Strategy and targets

The research at the Mathematical Institute (MI) at Utrecht University (UU) is characterized by foundational contributions to the understanding of mathematics and by interdisciplinary collaborations to advance science and address pressing problems facing society. The mission is *to contribute to the success of mathematics by developing mathematics and its applications at the highest level and disseminating it as broadly as possible*. Four strategic aims are in place;

- 1) to achieve a research output comparable to the best institutes in Europe;
- 2) to take a leading role in research areas in which they are active;
- 3) to reinforce the balance between fundamental and applied work and consolidate the MI into a coherent unit;
- 4) to significantly improve the MI gender balance.

These aims lead to a strategy that includes eight components, namely 1) striving for mass and focus within the active research areas, 2) establish the Utrecht Geometry Centre as a strategic theme, 3) establish Modelling & Complex Systems as a strategic theme, 4) reinforce History of Mathematics as a unique research theme, 5) train young researchers, 6) maintain a flat structure and create interaction, 7) foster a culture that values comprehensive publications, international collaboration and leadership, and 8) formulate a fierce action plan to address gender-disbalance.

Organisation

The MI is housed within the Faculty of Science of UU. The management team (MT) consists of the Institute Director, the Directors of Research and of Education, the Secretary to the Board, and a student representative. The MT is complemented by the Department Advisory Council, elected among staff and students.

Research at MI covers a broad range of fields. Formally, MI comprises two research groups: Fundamental Mathematics and Mathematical

Modelling. Two focus areas of the *sectorplan* roughly correspond to these groups, namely Utrecht Geometry Centre (UGC), and Modelling & Complex Systems (M&CS). A third, smaller research group is History of Mathematics.

At the start of the evaluation period, the Mathematical Modelling group was being set-up. Over the past years, this group already evolved into a solid unit; the present focus lies on creating more interaction between the groups. This is visible in the recent hirings, which are on the interface between the two groups. To create a stimulating environment for interactions, joint seminars are (or will be) organised. The committee is pleased with the explicit ambition of the MI to bridge the gap between fundamental and applied research in mathematics.

According to the committee, the organizational structure is strong. The Management and Full Professors are organized in a formal way. By monthly lunch meetings (Bring Your Own Lunch) also the other staff is informed, and participates in ongoing discussions. Staff at all levels (including PhD candidates) feel that they can provide input and contribute towards strategic decisions. The inclusion of all career stages in the decision making and the communication is rather informal, though seems to work well. Nevertheless, the committee recommends that the MI formalizes this process somewhat, making sure that no one is excluded.

The *sectorplan* positions led to a significant increase in staff, with seven positions at the tenure track level. These hirings do very well, which is reflected in their success in grant acquisition.

Academic culture and HRM

At the MI there is a very positive and inclusive atmosphere, where colleagues are easily approachable. This observation by the committee was confirmed in all interviews, and also the Dean mentioned the collegial atmosphere in the institute. The Education Director of MI plays an important role as counsellor for PhD candidates and junior staff.

Hiring committees involve both junior and senior staff members and at least 50% of committee members are female. Candidates are scored on criteria pertaining to research, education and leadership. The committee notices that UU truly values teaching, also in the career path. This can also be seen in the associate professor position of the Education Director, who plays an important role in the department. However, the teaching load is high. In the interviews it was mentioned that this high teaching load is a source of stress.

The Faculty introduced performance-based career-path contracts, which focus on results, rather than on time spent or presence. This leads to more freedom for research staff to organise their workload. The committee appreciates the fact that the performance criteria do not only include teaching and research activities. Also outreach activities, administrative tasks and service to the mathematical community are part of the criteria.

Tenure and development track

For most of the evaluation period, the tenure track system was in place. In collaboration with the supervisor, candidates set up a five year personal development plan to prepare for their future promotion. The criteria are predominantly qualitative, and the tenure track candidates consider them to be clear and reasonable. A mid-term evaluation provides insight into progress; part of the decision on tenure is the input by international referees on a portfolio. Recently, the MI decided to move away from the classical tenure track to make positions on assistant-professor level more attractive. In 2021 all candidates were given permanent contracts for the purpose of reducing employment insecurity. Currently, most staff are hired as tenured assistant professors with a one-year probation period. Exceptions are made for candidates who only recently obtained their PhD.

There are transparent criteria for obtaining tenure. It is positive that MI has a committee deciding on the promotions up to assistant professor level 1. Further promotions require a decision at Faculty level. The criteria for the

promotion to associate professor are less clear, and are currently being revised. The committee encourages the MI to include mid-career staff in the discussions on criteria.

New assistant professors are well supported. For example, there is support for staff members that advise their first PhD candidate. Temporarily switching to a part-time position, e.g. because of family reasons, does not pose problems, and the mid-career staff does not seem worried that this could harm their career or development opportunities.

Senior positions

The MI looks forward to a period in which many senior full professors will retire, some of which are very active and do outstanding research. The institute is aware of this and of the importance of hiring young talent as an investment towards the future. In the interview, the management mentioned the importance of a good hiring strategy. Focus lies on further integrating fundamental and applied mathematics research, and on connecting to other disciplines. For example, joint positions with Physics and Computer Science are planned. Also, the MI is looking at cooperation opportunities with the Utrecht School of Economics. Cross-over roles at the interface between the UGC and M&CS themes as well as strengthening the connection to other disciplines are part of the strategy as well.

The committee is of the opinion that the MI has a well-thought-out strategy to replace the large number of soon-to-retire professors. Yet, it emphasizes the importance of the supervising and mentoring role of the senior professors to help younger talents develop. As such, according to the committee it is important to aim at a combination of promotion opportunities for young talent and hiring more established researchers.

Diversity

The UU has an impressive diversity strategy and has managed to improve gender diversity from 4% to 19% and international diversity from 35% to 53%. Among the newly hired faculty approximately half is female. Most of them are

hired as (tenured or tenure track) assistant professors. On the levels of full and associate professor the numbers of women are lagging behind. Also, the gender balance of PhD candidates is off. The reason given by MI is that no gender policy can be imposed on grant winners. The committee considers it important that nevertheless action is taken.

During the interview with management, the committee learned about the very recent hiring of a female full professor in game theory. In the past the only female staff member served on many committees. Hiring additional female staff has improved this situation. The UU might consider compensating staff (in practice often women) with many administrative duties in some way.

PhD policy and training

The PhD completion rate is impressive, due in part to close monitoring of PhD candidate progress, the structure of the Graduate School, and as a result of the 'culture'. This is similar to the comment the committee heard from other universities with a good completion rate. The 'material for at least two papers publishable in good journals' requirement written in the self-evaluation report is followed more as a general guideline, and not a necessary condition.

There is great social cohesion amongst PhD candidates and postdocs. Funding of 2k EUR per year can be used for conferences, summer schools, research visits etc. PhD candidates mentioned encouragement to attend these from supervisors, as well as ability to tap into supervisors' academic network, this is nice to see.

The official teaching load is 15%, though this can easily be more when grading exams. Didactic courses are offered by the graduate school, though these are not mandatory. In general, 20 EC should be obtained through courses, which must include academic integrity. PhD issues can be brought up to a 'vertrouwenpersoon'. Locally, students find the department mentor to be very approachable. She is seen as the person to go to in case of problems and was mentioned

frequently.

In general, the committee is positive about the PhD training and policy. It does suggest stimulating a more proactive attitude in the PhD community. While there is a PhD council in the Graduate School of Natural Sciences, there is currently no representative from the Mathematics Institute. The committee believes that representation in such formal bodies can lead to better information in/outlets for PhD's, as well as better social cohesion within the department and faculty.

Research quality

The quantity and quality of the MI research output over the period of evaluation is excellent. An impressive number of prestigious, personal grants were obtained by the MI faculty members, and a lot of national and international awards and prizes were secured during the evaluation period. Many of the members take up leadership roles in national and international councils and committees. Their scientific leadership is also evidenced by the large number of plenary and keynote lectures, editorships of journals and book series, and invitations to participate in programs in renowned research centres.

International reputation relies currently for a large part on staff that has retired or will retire in the next evaluation period. While the strong involvement of retired faculty is positive, hiring several established mid-career researchers may be required to ensure keeping up the high quality of research. According to the committee, many recently hired assistant professors have great potential. The MI also needs to ensure that the junior and mid-career staff gets the opportunity to grow and – in time – fill the gap left by the retired and retiring staff.

The committee is happy to see that the small history of mathematics group is still part of the strategic plan.

Funding

It is a challenge for senior research staff to apply for funding for PhD positions. Although university

policy currently allows direct funding for PhD positions, the MI does choose not to fund PhD students at the cost of reduction in staff. This is troublesome for some of the researchers, particular more senior researchers, since the educational programmes in Utrecht provide many very good master students interested in starting a PhD

The explicit choice of the MI to primarily aim to forward the mathematical science rather than using an application-driven approach, puts the institute at a disadvantage in the current funding landscape. Even though the focus lies on fundamental research, the institute is still well-connected to applications. The committee agrees that it is unfortunate that being relevant to other disciplines is not regarded as societal relevance. Despite the shift towards more applied research topics, the committee agrees with the institute on the importance of the fundamental research that is being done. Even though that research might not directly lead to applications in the short term, it remains a crucial and extremely valuable asset in the collaboration with other departments in the Faculty of Science and UU. The committee suggests that the institute finds a way to approach the potential applications of fundamental research and even present the ability to – from a more fundamental perspective - quickly shift to different applications as a strength.

Open Science

The MI connects open science to the recognition and rewards programme. The institute is very much aware of the importance of open science and is investing in this topic. A nice start is made by the Open Science Task Force, but work remains to be done to make it more concrete, e.g., through the organisation of workshops.

The committee finds it recommendable that students learn to publish their software on Github and that researchers are encouraged to publish their data and research software. Yet, the formalization of this appears to be still a work in progress. The already existing Open Science Task Force could play a role here as well.

Relevance to society

The strategy of the MI to have a lot of connections with other disciplines is very visible; in these collaborations, the MI contributes with fundamental work. According to the committee this is certainly societally relevant, even when it does not immediately lead to a clear application. In addition, some nice examples of more applied research were given in which collaborations with industry and/or society were setup (banks, and UMCU). The committee advises the MI to be aware that the focus on fundamental work puts the institute at a disadvantage in the current funding landscape. Having industrial partners in the curriculum is a nice way of connecting students and industry both ways.

The committee appreciates the yearly alumni dinner in which plans are discussed and feedback is asked for. The LinkedIn group with alumni is another good-practice example. In the interviews, the MI also mentioned that contacts with industry are in place but mostly on an individual basis. The institute notices that the open culture of the MI is increasingly attracting industry with research questions. The committee is pleased to learn about this development; it recommends the institute to consider formalizing and structuring these connections. This may guarantee the continuation of the cooperation, even when the initial contact person would leave the institute.

Viability

The strategy for the upcoming period includes SWOT elements. The strategic aims largely remain unchanged.

The MI is doing well, it is a relatively small department with a predominantly fundamental and pure mathematics focus. Over the past years this has changed, e.g., by the *sectorplan* positions in applied mathematics. Still, even the applied researchers do fundamental research. Recent and future hires aim at covering the interface of pure and applied mathematics, thus increasing the interconnection between the groups. According to the committee this is a valuable step to take, and may also lead to increasing funding opportunities.

In general, the viability of the plans for the future is very convincing. The high research quality of the department and its dynamic and friendly environment makes it very attractive for outstanding researchers at all levels. Also, the strong educational reputation helps to have a continuous influx of good PhD candidates.

Concerning research quality, the MI puts its standards extremely high. On the one hand this is admirable and reflects its excellent and longstanding research reputation. On the other hand, the Dutch mathematical landscape has drastically changed. In particular the recent *sectorplan* investments and the growing societal relevance of mathematics have been used by some mathematics departments to stimulate the growth of new emerging fields. In view of the (healthy) competition between different mathematics departments and research fields in the Netherlands, this evolution makes the intention to keep the MI among the best mathematical institutes a major challenge.

The MI has an excellent strategy for keeping up the current positive trend in the next period. The applied mathematics group has been strengthened, and the connections between the different groups are extended. Still, more measures should be taken to ensure this goal. For example, organizing seminars and workshops with participants from different groups, both within and outside the MI, on well-chosen topics to stimulate collaborations and prepare for common funding applications. The strategy of focusing broadly on geometry, by covering a variety of different aspects in this field is good, though areas outside of this broad category also need attention, in particular mathematical analysis and partial differential equations.

It appears that after the strengthening of the modelling section there is a healthy balance between fundamental and applied mathematics. However, at present, the interaction between the

two sections appears still rather modest, and further steps should be taken to improve this.

Conclusion and recommendations

Overall, the MI is doing very well. Research output is outstanding, the atmosphere in the institute is open and pleasant and the institute is actively working on improvements. There is a clear view on what should be strengthened or changed, and the main recommendation by the committee is to continue on this path. To support developments and improvements, the committee has the following suggestions:

- The organizational structure allows for staff at all levels (including PhD candidates) to informally provide input on strategic decisions. The committee suggests to somewhat formalize this process to make sure nobody is excluded.
- Developments with respect to the tenure and development track of young, talented research staff are promising. The committee encourages the MI to provide clear criteria for the promotion to associate professor and do this in short term.
- The committee found that the MI has a good strategy to deal with the upcoming retirements of a number of full professors. In this respect, it is important to aim at a combination of hiring young talent and more established researchers, to maintain a good balance.
- Developments in gender diversity are encouraging, though efforts should continue. In particular at the senior levels and the PhD candidate level, the gender balance is off.
- It is important that the Mathematical Institute makes sure there is a representative in the PhD council at faculty level. This will lead to better information outlets for PhD candidates and better social cohesion within the faculty.

IX. Wageningen University

Introduction

For the first time, Biometris participated in this clustered research review in Mathematics. The organisation of the university and the position of mathematical and statistical research is very different from other Dutch universities. Therefore, the review of Biometris did not only focus on the quality and societal relevance of the research, the committee also extensively discussed the embedding and positioning of Biometris in the university and how it maintains and furthers its identity.

Strategy and targets

The Wageningen University and Research (WUR) mission is to *explore the potential of nature to improve the quality of life*. Biometris' mission is to *bring quantitative methods to life*. Data are becoming increasingly available. Together with advances in computing capacity and new methods for learning from data, there are opportunities for addressing societal issues. Biometris models and analyses data to gain knowledge and support operational decision making, working at the whole chain from design of experiments and strategies for data collection to process-based and data-driven integrative modelling. The strategy is to focus on interdisciplinary science and stay aligned with the Wageningen domains.

Research staff covers a broad range of expertise, from strongly theoretical to application fields. Biometris does mathematical and statistical research on topics of importance to WUR departments and groups. The chair groups furthermore play an essential role in education at WUR, by teaching mathematics and statistics courses at bachelor's, master's and PhD level.

According to the committee, the core mission of Biometris is bringing quantitative methods to life by providing mathematical and statistical methods to solve agro-environmental problems. Such methods are indispensable to develop, evaluate and integrate more efficient methods of

agricultural and environmental sustainability, with the aim of ensuring the feeding of humanity in a politically and ecologically dramatically changing world. Although a small group, Biometris is renowned worldwide and part of an excellent international university network. Moreover, it has joint forces with Leiden University to establish a master programme whose graduates are hired worldwide by universities and companies. A master programme at Wageningen University dedicated to quantitative methods and run by Biometris, also incorporating other data science methods, might serve basically all research groups of Wageningen University and help to pave the way of the university to solving complex present and future problems.

Organisation

Biometris is a group of mathematicians and statisticians at WUR. It consists of three groups: the WU chair group of Applied Mathematics, the WU chair group of Applied Statistics and the WR business unit for Mathematics and Statistics. The latter is not formally part of this review but is part of the operational unit. Groups at WUR belong to one of five 'science groups' (plant, animal, environment, food & nutrition, and social sciences). Formally, Biometris belongs to the Plant Sciences Group, but is involved in research and teaching of the other groups as well. Chair groups have teaching and research tasks, the business units have research and consultation tasks.

Research revolves around the definition of PhD and postdoc projects; the topics follow the strategic choice to develop quantitative methodology that is supportive and complementary to the general WUR themes. Key research themes are Statistical Genetics and genotype-to-phenotype modelling, Theoretical Biology and Systems Biology, Dynamic Systems, signals and control, Agent-Based Modelling, and Quality assurance for policy support models.

The Management Team (MT) involves the two chair holders and the manager of the business unit, as well as the coordinator of education. The MT makes joint decisions on relevant matters.

The committee extensively discussed the embedding of Biometris in WUR. The organisational structure of the university, in which each chair group is part of a single science group, is understandable from the university's perspective but risks to reduce the role of Biometris. The committee emphasizes the importance of these chair groups of ~~and~~ Biometris for research and education across the university. Mathematics and statistics are indispensable for high quality research in life sciences. Also, not only bachelor's courses in statistics, but also advanced master's courses in mathematics and statistics require a strong background in mathematics. The committee thinks that the expertise in Biometris is not sufficiently made use of by the university.

In the interviews the committee learned that Biometris wants to increase its participation in the Dutch mathematical landscape. This seems a good direction and the committee suggests focussing on the network aspects and clusters that are currently in place.

Academic culture and HRM

Academic culture is described in the self-evaluation report by an open atmosphere for new ideas, critical reflection, and large willingness to share data and results. The management ensures openness, safety, and inclusivity of the research environment.

According to the committee, there is a very positive working atmosphere in Biometris. Communication between different levels (full professors, TT, postdocs and PhD candidates) works very well. Staff at all levels in the Biometris group seem to get along with each other very well, and openly discuss all kinds of topics related to teaching, research, academic life in general. According to the TT staff the committee interviewed, the good social cohesion leads to collaboration.

Biometris has personnel dedicated to teaching, personnel obtaining or executing contract research and personnel working at more fundamental research at the academic level. The

strategy regarding personnel is aimed at creating an all-inclusive melting pot of the different groups, with joint housing, regular joint seminars, and social events. In addition, there are regular meetings on dedicated topics.

The senior university staff has a diverse scientific background; on the one hand people with a strong mathematical and statistical background with interest in the application to the life and environmental sciences, on the other hand people with domain knowledge and interest in improving the domain by introducing mathematical and statistical methods.

Tenure and development track

Tenure trackers generally set up their own subgroups. PhD candidates perform much of the research. The tenure trackers have set up their own niches and subgroups, keep a personal TT portfolio and are evaluated every 3-4 years by a review committee (the BAC) who provides a recommendation to the Director of the Plant Sciences Group. According to the self-evaluation report, guidelines on the evaluation tasks of the BAC are clear and aim at an unbiased and inclusive decision making. From the interview with tenure trackers, the committee concludes that all seem very happy with the situation and their position in Biometris. It seemed that most of the tenure trackers originally did not plan to go for an academic career at the university after their postdocs, but rather aim at a position in industry.

Diversity

Gender balance and rejuvenation of the group have become focal points at Biometris. The creating of TT positions in both chair groups helped to rejuvenate the group, to retain promising postdocs and attract new talent. According to the committee, the small size of tenured staff makes it difficult to evaluate the diversity.

PhD policy and training

In addition to doing research, PhD candidates use up to 15% of the time for activities around their training and education, e.g., attending and

presenting at conferences, seminars and participating in courses and Summer schools. Furthermore, up to 10% of the time is spent on teaching courses and the supervision of bachelor and master thesis students. However, as a result of the increasing number of students at Wageningen University, teaching load has increased considerably. Close monitoring of the teaching activities should be undertaken to make sure this 10% load is realistic. The six graduate schools at Wageningen University are responsible for the coordination and facilitation of the training and education of PhD candidates.

The PhD completion rate and the number discontinuations at WUR could be improved in the coming years. Most PhD candidates complete their PhD around the five-year mark. The reason for their current state was explained by the fact that PhD's must undergo an extensive educational undertaking – those with biology training must learn the mathematics; those with mathematics training must learn the biology. PhD candidates that take longer than four years to complete can opt for a teaching extension once their PhD contract comes to an end. This is a nice financial support from the university. Biometris is suggested to try and be even more active in nation-wide research and teaching clusters in order to improve on networking aspects among PhD candidates within the Netherlands, but also internationally.

PhD candidates and postdocs are happy with the frequency of supervision, training offered by the graduate schools, as well as the support for attending conferences and summer schools. One candidate mentioned that it is sometimes difficult for international candidates to find their bearings when arriving in the Netherlands for the first time. Perhaps this can be improved through a smoother onboarding process or a buddy system that links existing students / postdocs to newcomers.

Research quality

Academic impact is strengthened through publications in the most relevant topical venues, including top journals and conferences, both in applied and fundamental sciences, with a focus on

dissemination through open channels. According to the self-evaluation report, the chair groups are strong in collaborations with biological groups and environmental sciences groups, both inside and outside WUR. This generates a continuous flow of project ideas, grant proposals and applications.

It is difficult for the committee to assess the quality research based on the journals, since most publications are not in mathematical journals. The research is driven by applications, which is a major strength. Part of the exceptional quality of Biometris in applied mathematics is their strategy to collaborate with stakeholders outside university and involve PhD candidates and postdocs. This is organized very professionally by a business unit for contract research and consultation. This unit is not only a relevant source of income, but also a source of relevant research problems connecting university research with essential practical problems.

According to the committee, Biometris plays a singular role in the Dutch mathematical landscape in the sense that it embodies very well the societal relevance of mathematics, in this case applied to life science (according to its mission). The quality of the department can directly be measured by its convincing effectiveness in applying quantitative methods to concrete problems from life science. The result is undoubtedly impressive, despite of a minimal number of chairs. Also, stakeholders are extremely satisfied by their collaborations with Biometris.

Despite Biometris' clearly impressive research output, especially regarding data-driven quantitative methods for real-life problems, the committee believes that the university should amplify and better integrate the research activities and teaching expertise of Biometris in further interdisciplinary areas which could highly benefit from the expertise of Biometris in mathematical models and algorithms in statistics and data science.

Open Science

Open-source publications increased from 35% to

82% in the review period. In terms of open science, the committee's first impression is that WUR is ahead of many other departments through their incorporation of data and software management plans in proposals, along the lines of open data. Also, they are at present in all practical aspects fully open access when it comes to publications.

Relevance to society

In terms of societal relevance Biometris is outstanding; the interviews with societal stakeholders clearly demonstrated the unique value that Biometris brings. The research performed by Biometris is extremely relevant and the chair groups are in a unique position to combine mathematics with applications.

Through its integrated business unit, it is closely connected to applications, having a unique position at the crossroads of mathematics and agriculture.

Biometris is in a special position to contribute to both practical and fundamental mathematical challenges. The committee has the impression that Biometris is a bit underappreciated in WUR politics and would call upon the university to strengthen it as it plays an important role in their field.

Viability

For the upcoming period, Biometris aims at further development and improvement. Biometris envisions an ambitious strategy, involving the expansion of the chair groups, strengthening of the chair groups' position in the more fundamental mathematical sciences, expanded mathematical and statistical educational pathways withing WUR and a more prominent role within and outside WUR.

Future plans are well described in the self-evaluation report and the overall viability is very good. The committee believes though that there are some basic structural issues which are particularly challenging to overcome.

Biometris does an excellent job inside and outside

WUR but seems to suffer from the organisational structure of the university. Biometris belongs to 'Plant Sciences', but in view of its mission to bring quantitative methods to life sciences, it fully deserves greater visibility in all the university (joint research projects, teaching etc). The committee is not able to design solutions for this problem but strongly advises Biometris and the university to start a fruitful discussion on what is possible to make the impact of Biometris' work more effective inside the university. The committee has the strong feeling that currently too many opportunities are missed, and this is a pity in a period where the importance of quantitative methods keeps growing.

A second, but closely related, aspect is that two chair groups (Applied Mathematics and Applied Statistics) and only a few additional professors, is far too few for Biometris. In a modern university, new developments in emerging fields such as data science cannot possibly be covered by only two chair groups, also in view of the great number of interdisciplinary collaborations. The committee advises the university to seriously consider calls for at least two additional professors, calls which are interesting enough to attract excellent scientists (for example the possibility for the chair to hire younger staff in the chair group). These actions would also reinforce the position of Biometris in the Dutch mathematical landscape (with the possibility to enter a future *sectorplan*).

According to the committee, the viability of all future plans of Biometris described in the self-evaluation report would be strengthened by this sort of actions, which are fully justified by the excellent job done by Biometris during the evaluation period.

Conclusion and recommendations

Based on the self-evaluation report and the interviews, the committee concludes that Biometris has a unique position, and additional and useful role in the national landscape of mathematics. The mission to stimulate quantitative methods in life sciences is excellent. The societal relevance aspect is very strong, including the many contacts with industry and

strong impact on stakeholders. However, according to the committee Biometris could even have a greater impact inside WUR and in the Dutch mathematics community. In its recommendations, the committee will focus on these aspects and how to find solutions. The committee has the following recommendations:

- Biometris is doing an outstanding job, but the committee has the impression that the impact of Biometris in the university could be even stronger. Its most valuable expertise and experience on research, teaching and collaborations could be used much better. Two chair groups are far too few to cover the many prestigious research projects with internal and external partners, but they are also too few to amplify the interdisciplinary

teaching activities inside the university. Quantitative methods in life sciences will become ever more important. Therefore, the committee invites the university to increase its investments in Biometris and to discuss with the chairs of Biometris how to optimize these investments.

- The committee suggests that Biometris increases its activities in the national clusters and connects to the other Dutch mathematics departments.
- Having a master programme at WUR dedicated to quantitative methods, might serve all research groups at the university. It would be a major step in training the next generation of researchers who work on solving complex present and future problems.

Appendices

Appendix 1: The SEP 2021-2027

Criteria and Categories

The committee was requested to assess the quality of research conducted by the UHS as well as to offer recommendations to improve the quality of research and the strategy of the UHS. The committee was requested to carry out the assessment according to the guidelines specified in the Strategy Evaluation Protocol. The evaluation included a backward-looking and a forward-looking component. Specifically, the committee was asked to judge the performance of the unit on the main assessment criteria and offer its written conclusions as well as recommendations based on considerations and arguments. The main assessment criteria are:

- 1) **Research Quality:** the quality of the unit's research over the past six-year period is assessed in its international, national or – where appropriate – regional context. The assessment committee does so by assessing a research unit in light of its own aims and strategy. Central in this assessment are the contributions to the body of scientific knowledge. The assessment committee reflects on the quality and scientific relevance of the research. Moreover, the academic reputation and leadership within the field is assessed. The committee's assessment is grounded in a narrative argument and supported by evidence of the scientific achievements of the unit in the context of the national or international research field, as appropriate to the specific claims made in the narrative.
- 2) **Societal Relevance:** the societal relevance of the unit's research in terms of impact, public engagement and uptake of the unit's research is assessed in economic, social, cultural, educational or any other terms that may be relevant. Societal impact may often take longer to become apparent. Societal impact that became evident in the past six years may therefore well be due to research done by the unit long before. The assessment committee reflects on societal relevance by assessing a research unit's accomplishments in light of its

own aims and strategy. The assessment committee also reflects, where applicable, on the teaching-research nexus. The assessment is grounded in a narrative argument that describes the key research findings and their implications, while it also includes evidence for the societal relevance in terms of impact and engagement of the research unit.

- 3) **Viability of the Unit:** the extent to which the research unit's goals for the coming six-year period remain scientifically and societally relevant is assessed. It is also assessed whether its aims and strategy as well as the foresight of its leadership and its overall management are optimal to attain these goals. Finally, it is assessed whether the plans and resources are adequate to implement this strategy. The assessment committee also reflects on the viability of the research unit in relation to the expected developments in the field and societal developments as well as on the wider institutional context of the research unit.

During the evaluation of these criteria, the assessment committee was asked to incorporate four specific aspects. These aspects were included, as they are becoming increasingly important in the current scientific context and help to shape the past as well as future quality of the research unit. These four aspects relate to how the unit organises and actually performs its research, how it is composed in terms of leadership and personnel, and how the unit is being run on a daily basis. These aspects are as follows:

- 4) **Open Science:** availability of research output, reuse of data, involvement of societal stakeholders.
- 5) **PhD Policy and Training:** supervision and instruction of PhD candidates.
- 6) **Academic Culture:** openness, (social) safety and inclusivity; and research integrity.
- 7) **Human Resources Policy:** diversity and talent management.

Appendix 2: Programme of the site visit

22 February 2022

09:00	11:00	Online kick-off meeting committee and secretary
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27 March 2022

17:00	19:00	Onsite preparatory meeting - first preliminary findings
19:00		Dinner committee and secretary

Monday 28 March - VU Amsterdam

08:00	08:15	Travel to the meeting venue
08:15	09:00	Preparation interviews with VU
09:00	09:30	Management
09:30	09:45	<i>break</i>
09:45	10:30	Senior research staff
10:30	11:00	Mid-career research staff
11:00	11:15	<i>break</i>
11:15	12:00	PhD candidates
12:00	12:45	Evaluation VU
12:45	13:30	Lunch committee

Monday 28 March - Eindhoven University of Technology

13:30	14:15	Preparation interviews with TU/e
14:15	14:45	Management
14:45	15:00	<i>break</i>
15:00	15:45	Senior research staff
15:45	16:15	Junior and mid-career research staff
16:15	16:30	<i>break</i>
16:30	17:15	PhD candidates
17:15	18:00	Evaluation TU/e
18:30		Dinner committee

Tuesday 29 March - Leiden University		
08:00	08:15	Travel to the meeting venue
08:15	09:00	Preparation interviews with LEI
09:00	09:30	Management
09:30	09:45	<i>break</i>
09:45	10:30	Senior research staff
10:30	11:00	Mid-career research staff and tenure track
11:00	11:15	<i>break</i>
11:15	12:00	PhD candidates and postdocs
12:00	12:45	Evaluation LEI
12:45	13:30	Lunch committee

Tuesday 29 March - University of Twente		
13:30	14:15	Preparation interviews with UT
14:15	14:45	Management
14:45	15:00	<i>break</i>
15:00	15:45	Senior research staff
15:45	16:15	Mid-career research staff and tenure track
16:15	16:30	<i>break</i>
16:30	17:15	PhD candidates and postdocs
17:15	18:00	Evaluation UT
19:00		Dinner committee

Wednesday 30 March - University of Amsterdam (KdVI)		
08:00	08:15	Travel to the meeting venue
08:15	09:00	Preparation interviews with UvA
09:00	09:30	Management
09:30	09:45	<i>break</i>
09:45	10:30	Senior research staff
10:30	11:00	Mid-career research staff and tenure track
11:00	11:15	<i>break</i>
11:15	12:00	PhD candidates and postdocs
12:00	12:45	Evaluation UvA
12:45	13:30	Lunch committee

Wednesday 30 March - Radboud University		
13:30	14:15	Preparation interviews with RU
14:15	14:45	Management
14:45	15:00	<i>break</i>
15:00	15:45	Senior research staff
15:45	16:15	Mid-career research staff
16:15	16:30	<i>break</i>
16:30	17:15	PhD candidates and postdocs
17:15	18:00	Evaluation RU
19:00		Dinner committee

Utrecht University		
08:00	08:15	Travel to the meeting venue
08:15	09:00	Preparation interviews with UU
09:00	09:30	Management
09:30	09:45	<i>break</i>
09:45	10:30	Senior research staff
10:30	11:00	Mid-career research staff (with focus on network and external collaboration)
11:00	11:15	<i>break</i>
11:15	12:00	PhD candidates and postdocs
12:00	12:45	Evaluation UU
12:45	13:30	Lunch committee

Wageningen University & Research		
13:30	14:15	Preparation interviews with WUR
14:15	14:45	Management team
14:45	15:00	<i>break</i>
15:00	15:45	Research staff
15:45	16:15	Stakeholders (online)
16:15	16:30	<i>break</i>
16:30	17:15	PhD candidates and postdocs
17:15	18:00	Evaluation WUR
19:00		Dinner committee

Friday 1 April		
8.30	10.00	final meeting committee
10.00	12.15	Presentation initial findings by chair and committee
12.15	13:00	wrap up of the site visit with lunch

Appendix 3: Quantitative data

Vrije Universiteit Amsterdam

Table 1: Research staff in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#
Full professor	8.2	11	10.0	12	10	12	10	12	11.2	13	11.4	13
Professor by special appointment	0.8	4	0.8	4	0.8	4	0.8	4	0.8	4	0.8	4
Associate professor	4.0	4	2.0	2	1.0	1	1.0	1	2.0	2	5.0	5
Assistant professor	10.4	11	9.4	10	9.6	10	11.1	13	15.1	16	14.4	17
Postdocs	4.0	4	2.0	2	1.0	1	1.0	1	2.0	2	-	-
PhD candidates	17.8	18	15.8	16	11.2	12	11.8	12	11.8	12	17.8	18
Total research staff	45.2	52	40.0	46	33.6	40	35.7	43	42.9	49	49.4	57

Table 2 Main categories in research output 2015-2020

categories	2015	2016	2017	2018	2019	2020
Refereed article	72	50	70	58	53	80
Of which open access (%)	28	22	31	41	70	68
Books	1	3	1	1	2	1
Refereed book chapters	4	4	4	6	8	6
PhD theses	4	5	8	6	6	6
Conference papers (refereed)	7	6	6	8	9	7
Total academic papers	88	68	89	79	78	100

Table 3: funding in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding	25.5	65.1	25.1	66.2	20.7	70.4	23.7	75.3	28.7	81.8	37.6	83.3
Research grants	18.9	27.7	14.1	27.6	12.1	23.3	11.2	16.5	13.4	14.3	11.0	11.2
Contract research	0		0		0		0		0		0	
Other	0	7.2	0	6.2	0	6.3	0	8.2	0	3.9	0	5.6
Total funding	44.4		39.2		32.8		34.9		42.1		48.6	

Eindhoven University of Technology

Table 1: Research staff in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#
Full professor	11.1	12	10.4	11	10.5	11	10.2	11	9.0	9	10.8	11
Associate professor	9.8	11	8.5	9	8.4	9	9.0	9	9.4	10	9.4	10
Assistant professor	18.7	20	18.2	22	21.1	23	22.3	23	21.9	25	24.7	27
Postdocs	7.8	10	4.5	6	6.0	8	8.6	13	7.6	13	13.6	18
PhD candidates	54.3	67	53.7	67	52.8	71	42.2	61	46.5	65	58.1	79
Total research staff	101.7	120	95.3	115	98.8	122	92.3	117	94.4	122	116.6	145

Table 2 Main categories in research output 2015-2020

categories	2015	2016	2017	2018	2019	2020
Refereed article	152	142	139	126	127	102
Of which open access (%)	75	66	71	62	96	79
Books	4	2	6	0	1	0
Refereed book chapters	5	3	4	1	5	1
PhD theses	11	12	16	16	16	11
Conference papers (refereed)	57	69	46	41	48	35
Total academic papers	229	228	211	184	197	149

Table 3: funding in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding	61.4	44	58.7	47	61.4	48	60.0	48	68.6	53	86.7	55
Research grants	43.7	32	38.0	31	32.5	26	33.9	27	337.3	29	41.7	26
Contract research	21.0	15	17.0	14	21.6	17	18.5	15	9.9	8	11.7	7
Other	12.0	9	10.7	9	11.2	9	12.1	10	13.6	11	17.6	11
Total funding	138.1		124.4		126.7		124.5		129.3		157.7	

Leiden University

Table 1: Research staff in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#
Full professor	7.4	11	7.6	11	7.1	11	7.0	10	7.4	11	7.9	12
Professor by special appointment			0.4	1							0.1	1
Associate professor	4.9	6	4.8	6	5.2	6	6.0	7	6.7	8	6.3	7
Assistant professor	17.8	21	18.7	20	18.2	19	16.9	19	17.7	23	23.7	28
Postdocs	9.5	16	12.4	19	12.1	16	10.0	13	6.0	13	9.4	12
PhD candidates	54.7	64	53.3	69	50.7	61	44.5	55	36.1	49	37.4	53
Total research staff	94.3	118	97.3	126	93.3	113	84.5	104	73.9	104	84.7	113

Table 2 Main categories in research output 2015-2020

categories	2015	2016	2017	2018	2019	2020
Refereed article	94	84	80	87	121	119
Of which open access (%)	89	85	91	91	93	95
Refereed book chapters	4	5	3	2	1	4
Monographs	3	1	2	1	0	0
PhD theses	11	15	11	14	14	13
Conference papers (refereed)	6	6	5	2	6	6
Total academic papers	118	111	101	106	142	142

Table 3: funding in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding	39.8	41	43.1	43	47.0	48	49.3	56	40.8	58	58.1	69
Research grants	50.6	53	50.2	49	41.0	42	28.6	33	22.2	31	21.0	25
Contract research			0.2	0	1.0	1	2.5	3	1.5	2	0.1	0
Other	5.7	6	7.6	7	8.2	8	7.4	8	6.0	9	4.4	5
Total funding	96.1		101.2		97.2		87.7		70.5		83.6	

University of Twente

Table 1: Research staff in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#
Full professor	7.6	8	8.4	10	8.4	10	9.5	12	10.1	12	10.5	13
Professor by special appointment	0.4	2	0.4	2	0.4	2	0.4	2	0.3	2	0.2	1
Associate professor	3.9	6	3.9	5	3.6	5	2.6	4	3.7	6	6.3	9
Assistant professor	14.1	16	11.5	15	11.4	14	12.9	15	14.3	19	15.1	20
Postdocs	2.7	6	3.3	10	6.1	12	3.0	8	4.3	6	7.5	12
PhD candidates	25.8	31	20.6	26	17.8	22	15.6	20	15.4	19	20.4	28
PD Eng candidates							1.3	3	3	3	1.7	2
Total research staff	54.5	69	48.1	68	47.8	65	45.4	64	51.1	67	61.7	85

Table 2 Main categories in research output 2015-2020

categories	2015	2016	2017	2018	2019	2020
Refereed article	83	77	78	90	67	77
Of which open access (%)	17	35	53	72	63	45
Refereed book chapters	6	2	6	2	1	4
Monographs	0	0	0	0	3	1
PhD theses	10	9	13	4	10	3
Conference papers (refereed)	36	40	26	33	31	27
Total academic papers	135	128	123	129	112	112

Table 3: funding in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding	35.4	55	33.2	56	35.4	61	37.8	66	41.2	65	46.0	60
Research grants	17.8	28	13.5	23	13.1	22	8.4	15	12.9	20	21.1	27
Contract research	7.4	12	6.5	11	6.0	10	6.4	11	5	8	3	4
Other	3.6	6	5.6	10	3.8	7	4.9	8	4.7	7	6.9	9
Total funding	64.1		58.8		58.4		57.5		63.9		77.0	

University of Amsterdam

Table 1: Research staff in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#
Full professor	9.6	13	9.6	13	9	10	9	10	8	10	9.9	11
Professor by special appointment	0.4	2	0.4	2	0.4	2	0.6	3	0.6	3	0.6	3
Associate professor	8.2	10	9.2	11	9.7	12	9.7	12	8.9	11	9.4	11
Assistant professor	9.5	10	9.3	10	9.7	11	10.7	12	11.7	13	11.7	13
Postdocs	8.5	10	5.3	6	8.3	9	6.7	7	3.8	4	6.0	6
PhD candidates	26.7	27	20	21	18.5	20	22.3	23	25	26	25	26
Total research staff	62.9	72	53.8	63	55.6	64	59.0	67	57.0	67	62.6	70

Table 2 Main categories in research output 2015-2020

categories	2015	2016	2017	2018	2019	2020
Refereed article	87	75	82	61	83	73
Of which open access (%)	51	60	63	61	54	62
Books	1	3				2
Refereed book chapters	2	2	5	5	4	3
PhD theses	7	9	6	8	12	5
Conference papers (refereed)	5	12	1	7	10	8
Total academic papers	102	101	94	81	109	91

Table 3: funding in FTE

	2015		2016		2017		2018		2019		2020	
		%		%		%		%		%		%
Direct funding		25		33		30		38		43		51
Research grants		72		64		66		58		50		38
Contract research		2		2		3		2		3		5
Other		1		1		1		2		4		6
Total funding		100		100		100		100		100		100

Radboud University

Table 1: Research staff in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#
Full professor	6	6	5	5	6	6	6	6	6	6	6	6
Professor by special appointment	0.4	2	0.4	2	0.2	1	0.2	1	0.2	1	0.2	1
Associate professor	5	5	5	5	4	4	4	4	4	4	4	4
Assistant professor	6	6	7.2	8	7.2	8	10	10	10	10	14	14
Postdocs	9	9	4	4	6	6	5	5	4	4	3	3
PhD candidates	12	12	8	8	10	10	11	11	12	12	15	15
Total research staff	37.4	39	29.6	32	32.4	34	35.2	36	35.2	36	41.2	42

Table 2 Main categories in research output 2015-2020

categories	2015	2016	2017	2018	2019	2020
Refereed article	45	39	43	58	55	56
Of which open access (%)	17	31	38	50	52	50
Refereed book chapters	8	22	13	4	3	13
Monographs	1	2	1	1	0	1
PhD theses	5	3	3	2	3	1
Conference papers (refereed)	2	0	4	0	0	3
Total academic papers	61	66	64	65	61	73

Table 3: funding in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding	19.1	51	19.6	59	19.6	61	23.4	67	23.6	67	31.8	78
Research grants	18.0	49	12.7	41	12.7	39	11.7	33	11.4	33	9.2	22
Contract research												
Other												
Total funding	37		29.2		32.2		35		35		41	

Utrecht University

Table 1: Research staff in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#
Full professor	8.3	9	9.3	10	8.3	9	8.1	9	7.5	9	5.7	7
Professor by special appointment	1	1	1	1	1	1	1	1	1	1	1	1
Associate professor	6.0	6	6.0	6	6.0	6	6.0	6	7.0	7	9.8	10
Assistant professor	9.6	9	9.6	11	12.6	14	13.6	15	15.6	17	14.8	16
Postdocs	5.1	6	9.1	10	5.1	6	6.1	7	12.1	13	9.0	9
PhD candidates	12.0	15	17.0	17	18.0	18	18.0	20	17.5	18	18.1	19
Total research staff	42.0	46	52.0	55	51.0	54	52.8	58	60.7	65	58.4	62

Table 2 Main categories in research output 2015-2020

categories	2015	2016	2017	2018	2019	2020
Refereed article	49	60	67	70	67	58
Of which open access (%)	61	60	67	69	91	86
Books	1	0	0	2	1	0
Monographs	1	0	3	0	2	3
PhD theses	5	7	4	2	6	6
Conference papers (refereed)	2	5	10	6	5	7
Total academic papers	58	72	84	80	81	74

Table 3: funding in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding	10.4	38	12.4	36	13.2	34	16.2	46	19.4	43	20.3	48
Research grants	16.0	59	21.0	61	24.0	61	21.0	50	25.0	55	20.0	47
Contract research	1.0	4	1.0	3	2.0	5	1.0	4	1.0	2	2.0	5
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total funding	27.4		34.4		39.2		38.2		45.4		42.3	

Wageningen University & Research

Table 1: Research staff in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#
Full professor	2.2	3	2.2	3	2.2	3	2.2	3	2.0	2	3.0	3
Professor by special appointment	0.2	1	0.2	1	0.2	1	0.2	1	0.2	1	0.2	1
Associate professor	1.9	2	1.9	2	2.7	3	1.9	3	1.9	3	1.7	2
Assistant professor	7.0	7	8.3	9	8.8	10	9.8	11	10	11	11.3	12
Postdocs	4.2	5	4.6	5	8.2	9	5.0	5	6.0	6	8.0	8
PhD candidates	24.0	24	21.6	22	24.0	24	25.0	25	23.8	24	20.8	21
Total research staff	39.5	42	38.8	42	47.1	50	44.1	48	43.9	47	45.0	47

Table 2 Main categories in research output 2015-2020

categories	2015	2016	2017	2018	2019	2020
Refereed article	54	71	63	81	91	93
Of which open access (%)	35	41	54	58	68	82
Books	0	1	1	5	0	0
Refereed book chapters	1	1	6	1	1	1
Monographs						
PhD theses	2	5	4	2	4	5
Conference papers (refereed)	1	2	4	2	4	1
Total academic papers	59	83	80	93	109	101

Table 3: funding in FTE

	2015		2016		2017		2018		2019		2020	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding	10.4	42.5	8.4	35.6	10.3	35.5	10.2	37.8	8.1	34.0	8.1	34.6
Research grants	7.2	29.5	9.2	39.3	11.3	39.1	9.2	34.0	8.8	37.0	6.7	28.8
Contract research	6.8	28.0	5.9	24.9	7.4	25.4	7.6	28.2	6.9	29.0	8.6	36.6
Other												
Total funding	24.4		23.5		29.0		26.9		23.8		23.3	