Annual Report 2018

TU Delft

Colophon

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Design
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On the cover
Postdoc Johan Steimes conducts research into flame stability and the reduction of harmful emissions from natural gas and hydrogen flames using advanced laser diagnostics in the combustion laboratory of Process and Energy, Faculty of Mechanical, Maritime and Materials Engineering.

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TU Delft Annual Report 2018

TU Delft

Preface

Executive Board

With the appointment of Nicoly Vermeulen MBA and Professor Rob Mudde, responsible for, respectively, operations and education, the new Executive Board was complete at the beginning of 2018. Together, we are buckling down to achieve our mission: impact for a better society. That is how our organisation formulated this in our Strategic Framework for 2018-2014. The first boost for this strategy document was not long in coming: in March, the international Open Education Consortium awarded TU Delft a prize in the category of open policies, for the way in which openness is incorporated into the strategy.

However, actions speak louder than words. How can we ensure that our activities have a positive impact on society? We can achieve this by gearing our research and education to global challenges, such as those in the UN's sustainable development goals: a blueprint for peace and prosperity for people and the planet, now and into the future, as the UN puts it. These goals reflect a great many challenges that we are and will continue to work on in our research, such a clean water and sanitary facilities, energy from renewable sources, smart cities and sustainable development.

The biggest challenge of this century is climate change. Our research regularly brings its scope and gravity clearly into view. For instance, scientists at TU Delft have worked on various research projects which have showed that the ice cap in West Antarctica is melting faster and faster. Other research has showed that climate change will lead to an increase in extreme sea water levels because of a combination of high tide and extreme weather, and therefore to a higher risk of flooding in coastal areas. This is important research, which leads not only to new insights but also to fine publications in Science and Nature – even if it is not always so great to be the bringer of bad news.

In that respect, the first Land Subsidence Map of the Netherlands also filled us with mixed feelings. A team of researchers led by Professor Ramon Hanssen based their land subsidence model on three different kinds of measurement data: satellite radar, GPS and gravity measurements – which was a first. The outcome: land in the Netherlands is subsiding more than expected, and, here too, climate change appears to be playing a large role. Fortunately, all of these findings are good news in a sense, because they tell us exactly what is the matter so that we can take the first step towards implementing measures and solutions. We as a university are of course hard at work on this too. For instance, 2018 saw the start of the e-Refinery, a consortium that takes an integrated approach – from materials to processing and scaling up – to supporting the chemicals and energy industry with their climate challenge. However, it seems that technology is not always the only possible solution to address the consequences of climate change. The introduction and reintroduction of plants and open water is the best way of combating extreme heat in our cities, concluded doctoral candidate Anna Solcerova in her dissertation. Our behaviour can also play a role. Spin-off company HOMIE has introduced a business model where people pay per wash whenever they use their washing machine. Researchers studied customers' laundry behaviour and thus demonstrated that such a pay-per-use business model promotes

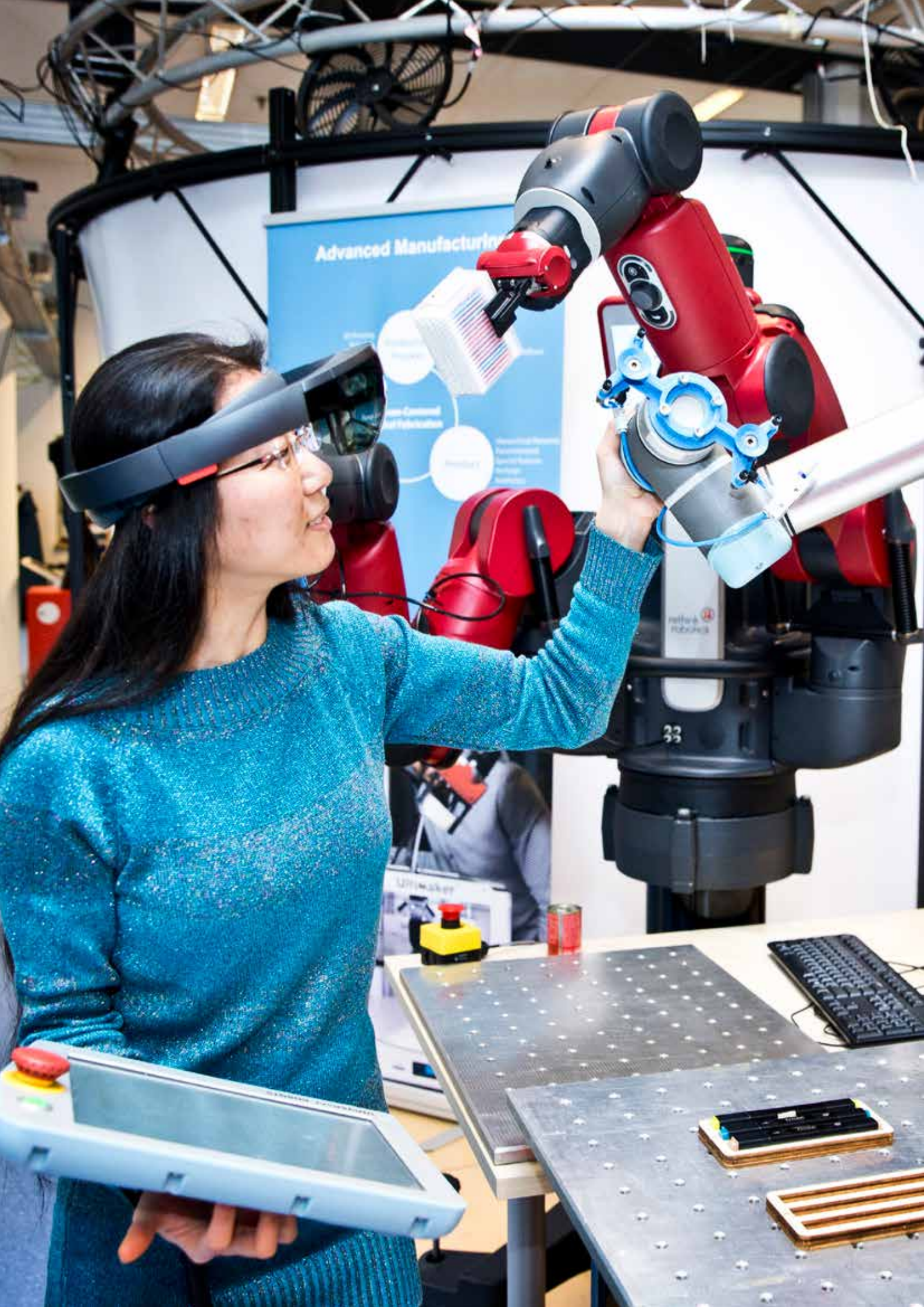
more sustainable consumer behaviour: there was a significant drop in the number of times that people used their washing machine per month, and in the average washing temperature. No matter where the inspiration for new solutions comes from, one thing is for sure: government bodies, businesses and researchers are best served by working together on the development of those solutions. So, our campus is working on transforming into what can be called campus 4.0, an environment with everything that is needed for innovations to flourish. We are talking about researchers and laboratories but also living labs, facilities for start-ups and also strong ties to government bodies, the business community and industry. In 2018 we continued to work on this innovation ecosystem. We welcomed new residents to the campus, such as metrology institute NMi and electronics group ABB. And outdoor laboratory The Green Village opened its Water Street, a living lab where entrepreneurs, researchers and the government will also be working together to try to find solutions for flooding resulting from climate change.

Education naturally remains our priority. After all, our graduates have always been our most valuable contribution to society. Or as Calvin Rans, our best lecturer of 2018, put it: education is the way to make greater impact. Here too we face challenges. How can we provide our students with the right knowledge and skills in such a rapidly changing world? Ten years ago, for example, we could never have imagined that we would now be doing research on things such as cybercrime, the quality of Twitter discussions or the possibilities of an internet of plants. Undoubtedly, our graduates will soon be facing all kinds of new issues in their professional practice. Another challenge remains the huge influx of students. The grand opening in September of Pulse, a new teaching building, can provide part of the solution. With 1020 instruction seats and 275 study places, the building literally gives us more room. In addition, it has been designed for new forms of motivational teaching. In the Pulse building innovations that have been developed in the adjacent Teaching Lab will be put into practice. This is one way to continuously keep our teaching fresh and up to date.

In the meantime, our student dream teams have been performing better than ever in international student projects. It has become so commonplace for students from TU Delft to impress in international projects that we actually only notice when that does not happen, such as last summer when the launch of the Stratos III rocket failed. It may not have been very nice for the students of Delft Aerospace Rocket Engineering (DARE), but it was certainly not the end of the world. After all, you never learn as much as when something goes wrong. That's what really gets you thinking.

However, we hope that it will not take the students of DARE 350 years to find the answer. That's how long it took to solve the mystery of the Van Leeuwenhoek microscope. Thanks to neutron tomography, a non-invasive imaging technique, it was possible to show that Van Leeuwenhoek was simply extremely skilled in grinding and polishing his tiny lenses. It was at least as surprising to find out that not all the yellows in Van Gogh's Sunflowers will withstand the ravages of time. For the lighter coloured parts of the flower and the pale yellow background of the composition, Van Gogh used what is known as 'jaune citron'. The colour has the tendency to darken under the influence of light and humidity. This is a fine example of the broad spectrum of research taking place at TU Delft.

Even if the Sunflowers may be losing some of their lustre, there are also rays of hope: never before in history have there been so many Dutch engineers as there are today – many of them from TU Delft, of course – and there have never been so many students at TU Delft. With all this potential for innovation, we should be able to make a real difference in the world. That remains our mission.


Advanced Manufacturing

Contents

Report of the Supervisory Board

In 2018, the Supervisory Board was made up of the following members:
- Drs.Ir. J. van der Veer, president, former CEO of Shell (appointed until 1 July 2021, second term)
- Prof. L.L.G. Soete, former Rector Magnificus of Maastricht University, honorary professor in the School of Business and Economics at Maastricht University and UNI-MERIT professorial fellow (appointed until 1 May 2021, first term)
- Ir. L.C.Q.M. Smits van Oyen MBA, director and major shareholder of companies in the healthcare, IT and tourism sectors (appointed until 1 January 2021, second term)
- Drs. C.G. Gehrels, member who enjoys the confidentiality of the employee and student participation bodies, European Cities Director of Arcadis (appointed until 1 June 2019, first term)
- Drs. G. de Zoeten RC, former CFO of Leaseplan (appointed until 1 May 2020, first term)

Vision and strategy

On 30 October 2017, the Executive Board approved the new strategic plan for the 2018-2024 period, 'Impact for a better society, TU Delft Strategic Framework 2018-2024'. The Supervisory Board followed and oversaw the strategic developments at TU Delft in 2018 on the basis of this strategic plan.

Strategic cooperation

At the local level, the Board is involved in TU Delft's strategic cooperation with the Municipality of Delft. The Municipality and TU Delft have signed a covenant to this end. The agreements made within this context will be elaborated and implemented in the years ahead.

Regionally, TU Delft works together with Leiden University and Erasmus University Rotterdam in the LDE alliance. In 2018, the Supervisory Board approved the extension of the LDE Joint Regulations. TU Delft started to explore further collaboration with the Erasmus Medical Centre in 2018. Healthcare and technology continue to become more interconnected, which is a reason to identify the potential for working together. To this end, the Supervisory Board maintains contact with the Executive Board and Supervisory Board of the EMC.

At the national level, TU Delft has a partnership with Eindhoven University of Technology, the University of Twente and Wageningen University: the 4TU.Federation. The presidents of all Supervisory Boards of universities in the Netherlands meet twice a year to discuss national developments relating to the regulation of higher education. The Minister of Education, Culture and Sciences attends one of these meetings each year.

Teaching and Research

The Supervisory Board is actively involved in the developments in the field of education. Matters such as new degree programmes, the relocation of degree programmes, the possible introduction of a cap on student intake for certain programmes, and quality-assurance policy are carefully discussed with the Supervisory Board before they are implemented. Accreditation and re-accreditation processes for the degree programmes and research visitations are also regularly discussed with the Board. Preparation for both the strategic developments in teaching and research and the ensuing activities takes place in the Teaching and Research Quality Assurance Committee (KOO), which meets twice a year for this purpose. The Supervisory Board is informed on a quarterly basis about the strategy and developments of TU Delft with regard to online education, the development and sharing of MOOCs – in which TU Delft is leading the way internationally – and the Extension School.

Campus

The real-estate issues of TU Delft are discussed in the meeting of the Supervisory Board each quarter, and further decisions are made in the form of approval, if necessary. Throughout the year, the Supervisory Board paid close attention to the preparations for updating the campus strategy and its financing. The Supervisory Board approved a collaboration agreement with the Science Park Fund (SPF). The aim of the SPF will be to invest in property on science parks in the Netherlands on behalf of third parties. The collaboration agreement with the SPF is aimed at helping TU Delft find a structural long-term solution to developing its valorisation goals in the Science Park and on TU Delft Campus.

Administration and Management

On 30 April 2017, the Supervisory Board adopted a new university governance model for TU Delft. This governance model took effect on 1 January 2018 and institutes an Executive Board consisting of three members: Rector Magnificus/President of the Executive Board, Vice-Rector Magnificus/Vice-President for Education, as well as the Vice-President of the Executive Board and a Vice-President for Operations.

In 2018, the Supervisory Board held four regular meetings with the Executive Board and four meetings without the Executive Board. In addition, two strategy meetings were held, during which a number of strategic issues for TU Delft were discussed in detail with the Executive Board. Examples in this regard include the national advisory programmes for Higher Education funding, the Sector Agreement between the Ministry of Education, Culture and Science and the Association of Universities in the Netherlands, the quality agreements, the intake of students (Dutch and international students) and possible scenarios to manage these.

The Board has three committees: the Remuneration and Appointment Committee, the Audit Committee, and the Teaching and Research Quality Assurance Committee (KOO). The Audit Committee met three times in 2018, and the Teaching and Research Quality Assurance Committee twice.

Supervisory Boards must also monitor compliance with legislation and regulations by the board. To enable the Supervisory Board to perform this supervisory task properly, subjects including actual or anticipated amendments to the law, activities in the field of academic integrity, the Code of Ethics, Safety and Security, and information Security are discussed with the Board on a regular basis. Every six months, the Supervisory Board discusses an overview of current legislative developments that relate to higher education and research.

The Supervisory Board visited a number of faculties and service departments in 2018. Every quarter, an overview of activities is compiled for the Board. The overview contains notable achievements, subjects and developments relating to all organisational units, faculties and departments. Individual members of the Supervisory Board engage in irregular informal consultation with managers from various parts of the University Services. The president of the Supervisory Board engages in frequent informal consultation with members of the Executive Board, and particularly with the president.

Finances and operational management

Audit Committee

The Audit Committee met three times in 2018. Examples of important agenda items were major investment projects (primarily in real estate), including the funding of these investments. Further items discussed were the reports, the annual audit plan and the planning and results of Internal Audit activities, and of course the financial results and cash flow. Also on the agenda were the discussion of the 2017 audit report, the 2018 management letter, the associated improvement initiatives, and the 2019 budget. The 2017 audit report and the 2018 management letter were discussed in the presence of the external auditor.

Supervisory Board

In its meeting on 25 May 2018, the Supervisory Board approved the 2017 Annual Report and the Financial Statements; in its meeting on 21 December 2018, the Board approved the Budget for 2019. During its meetings in 2018, the Board focused much of its attention on the financial position of TU Delft, prepared by the Audit Committee (see above). At each meeting, Finance presented a controller letter containing the results for the previous quarter. The Supervisory Board concludes that the financial position of TU Delft is healthy and that control processes are in order. The Supervisory Board is aware of the downward trend in the financial results due to all the necessary investments and costs. The Supervisory Board has recommended careful consultation with those concerned about these developments, the priorities and choices.

Employee participation

The Higher Education and Research Act (WHW) lays down the independent right to direct consultation between staff representatives and the Supervisory Board, the right to nominate one of the members of the Board and advisory powers for the profiles of the Board members. The Supervisory Board and the representative bodies have made procedural agreements concerning these matters. One of the members of the Supervisory Board has conducted informal discussions with the confidential committee of the Works Council and the Student Council on several occasions. In addition, several members of the Supervisory Board attended meetings of the Works Council and the Student Council.

Personnel and internal affairs

On 1 January 2018, TU Delft bid farewell to two members of the Executive Board: Rector Magnificus Prof. Karel Luyben and Vice President for Education & Operations Drs. Anka Mulder. As a result of the introduction of the new governance model, the Supervisory Board appointed Prof. Tim van der Hagen – who was appointed President of the Executive Board in 2016 – to the position of Rector Magnificus/President of the Executive Board as of January 2018. In autumn 2017, the Supervisory Board began recruitment for a Vice-President for Operations, in accordance with the new governance model. The Board appointed Drs. Nicoly Vermeulen to fill this position as of 1 January 2018. The Executive Board appointed Prof.Dr. Rob Mudde to fill the position of Vice-Rector Magnificus/Vice-President for Education as of 1 March 2018. Together with the representative bodies, the Executive Board will evaluate the new governance model at the beginning of 2019.

In 2018, the Remuneration and Appointments Committee again conducted annual appraisal interviews with the individual members of the Executive Board.

In accordance with Article 4 of the TU Delft Supervisory Board Regulations, the Board is responsible for determining the quality of its own performance. To this end, each year the Supervisory Board discusses its own performance as well as that of the individual members, and the associated consequences, without the Executive Board being present. The self-evaluation was also completed in 2018 on the basis of a questionnaire filled in by all members beforehand. The Supervisory Board also evaluated its president under the supervision of the vice-president.

In conclusion

TU Delft's policy regarding the salary of the administrators and supervisors is in line with the Senior Officials in the Public and Semi-Public Sector (Standards for Remuneration) Act (WNT) and with the agreements made with the Ministry of Education, Culture and Science.

In its own opinion, the Supervisory Board performed its taks in 2018 in accordance with the governance code. The Supervisory Board also honoured the principle of independence in 2018.

Finally, the Supervisory Board would like to thank TU Delft and its administrators for their constructive cooperation.

Key indicators

Education

Intake of new Bachelor's students:	3971	students
Intake of new Master's students:	1750	students
Intake into the bridging programme:	210	students
Total number of Bachelor's students:	13.081	
Total number of Master's students:	11.151	
Total number of students in the bridging programme:	471	
Positive Binding Recommendation on Continuation of Studies in the 1st year:	71%	
Bachelor's degrees:	2473	
Master's degrees:	3357	
PDEng degrees:	27	

Research

Number of peer-reviewed publications:	3524	
Whereof Open Access publications:	2241	
Number of doctoral candidates *	2816	
Number of doctorates:	364	
PhD pass rate within five years:	43%	
Postdocs	496	FTE

Staff

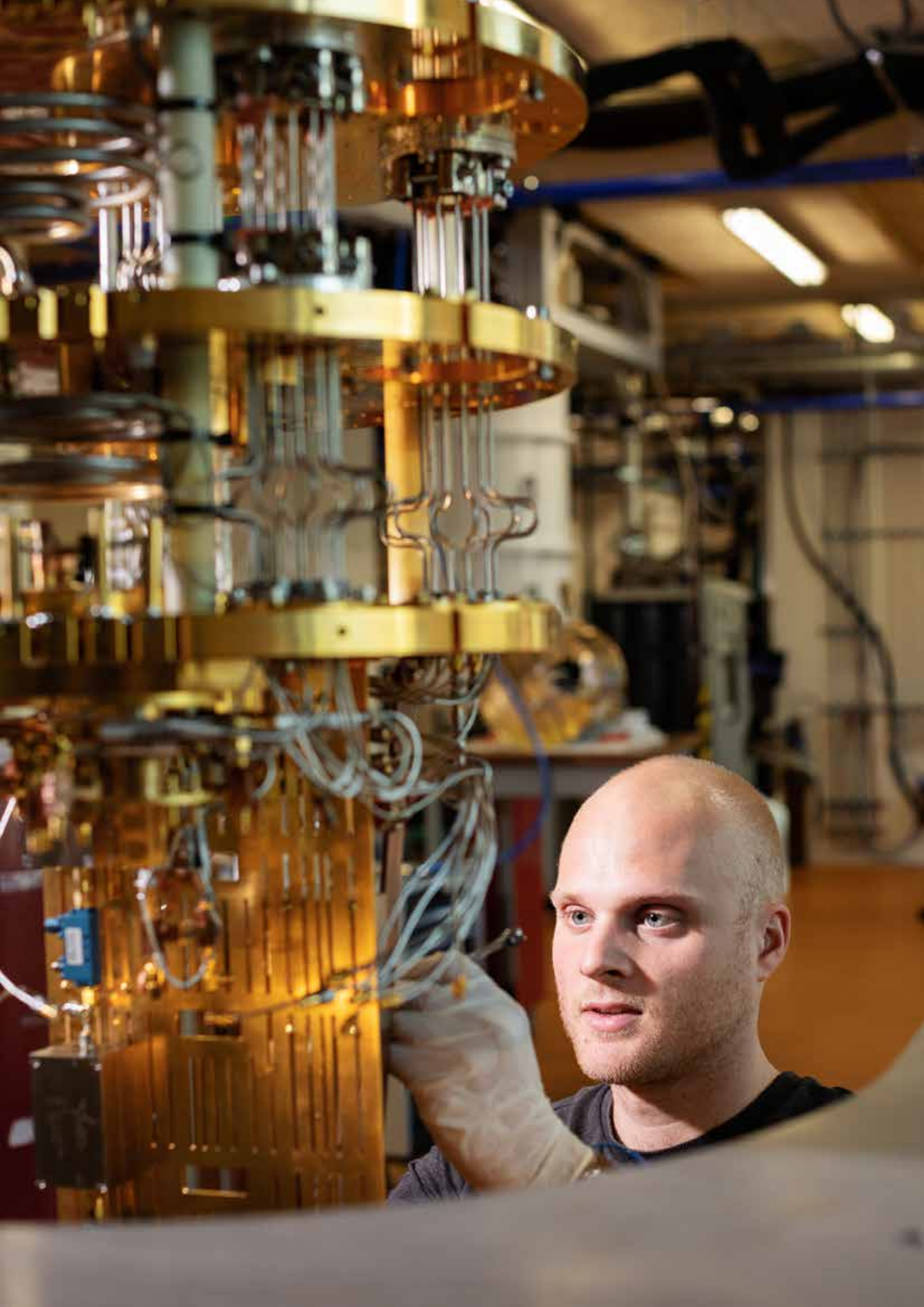
Permanent Faculty+ **	956	FTE
Administrative and support staff (OBP), including student assistants, total	2187	FTE

Financial matters

Government funding	504,1	M€
Indirect funding	58,4	M€
Contract funding	151,6	M€

NOTE: For additional figures, see: **www.tudelft.nl/en/about-tu-delft/facts-and-figures/**

* This refers to the number of people following doctoral programmes at TU Delft, regardless of whether they have been appointed and/or funded by TU Delft.
** This refers tot he number of FTE for deans, professors (full, associate en assistant) with a permanent contract and tenure trackers (with or without a permanent contract).



1 TU Delft

1.1 Institutional profile

With approximately 24,700 students and 5,400 staff, TU Delft is the largest university of technology in the Netherlands. With a tradition of more than 175 years in civil engineering, we have developed a broad research portfolio that, divided among 41 departments and eight faculties, spans practically the entire range of engineering sciences. TU Delft is the highest-ranking Dutch university, and it is one of the top 20 universities of technology worldwide (THE & QS). The university offers a broad range of high-quality degree programmes and unique facilities and is a world research leader in such diverse areas as quantum-nano, bio-nanotechnology, maritime engineering, architecture, transport, water management, aerospace technology and robotics.
The mission of the university is to contribute to solving global challenges by educating new generations of socially responsible engineers and expanding the frontiers of the engineering sciences.

Impact for a better society

As TU Delft we not only strive to be good at what we do, but we also want to be good for something. We strive to balance our pursuit of world-class academic excellence and providing high-quality education on the one hand, and providing expert-solutions to societal problems on the other hand. Again in 2018, we have demonstrated in a variety of areas that societal impact and academic excellence can be mutually reinforcing. 'Living labs', ground-breaking initiatives in which we play a key role – including robotics cluster RoboValley and the Medical Delta medical technology consortium – offer many possibilities for making education and research integral elements of working to address societal challenges. In these and other areas, various teams within the university are developing new strategic partnerships with other universities, as well as with private and civic sector partners. In the process, we make good use of the complementarity of the universities in the region through the LDE Alliance, and carefully coordinate with the other technical universities in the Netherlands within the 4TU.Federation.

Interconnectedness of research, education and valorisation

At TU Delft, research, education and valorisation cannot be considered in isolation. Quite the contrary in fact - these three cornerstones enhance one another. The technical and scientific knowledge acquired through our research activities feeds naturally into education and knowledge valorisation at TU Delft. Equally, interaction with inquisitive and critical students, businesses and government agencies also results in new and unexpected research questions. Research, education and knowledge valorisation inspire one another.

1.2 Strategic priorities

In 2018, TU Delft presented a new strategic plan for the next six years: the Strategic Framework for 2018-2024. A common thread throughout this framework is formed by four major principles that we aim to develop further in the years ahead: Excellence, Impact, Involvement and Openness. These characteristics are reflected in all of our core activities, which can be subdivided into four operational areas: Students & Education; Research & Innovation; People & Community; and Campus & Services. The four basic principles are linked to the operational areas in the following matrix. The table below is not intended to provide a complete overview of the Strategic Framework, but aims to give an impression of the way in which the various elements are related and how, collectively, they map our vision on the future. The Strategic Framework is available at www.tudelft.nl/en/about-tu-delft/strategy.

Strategy on one page

	Excellence	Impact	Engagement	Openness
Students & Education	We strengthen our ambitious study culture that is characterised by substance, challenges and academic breadth.	We prepare students for solving societal challenges and educate tomorrow's responsible leaders in science, engineering, design and innovation.	We invest in lifelong learning, offering a relevant portfolio in a global environment.	We promote and facilitate Open Education. We strengthen online education.
Research & Innovation	We strive to increase the number of scientific focal points.	We make a significant contribution to the solution of societal challenges by combining science, technology and design in a responsible manner.	We promote outreach to the wider (local) public; we strengthen global engagement via joint research initiatives.	We promote and facilitate Open Science and Open Innovation. We increase the number of large-scale public-private partnerships.
People & Community	We challenge our students and staff to get the best out of themselves and provide them with the necessary support to do so.	We support students and staff members to co-create and deliver solutions to community concerns.	We create stronger engagement with our alumni and people from the surrounding area; together, we build a 'TU Delft community for life'.	We are convinced of the importance of diversity, as a cornerstone for innovation. We aim to integrate internationalisation in all our core activities.
Campus & Services	We develop excellent, user-friendly and efficient services.	We develop the campus as a multi-partner 'Living Lab' in which education, research and innovation contribute to solving societal challenges.	We gear our facilities and services to our aim to make a sustainable and responsible contribution to the region, the Netherlands and the world.	We develop our campus in such a way that we are more welcoming to interested people from the near surroundings.

1.3 Management and Organisation

The Delft University of Technology is an institution governed by public law, in accordance with the Higher Education and Scientific Research Act (WHW). Its main tasks are to provide university education, to perform scientific research, to transfer knowledge to society and to promote a sense of social responsibility. The university is designated as an Institution for General Benefit (ANBI). The main administrative structure of TU Delft is established in the WHW and in the Executive and Management Regulations (BBR) and the Mandate Regulations – which are based on the WHW, all in accordance with the VSNU Code of Good University Governance. TU Delft distinguishes three administrative layers: the Executive Board, the faculties and the academic departments. These three administrative levels are subject to the principle of integrated management: the Executive Board, the deans, and the departmental directors are responsible for both the primary process and support processes. All support services are grouped in University Services.

Organisational structure

Supervisory Board

The Executive Board is accountable to the Supervisory Board (RvT) appointed by the Minister of Education, Culture and Science. The Supervisory Board supervises the tasks carried out and the exercising of powers by the Executive Board and has a number of duties set down by law.

Executive Board

The Executive Board is the highest-ranking administrative body of TU Delft, and is charged with the governance and management of the university. The members of the Executive Board are appointed by the Supervisory Board. The decision-making process adhered to by the Executive Board is based on the collegial principle, in which the Rector Magnificus/President is first amongst equals and bears final legal responsibility for the decision-making process.

Faculties

There are eight faculties at TU Delft. The university's primary tasks – academic research and teaching, and the valorisation of research, as described in the Higher Education and Research Act (WHW) – are carried out by the faculties. For an overview of the academic departments in each faculty, see Appendix 1.

University Services

University Services supports the primary processes in the organisation, organises the administrative processes, and coordinates central policy processes. From a financial and administrative perspective, the University Services are headed by the Vice-President for Operations, member of the Executive Board.

Central consultation bodies

Operational Committee

The Operational Committee is a consultative body that consists of the members of the Executive Board and the deans of the eight faculties. In the Operational Committee, the Executive Board consults every three weeks with the deans on matters of general importance to the entire university.

Board for Doctorates

The Board for Doctorates consists of the Rector Magnificus (chair), the Pro Vice Rector (vice-chair) and the deans of the faculties or a professor from the faculty nominated by

the dean. A university's Board for Doctorates is authorised to grant the title of Doctor on the basis of a defence of a doctoral dissertation. The legal provisions concerning the Board for Doctorates are set down in the Higher Education and Research Act.

Council of Professors

The Council of Professors consists of a panel of experienced professors employed at TU Delft. The Council of Professors provides both solicited and unsolicited advice to the Executive Board on TU Delft as 'academic institution'.

Representative Bodies

TU Delft has a number of consultation bodies as set down by law, with which the Executive Board conducts formal consultations. TU Delft has a shared consultation procedure, which involves the Works Council (WC) and the Student Council (SC). The members of the Works Council and the Student Council meet in the General Assembly of Councils (GV).

Works Council

Depending on the number of eligible voters, the Works Council consists of up to 25 members, who are elected for a period of three years. In 2018, the Works Council had 23 members. The members of the Personnel Committees are elected simultaneously with the Works Council. The Works Council has the right to be informed, the right to appeal and the right to initiate, in addition to having advisory powers on specific topics (as in the recruitment and selection of members of the Executive Board) or right of approval. In principle, consultations are held on every matter concerning TU Delft, or where they must be held in accordance with the Works Councils Act.

Student Council

The Student Council has ten members, which are elected for a period of one year. Based on the Higher Education and Scientific Research Act (WHW) and the Student Council Regulations, the Student Council has the right to be informed, the right to appeal and the right to initiate, in addition to having advisory powers on specific topics (as in the recruitment and selection of members of the Executive Board) or right of approval.

General Assembly of Councils

The members of the Works Council and the Student Council together constitute the General Assembly of Councils (GV). The General Assembly of Councils has the right of approval in several areas. The General Assembly of Councils also has the right to nominate one Supervisory Board member who enjoys the particular confidence of the consultation bodies.

Personnel Committees

The Works Council has nine Personnel Committees – one in each faculty and one in University Services. The Personnel Committees hold consultations with the dean of the faculty in question or the administrator of University Services. The Works Council Act specifies the topics for which the Personnel Committees have the right of approval, advisory powers and the right to be informed.

Faculty Student Councils

There is a Faculty Student Council in each faculty. The Faculty Student Councils have the right to be informed and to initiate, and – in specific areas – advisory powers or the right of approval. The Faculty Student Councils hold consultations with the dean of the faculty in question.

Boards of Studies

Each programme has its own Board of Studies. Students and tutors from the programme in question are represented on the boards. The Higher Education and Research Act gives specific powers to the Boards of Studies, including the power to issue recommendations on the Teaching and Examination Regulations, annually assessing how those matters are carried out, and providing broad advice on said matters to the management of the degree programme in question. Since the passing of the Enhanced Governance Powers (Educational Institutions) Act (2016) into law, the position of the Boards of Studies has been strengthened: as well as being advisory bodies, they now also qualify as participation bodies with the right to approve certain parts of the Teaching and Examination Regulations.

In addition to the employee and student representative bodies, there are the four **unions that are represented in the Local Consultation Body (VLO):** FNV Overheid, CNV Publieke Zaak, AC-HOP and CMHF. These unions consult with the Executive Board in the Local Consultation Body on issues relating to working conditions and the legal status of staff members that must be arranged within TU Delft, based on the Collective Labour Agreement for Universities in the Netherlands (CAO-NU).

Executive Board

Prof.dr.ir. Tim van der Hagen
Rector Magnificus / President of the Executive Board (RM/VC)

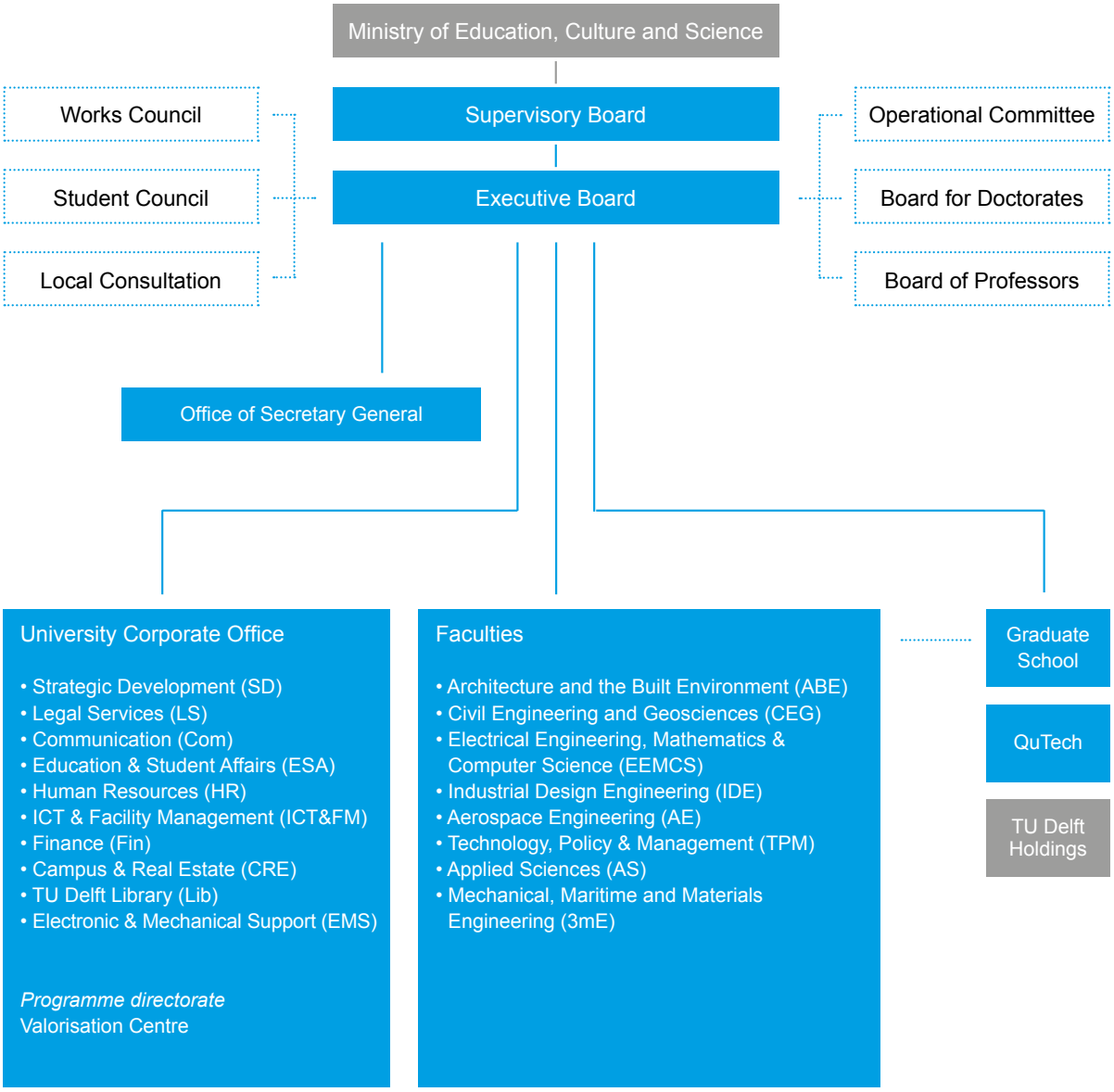
Drs. Nicoly Vermeulen MBA
Vice President Operations (VPO)

Prof.dr. Rob F. Mudde
Vice Rector Magnificus / Vice-President (VRM)

Faculty's and deans

Faculty	**Dean**
Architecture and the Built Environment (ABE)	Prof.dr.ir. B.M. Geerken (a.i.)
Civil Engineering and Geosciences (CEG)	Prof.dr.ir. J.D. Jansen
Electrical Engineering, Mathematics and Computer Science (EEMCS)	Prof.dr. J.A.J. Schmitz
Industrial Design Engineering (IDE)	Prof.ir. M.A. Voûte
Aerospace Engineering (AE)	Prof.dr. H.G.C. Werij
Technology, Policy and Management (TPM)	Prof.dr. E.J. Fischer (a.i.)
Applied Sciences (AS)	Prof.dr.ir. L.J. van Vliet,
Mechanical, Maritime and Materials Engineering (3mE)	Prof.dr. T.S. Baller

Organogram TU Delft



Investment and pre-investment for the student loan system

TU Delft continuously invests in the quality of its education. Examples include Pulse, a new teaching building opened in 2018, and the development of Brightspace, a digital learning environment.

Additional funds will gradually become available under the new Student Loans (Higher Education) Act that should be invested in the quality of education. In advance of that, TU Delft has been using its own funds since 2015 to get a headstart on putting activities in place for which the funds from the student loans are intended. In 2015 and 2016, this was €6 million a year, and since 2017 this has amounted to €8 million annually. This amount is structurally divided among the faculties on the basis of long-term budgets. The majority of these funds are invested in high-intensive, smaller-scale teaching by increasing the capacity of teaching staff. This investment policy has the support of the representative bodies.

In 2016 and 2017, not all of the available budget was spent. It was agreed with the representative bodies that these funds would remain earmarked for their original intention. One-off improvement projects were defined for this purpose, led by the Student Council. This concerns projects amounting to €1.4 million, which have since been approved and are now in progress. The chart shown opposite shows the relative distribution of the projects by theme.

Relative division of €1.4 million for projects by theme

1	More intensive, smaller-scale teaching	13%
2	More and better support for students	32%
3	Study success	2%
4	Educational differentiation	0%
5	Suitable and high-quality teaching facilities	52%
6	Further professional development for lecturers	2%
		Total 100%

Since 2018, the university has also recorded income from the Student Loans (Higher Education) Act. In 2018, this income amounted to €5.8 million. For 2019, a sum of €5.4 million has been accounted for in the budget.

In 2018, the entire structural budget of €8 million was spent. On top of that, the faculties together spent an extra €0.7 million on carrying out the plans. The chart below shows the relative expenditure of the funds by theme for the 2015-2019 period.

Investment category	Actual 2015	Actual 2016	Actual 2017	Actual 2018	Budget 2019
1. More intensive, smaller-scale teaching	19%	77%	88%	85%	83%
2. More and better support for students	0%	13%	6%	9%	7%
3. Study success	0%	0%	0%	0%	0%
4. Educational differentiation	0%	0%	0%	0%	0%
5. Suitable and high-quality teaching facilities	47%	1%	0%	2%	1%
6. Further professional development for lecturers	33%	9%	7%	3%	3%
7. Investment fund 2019-2020 (projectbudget)	0%	0%	0%	0%	6%
TOTAL	100%	100%	100%	100%	100%

In the Sector Agreement on University Education 2018, which was signed on 9 April 2018 by the Minister of Education, Culture and Science and the Association of Universities in the Netherlands, it was agreed to invest the funds from the student loan system in the years ahead based on quality agreements. At TU Delft, the details of these agreements were worked out in the course of 2018 in close collaboration with the representative bodies. These agreements were laid down in December 2018.

Part of these quality agreements is an annual ‘investment fund’ of €0.5 million for the regular funding of short-term projects, within the six nationally defined themes. The idea behind this is to thus annually involve the sitting Student Council in the proposals for the relevant year, in the spirit of the sector agreement. The Executive Board has committed itself to making this investment fund possible starting in 2019. It has been agreed to transfer any financial resources remaining from 2018 to the fund. This will be topped up to €0.5 million through the provisional allocation of additional resources in 2019. As the entire budget was spent in 2018, €0.5 million in resources were provisionally allocated in 2019. These will flow back to TU Delft as from the year in which the income from the Ministry of Education, Culture and Science exceeds the amounts allocated. TU Delft therefore pre-funds this investment fund.

Reflection of representative bodies on expenditure of funds from student loans/pre-investments in 2018

In 2018, a sum of € 8 million was allocated and effectively spent in the framework of funds from student loans/pre-investments. In the years 2016-2017, increasing pre-investments were made on the basis of structural plans. In the year 2018, these were almost entirely incorporated into the institution. These plans were developed in the years 2016-2017 in close cooperation with the representative bodies; in 2018, no new plans saw the light of day in this respect. The annual report contains an overview of the relative distribution by investment category. It shows a strong focus on high-intensive, smaller-scale teaching.

On the income side, the stated 8 million in 2018 consisted of a contribution from the Ministry of Education, Culture and Science's student loan programme of about € 5.8 million and a pre-investment contribution from the institution of about € 2.2 million.

In 2017, a sum of € 8 million (pre-investment) was allocated as well. Not all of this amount was spent. There was a remainder of about 700,000. This amount was made available in the course of 2018 for non-structural short-term projects. The representative bodies, primarily on the student side, have taken the lead and, in close consultation with faculties and teaching services, proposed plans to spend these remaining funds. In June 2018, these proposals were ratified after the approval of the General Assembly of Councils. The annual report contains a consolidated overview of the relative distribution by investment category for 2016 and 2017. This shows that a substantial part has now been allocated to suitable and high-quality teaching facilities.

Processes concerning the remaining funds from 2016, of about € 0,7 million, took shape in 2017, and it was not until November 2017 that they led to an approved spending plan. Most activities started in 2018. Many projects were small in scale or still in an early stage, partly because of the pressure of time.

The processes concerning the remaining funds from 2016 and 2017 led to a positive evaluation, and the General Assembly of Councils has argued for continuation in the years 2019-2024 of funds for non-structural projects to improve education. In consultation with the Executive Board, this has prompted the creation of an annual investment fund of € 0,5 million. The investment fund offers chances to take a broader approach to different themes, in accordance with the aims of both the Executive Board and the representative bodies. As of 2019, this fund will be funded (or pre-funded) from student loan investments. The fund will thus form an integral part of the quality agreements, fulfilling an express wish of the representative bodies. The final decision did take some time, however, which led to uncertainty within the representative bodies and slowed down the process, with the result that an approved spending plan will not be ready until sometime during 2019. In the past, a strong emphasis was placed on more intensive, smaller-scale teaching and good teaching facilities. This enabled us to meet the demand at that time. By learning from the process agreements made in 2015 we were able to improve the processes in 2018. The representative bodies will now become an integral part of the process in order to meet today's needs.

The representative bodies look back positively on the processes around spending the funds from the student loans/pre-investment funds. There is sufficient opportunity to contribute their own ideas. People were able to contribute to plans being put forward at both the university and the faculty levels. The involvement of the representative bodies will be continued in the Quality Agreements. For the 2019-2024 period, the representative bodies intend, at both the university and the faculty levels, to make a greater contribution to formulating new structural plans, such as planned starting in 2020. This will be in addition to the professionalisation of their input on the investment fund.

2 Education

2.1 Introduction

TU Delft trains students to be prepared to contribute to the solution of current and future problems in society. Our curriculum centres on the ‘T-shaped profile’, which allows students to acquire thorough, in-depth expert knowledge, while becoming familiar with other fields and building competence in the application of technical knowledge in the ‘real’ world. Education and research are closely intertwined throughout the curriculum. In this way, we ensure that our graduates can start their professional careers with knowledge of the latest research results within their fields, along with state-of-the-art developments in engineering. In addition, TU Delft offers students the opportunity to develop themselves outside the curriculum. There is an active student community that organises many social and cultural activities, and there are a large number of challenging student projects within TU Delft.

TU Delft’s student population continued to show a steady growth this year (see section 2.2). In recent years, the population grew from nearly 17,000 students in 2010 to almost 25,000 students in 2018. That in itself is a sign of success: society has a great need for our graduates, and our students are highly valued by top companies. In the Times Higher Education Global University Employability Ranking 2018, TU Delft again occupied 1st place in the Netherlands and 55th place worldwide. In the 2018 National Student Survey, our students once again rated the programmes with scores well exceeding 4 (on a scale of 5). Given the challenges that TU Delft is facing with the growth in the number of students, it is encouraging that student satisfaction has remained about the same. However, growth also brings challenges: maintaining the high level of the quality of our education, keeping the student/staff ratio healthy and accommodating all students. That is the reason why the new PULSE teaching building was opened in 2018, with 13 teaching rooms and 275 study spaces (see section 2.4).

TU Delft is working on a variety of career programmes for academic staff, for instance to make it possible for them to excel in teaching, education leadership and/or education research. In 2018, policy was adopted to this end for working on a promotion with teaching as a preference. The link between research into education will be further strengthened through research in our TU Delft Teaching Lab, and by working with our partners in the LDE Centre for Education and Learning, the 4TU Centre for Engineering Education and international partners (see section 2.6).

The scope of our educational mission reaches beyond the student population on our campus: The permanent education of our graduates and other working professionals is part of our mission. With this mission, we can meet the ever-changing knowledge demands of our alumni and engineers. Further additions were made to the curriculum

for professionals, as well as the online courses, in 2018. This year saw further growth in the number of online students: in the summer of 2018, more than two million students worldwide had registered for open and online courses offered by TU Delft (see section 2.3).

2.2 Education in brief

Degree programmes

The sixteen Bachelor's degree programmes at TU Delft span a broad range of engineering sciences and have a strong disciplinary focus. Four of these Bachelor's degree programmes are now offered in English: Aerospace Engineering, Applied Earth Sciences, Nanobiology and Computer Science and Engineering (since September 2018). Four of the Bachelor's degree programmes are joint-degree programmes within the cooperation between the Leiden University, Delft University of Technology and Erasmus University Rotterdam (LDE). These are Clinical Technology, Life Science & Technology, Molecular Science & Technology and Nanobiology.

TU Delft has 33 Master's degree programmes, most of which are offered in English. Four of these are joint degree programmes with other Dutch institutions: Nanobiology (LDE), Technical Medicine (LDE), MADE (Wageningen University) and Systems and Control (University of Twente and Eindhoven University of Technology). Students in eight Master's degree programmes take part in a double/multiple-degree partnership with foreign institutions. TU Delft also offers two post-Master's degree programmes.

Four PDEng degree programmes are offered as well. PDEng is a two-year programme with a focus on application offering a solid grounding for kick-starting a career in the industry. These programmes have been certified by the Certification Committee for Technological Design Programmes (CCTO).

In the autumn of 2018, the Executive Board decided to increase the institutional tuition fees for 2019-2020 for Bachelor's and Master's degree programme for students from outside the EER, because the cost of the degree programme exceeds the institutional tuition fee. All degree programmes offered by TU Delft are listed in the TU Delft Register of Programmes.

Numerus Fixus

For the 2018-2019 academic year, there were five Bachelor's degree programmes with a numerus fixus for selection and placement: Industrial Design Engineering, Architecture and the Built Environment, Nanobiology, Aerospace Engineering and Clinical Technology. For academic year 2019-2020, also Computer Science and Engineering will be a Numerus Fixus programme.

Intake and student population

The growth in the number of Bachelor's students at TU Delft seen in previous years is continuing. The is due, on the one hand, to the growing popularity of science and technology programmes among Dutch pre-university students and, on the other, to the unexpectedly keen interest in the Computer Science and Engineering degree programme – offered in English since September 2018. In addition to the great interest in the Netherlands, many foreign students have also found their way to this degree programme. The total population at TU Delft grew last year (see figure 1). The population of Master's students grew as a result of the larger intake from

Bachelor's degree programmes at TU Delft; the external intake of Master's students (first-year students at institution) saw a slight decrease. In 2018-2019, we witnessed a minor decrease in the number of non-EER students. See figure 2 for an overview of the student population for each study phase (please note that the definition of the population was altered in 2016; as from 2016, students who take part in shared programmes, where TU Delft is not the coordinating university, also count towards the population).

Proportion of female students

	Change (%)	Number in 2018	Number in 2017
Intake of Bachelor's students	+13%	3.971	3.518
Population of Bachelor's students	+ 6%	13.081	12.383
External intake of Master's students (first-year students at institution)	-1%	1.750	1.770
Population of Master's students	+5%	11.151	10.647

Figure 1: Intake and population figures

The percentage of female students in the Bachelor's population increased from 26.3% to 27.4%; in the Master's population from 28.7% to 29.2%.

Proportion of foreign students

In 2017, the population of foreign students was 4,613 (19.7% of the total number of students) and, in 2018, it was 5,299 (21.5% of the total), representing an increase of 15%. Where in 2018 the proportion of foreign Bachelor's students was just over 11%, this was 35% in the Master's phase.

Drop-out rate and binding recommendation on the continuation of studies

The drop-out rate in the first year of the Bachelor's programme remained stable at around 18%. Immediately after the review of the Bachelor's curriculum, the internal-switch rate increased from 8% to 11%, but it has since declined again to 8.9%. The proportion of students with a positive binding recommendation on the continuation of studies was 71%. This is a slight decrease compared to 2016/2017, when this was 74%. The proportion of postponed recommendations rose from 3% (2016/17) to 5%.

Degree certificates

A total of 2,473 Bachelor's degree certificates were awarded in the 2017/2018 academic year. This represents an increase of 9% compared to the previous year (2,259). The number of Master's degree certificates rose from 3,137 in 2016/2017 to 3,357 in 2017/2018: an increase of 7%. In 2017/2018, the proportion of cum laude among Bachelor's degrees awarded was 9% (2016/2017: 11%), and 11% of the Master's degrees awarded (was 10%).

Pass rates

The pass rate in the Bachelor's degree programmes after four years has increased sharply since 2006, as a result of the curriculum review in the Bachelor's programme and the binding recommendation on the continuation of studies. For developments in the pass rates in Bachelor's degree programmes, see Figure 3.

Doctoral candidates and graduate school

The intake of doctoral candidates increased slightly in 2018, from 522 to 528 (+1%). The population increased slightly from 2,799 to 2,816 (+1%). There were 364 defence ceremonies at TU Delft. The proportion of cum laude defences of the doctoral dissertation was 5.5%. For a breakdown of the PhD population by female/male ratio and Dutch/foreign nationality, see Figure 4. Mandatory for doctoral candidates, the Doctoral Education programme offers doctoral candidates a wide range of courses and activities in terms of transferable, research-related and discipline-related skills. The opportunities relating to transferable skills include attention to introduction to the Doctoral programme, ethics and integrity, teaching skills and career development. The skills in the other categories are acquired in part through the ordinary practice of research or in specialised courses. Doctoral candidates have assessed the quality of the training offered with an average score of 8.3 on a 10-point scale.

Professional education

The permanent education of our graduates and other working professionals is part of our teaching mission. In addition to the post-Master's degree programmes and the PDEng degree programmes, TU Delft has a broad range of programmes and courses (some of which are offered online) for working professionals. Currently, more than 10 programmes and 30 courses are offered. With this mission, we can meet the ever-changing knowledge demands of our alumni and engineers in general. Collaboration with businesses brings professional practice and education closer together.

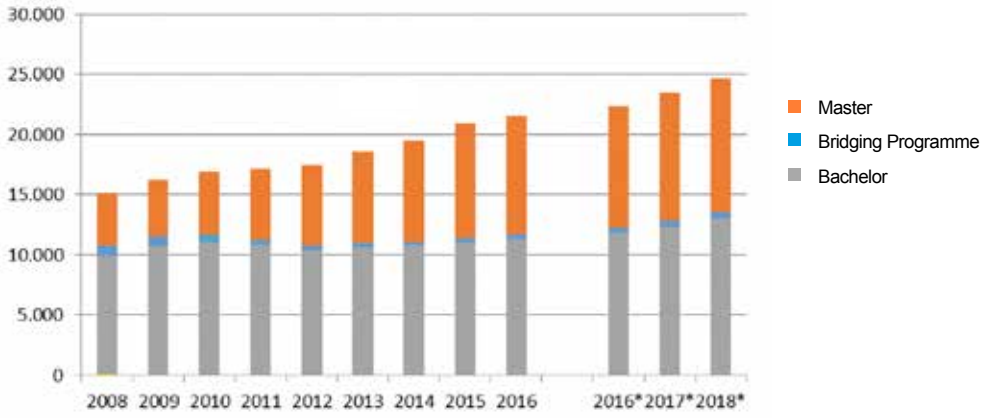


Figure 2: Student population for each study phases (Note: as from 2016, students who take part in shared programmes also count towards the population.)*

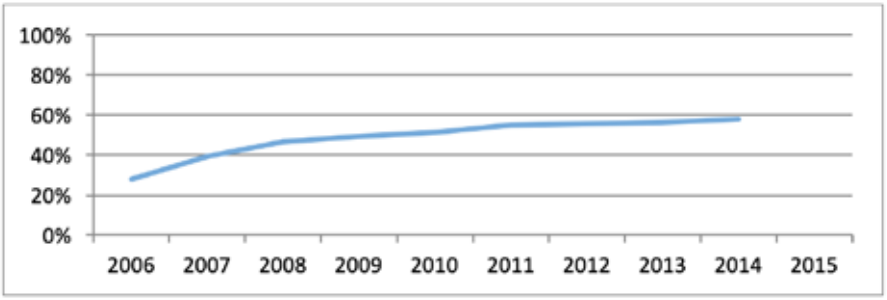


Figure 3: Pass rates in the Bachelor's degree programmes (percentage of re-enrollers who complete the BSc in four years)


15

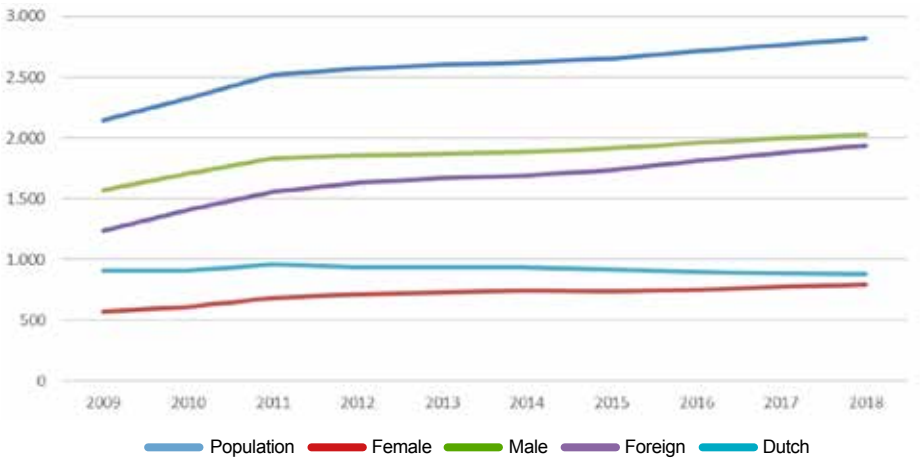


Figure 4: total population of PhDs and breakdown by female/male and Dutch/foreign nationality.

2.3 Educational developments

TU Delft vision on education

TU Delft's Vision on Education (November 2017) gives direction to the learning experience that TU Delft seeks to offer students and the responsibilities of all parties in this endeavour. A key aspect in this respect is that we guide students and doctoral candidates in such a way that they can take control of their own development and learning process. We encourage active learning through various teaching methods, including online and blended learning. Students are given the opportunity to apply their knowledge and skills during assignments where they work with other students from different disciplines and backgrounds. We encourage and support ambitious and enterprising students, and we give academic staff the opportunity to focus on teaching, didactic leadership and/or educational research. We teach our students 21st-century skills to set them up for a successful career in a rapidly changing, digital society.

Education on offer

Bachelor's and Master's programmes

Slight changes to the curriculum were made in nearly all degree programmes in 2018. In 2018, a more significant change was made to the Bachelor's degree programme in Computer Science and Engineering, to address the larger number of new students compared with previous years. The degree programme modified the teaching concept in such a way that it becomes easier to scale up to match the larger number of students, and teaching teams were introduced as well. The more than 30 master's degree programmes include mono-disciplinary and multidisciplinary programmes. Not only are the Master's degree programmes closely aligned with the research priorities, they also have a stronger focus on design.

After the successful implementation of Brightspace, our collaboration and learning environment, was further broadened last year in close collaboration with students and lecturers. Because education is becoming increasingly blended, with a mixture of online and offline activities, there is also a growing need for digital support with good digital applications. Several applications have been added, and lecturers receive assistance to incorporate these IT applications into their teaching.

Digital education

TU Delft is internationally recognised as a forerunner in the field of open and online education. Our ambition is to share our knowledge with the world and to improve the quality of our online and campus education through the use of digital teaching methods. At the end of 2018, 95 TU Delft MOOCs (Massive Open Online Courses) were available via the online platform EdX, where a total of more than 2.2 million learners registered from around the globe. A learner can be a pupil taking a course on programming in Scratch, a professional who takes part in a programme on electric cars, a prospective student taking a refresher course on mathematics or a PhD student taking an MOOC on quantum cryptography.

Professional Certificate Programmes (PCP) are a series of programmes designed in co-operation with businesses. A programme comprises two or more MOOCs where learners brush up their skills on subjects of current interest. Examples are data analyse, the design of medical applications or electric cars. Last year, the range on offer was increased to ten PCPs.

Developments in Open Education

TU Delft actively supports Open Education and encourages lecturers to make their teaching materials accessible under an open licence. This year, TU Delft started to produce open textbooks; the first three textbooks were presented in the Teaching Lab in December. TU Delft Library provides lecturers with the necessary support, such as in workshops.

In 2018, TU Delft received a grant from the Ministry of Education, Culture and Science for the fifth time in a row as part of the open and online education stimulation programme. The project focuses on embedding a peer review process in a game-based learning environment. This creates a safe learning environment where students can give and receive formal and informal feedback from each other.

Within mathematics, steps were taken to actively reuse materials developed by lecturers at TU Delft and at partner universities. This includes videos, slide packs and a large database of assignments and practice assignments. In this respect, a growing group of lecturers form an active community as continuing steps are taken to build on the results of the OpenUpMath model project, which is funded by the Association of Universities in the Netherlands and the Ministry of Education, Culture and Science. In addition, mathematics is offered as part of PRIME (Programme Innovation Mathematics Education) within the context of engineering, where new materials are developed, existing materials are collected and practice materials are made available to students online.

TU Delft received various awards for its open education this year, just as in the past. At the OEGlobal congress in Delft, Félienne Hermans received the Open Education Educator Award for Excellence, and Rob Mudde accepted the award for open policy for the Impact for a Better Society strategic framework on behalf of TU Delft. The Rethink the City MOOC and the TU Delft Online Learning Hub received an honourable mention.

2.4 Education quality

Quality assurance for degree programmes

In 2017, for the second time, TU Delft received a positive assessment from the Accreditation Organisation of the Netherlands & Flanders (NVAO) on the educational quality assurance system based on the Institutional Assessment of Quality Assurance

(ITK). This resulted in the extension of the ITK until November 2023. The international panel of peers complimented TU Delft on its culture of quality and the underlying quality system, and it was impressed by the university's open and online education initiatives – an area in which TU Delft can be regarded as world-class, according to the panel. In addition to the institutional assessment, the NVAO assesses individual degree programmes. In 2018, the Master's degree programmes in Geomatics and Systems and Control (4TU) received definitive re-accreditation from the NVAO for a period of six years. In 2018, the Master's degree programme in Industrial Ecology (joint degree) went through the re-accreditation process and is now awaiting definitive re-accreditation following a positive inspection assessment. The new Master's degree programme Metropolitan Analysis, Design and Engineering received conditional accreditation. A total of 30 programmes are to go through a re-accreditation process in 2019 (12 Bachelor's degree programmes and 18 Master's degree programmes).

Development of lecturer quality

In 2017, TU Delft opened its Teaching Lab as the central hub for lecturers and lecturer development. Within the Teaching Academy, the community of TU Delft lecturers, educational developments are brought together, and cooperation and innovation in education are encouraged. To this end, the Teaching Lab provides lecturers with testing and collaboration environments for educational experiments and space for engaging in discussions or initiating educational projects with each other. The Teaching Lab also serves as a relaxed meeting place, with many over-arching educational events being organised here, including the annual Education Day and interfaculty consultations. In 2018, this location was physically connected to PULSE, the new teaching building.

TU Delft promotes a culture that enables staff to excel in education. In addition to the activities in the Teaching Lab, an annual education day is organised as well. In 2018, its theme was 'Unlock Potential'. The education day also honoured lecturers by awarding a prize for best teacher at TU Delft 2018. This was followed by announcing the name of four new education fellows who had made a substantial and valuable contribution to education at TU Delft.

TU Delft expects all its lecturers to have a University Teaching Qualification. In 2018, a University Teaching Qualification course was held for the first time in a boot camp setting as lecturers went through the whole course in one week. This concept was highly appreciated by lecturers and trainers alike. TU Delft wants all teaching staff to be well equipped to teach in English. It has been agreed with the representative bodies to harmonise the language requirements for Bachelor's and Master's degree programmes to this end.

Ambitious culture of study

TU Delft offers its students new challenges in addition to the regular curriculum. The university aims to offer all students something extra – not just to encourage honours students alone in this regard. Students can take part in activities such as lectures, student trips and workshops. Above-average students can take part in double-degree programmes and honours programmes. In 2018, 180 students entered the Bachelor's programme from the Delft honours programme. Within the programme, students follow faculty modules and projects worth 15 ECTS, and at least 5 ECTS within an interdisciplinary programme.

Extra-curricular student projects

TU Delft attaches great value to the extracurricular activities of students. In addition,

many students devote themselves to administrative and other activities for study associations or community student initiatives. In addition, the university facilitates dream teams where students, often successfully, take part in international competitions. In this context, students not only achieve excellent results but they also learn to work in interdisciplinary teams, manage projects, learn how to work with companies and experience for themselves what it is like to design, realise and test out their ideas. In 2018, for example, a team of students from Delft successfully took part again in the Solar Challenge, the solar-powered car race event through South Africa. The iGem team developed a technology that can detect gene doping, and Project March continued to work on an exoskeleton that can enable paraplegics to walk again. Other student teams worked on projects such as a human-powered submarine (WASUB), racing cars that run on hydrogen (FORZE and Eco-runner) and a super fast bike (Human Power Team).

2.5 Educational support

Preparatory activities

Throughout the education chain, TU Delft devotes attention to introductions to science and technology. The Science Centre and the informational activities focus primarily on secondary-school students and their parents. Continued education and the inspiration and motivation of primary and secondary school teachers takes place in the Wetenschapsknooppunt Zuid-Holland and Bètasteunpunt Zuid-Holland. The pre-university talent programmes Junior TU Delft and Math & Science Classes are available to students in the fifth year of pre-university education who are looking for a real challenge. The STELA project was completed at the end of 2018. This project aimed to create a stronger link between secondary school and the university by using learning analytics. The project was carried out in co-operation with KU Leuven, TU Graz, Nottingham Trent University and SEFI.

Bachelor's information

To give pupils an even more accurate idea of what they can expect in the degree course programme, the design of the open days was changed in 2018. The number of open days has been increased from four to five to make the event less massive. The programme has been changed as well: the information sessions take place in the faculties only now, and they last longer. These sessions provide more in-depth information on choosing a degree programme, including a lecture on a module representative of the degree programme. In addition, trial programme modules are now available for almost all Bachelor's degree programmes, where pupils can get a good impression of the content of the degree programme online as well. To provide an initial, general impression of TU Delft, a campus tour is organised every Friday afternoon, where pupils are given a guided tour of the campus by a student.

Programme choice check

The Programme Choice Check is a matching tool offered to help pupils make a conscious choice. All applicants for a degree programme without a numerus fixus receive an online questionnaire. After filling it in, they receive a personal recommendation about the degree programme. Everyone who applies before 1 May is entitled to such advice on their choice of a programme. Depending on the recommendation (positive, negative or unsure) and the degree programme, applicants will be invited to take part in a programme choice check activity offered by the degree programme. These activities vary according to the programme.

Master's information

In 2018, a customer journey was made of international students who decide to pursue a Master's degree. What process do these students go through, and what problems do they encounter? In 2019, this information will be used to improve bottlenecks in the programme choice and registration process. Many international students who decide to pursue a Master's degree can also benefit from the experiences of current students. In 2018, TU Delft therefore started Student Stories, where international students talk about their experiences at TU Delft. TU Delft did not run any specifically international recruitment campaigns in 2018.

Additional support and guidance during the degree programme

In addition to the support provided in the faculties by academic counsellors, mentors, internship coordinators and international coordinators, all students have access to a broad range of support. While individual students are welcome here, they can also make use of the wide range of workshops and training courses focusing on effective studying, personal support, programme selection and career planning. Examples include smarter ways to prepare for exams, studying with dyslexia and thinking constructively when dealing with fear of failure. As part of the professionalisation of the support, a week of master classes was offered to all academic counsellors this spring, and this year was the first time that a professionalisation programme was offered to academic counsellors in connection with LDE.

Choosing and switching degree programmes within TU Delft

During their studies, students may have doubts or need to make choices (e.g. relating to the BSA). Students can then discuss their situation with the academic counsellor in the faculty or make use of workshops and individual counselling. Master's Choice workshops are offered as well.

Students work on sustainable development goals in multidisciplinary teams

Academics and students at TU Delft use their expertise and skills to find concrete solutions to global problems. TU Delft supports these student initiatives, who work in multidisciplinary teams on the sustainable development goals formulated by the United Nations. Here they focus primarily on countries in Sub-Saharan Africa and South-east Asia. In 2018, slightly more than a hundred students were involved in a large number of projects (14 individual projects and 15 multidisciplinary projects). They worked in areas such as improving drinking water systems, research into the pollution of surface water and drinking water, problems with waste and plastic, food supply, effects of climate change, rapidly growing cities, floating homes and low-cost techniques to improve healthcare. All projects target high-impact solutions, based on science and technology. Students work with local partners, as they together implement and test their solutions for use in real-life situations.

Studying with a disability

The percentage of students who state they have a functional impairment is between eleven and fourteen per cent. The largest group by far state they have dyslexia, with ADHD and ASS trailing far behind. These students are at high risk of incurring study delays or dropping out. The Study Buddy Project provides one-on-one guidance for students with disabilities or chronic illnesses by matching students with 'study buddies'. In 2018, many students utilised the opportunity to have a study buddy. The collaborating with the Municipality of Delft, with the aim to pave the way to the job market for graduates with a functional impairment, has resulted in some nice jobs.

Scholarships for international Master's students

In 2018, several scholarships were used to encourage international student mobility within the Master's programme, such as Holland Scholarships In 2018, twenty-four international students received a full grant from the Louise and Justus van Effen Scholarship Fund. A gift to the University Fund made five scholarships available to women from low-income countries and for pursuing a Master's degree programme at TU Delft. Delft Global Initiative provided four grants to excellent students from Sub-Saharan Africa.

Support for doctoral candidates

Doctoral candidates make good use of the services of the PhD psychologists, where many doctoral candidates received pre-emptive help preventing drop-out. In addition, part of the Doctoral Education (DE) programmes include training by psychologists and student counsellors, which enables doctoral candidates to identify problems earlier on and cope better with the workload. To provide further support for the healthy functioning of doctoral candidates, the TU Delft Health Coach programme is also available to doctoral candidates: 78 doctoral candidates started this programme in 2018.

2.6 Educational collaboration

Leiden – Delft – Erasmus Strategic Alliance (LDE)

Six joint-degree programmes are offered within the LDE Alliance between TU Delft, Leiden University and Erasmus University Rotterdam. Cooperation in minors has been further strengthened, and the LDE minor Frugal Innovations for Sustainable Global Development commenced in 2018. Developed within the LDE Centre for Frugal Innovation in Africa, this multidisciplinary minor focuses on developing smart and simple solutions in the struggle to improve living conditions for the very poorest, which is one of the objectives of the UN. Within the LDE context, TU Delft also participates in the Centre for Education and Learning (CEL). The focus of this collaboration is on improving the quality of university education. Partners collaborate in the area of research on higher education, professional development for lecturers and educational innovation, as well as online and blended learning. In 2018, the position of director of research of CEL was filled by professor Marcus Specht, chair of Digital Education in the faculty of EEMCS.

Education in 4TU.Federation

Two joint-degree Master's degree programmes are offered within the 4TU.Federation. The 4TU Centre for Engineering Education (CEE) plays an important role in educational collaboration (see also section 4.6). In 2018, CEE developed a conceptual guide for

future engineering education based on the necessary skills that society is likely to expect of engineers in the next ten to twenty years. This framework was validated in a number of workshops and presented amid great interest to the International Conference of the CDIO (an international network of 160 universities of technology and institutes of higher education) in Japan.The development of the Joint Interdisciplinary Master's Project is the second project that comes to mind. This brings together Master's students with sector organisations, companies and academic staff from TU Delft to work on various socially and technologically relevant projects that go beyond individual disciplinary building blocks. In 2018, a successful pilot project was run with the participation of sixteen students. The aim is to work up to 60 students in the coming academic year.

Regional collaboration with universities of applied sciences and Leiden University
TU Delft has an intensive partnership with The Hague University of Applied Sciences, the Rotterdam University of Applied Sciences and InHolland Delft, as part of one of the science and technology networks in the Netherlands (Bètasteunpunt Zuid-Holland). The collaboration is aimed primarily at providing continued education and inspiration to teachers in secondary education, as well as to lecturers in applied professional or university education. Bètasteunpunt Zuid-Holland works closely here with the regional Leiden help desk, which is coordinated by Leiden University. In addition, efforts were started to expand collaboration concerning the intake and mobility of graduates of universities of applied sciences to TU Delft, as well as the improved opportunities for TU Delft students to transfer to universities of applied sciences. The regional collaboration has been expanded to include 55 secondary schools in Zuid-Holland via Bètasteunpunt Zuid-Holland, which primarily make use of the opportunities for continued education for lecturers. In addition, TU Delft takes part in the Zuid-Holland teaching network. This teaching network connects secondary education to institutes of higher education and universities, with the focus on lecturer professionalisation and alignment. This brings various companies and social institutions in the region together to promote practice-based and current education.

International cooperation

TU Delft is an active member of a number of European university networks with the aim of seeking out best practices for the diversity of organisational and management issues within universities. The IDEA League is a strategic collaboration between five leading European universities of technology: TU Delft, RWTH Aachen, ETH Zurich, Chalmers University and Politecnico di Milano. TU Delft is also a member of the European Universities Association (EUA). As one of its founders, TU Delft is an active member of the Conference of European Schools for Advanced Engineering Education and Research (CESAER), an international non-profit association of 51 prominent European universities of technology and institutes of technology in 26 European countries. The Bachelor's and Master's degree programmes and students benefit from TU Delft's participation in programmes such as the Global Engineering and Education Exchange (GlobalE3) and UNITECH. In addition, TU Delft is an active member of the European Society for Engineering Education (SEFI), the largest network of institutions of technical education in Europe.

Exchange agreements

Students in eight Master's degree programmes take part in a double/multiple-degree partnership with foreign institutions. These partnerships were often initiated with a European grant (Erasmus Mundus), but they now continue without any grants. Two Erasmus Mundus programmes are now running. In 2018, a number of successful current exchange agreements with different partner institutions worldwide were renewed. In addition, negotiations have commenced on various new agreements with universities in

Asia, America and Australia. The number of exchange students that come to Delft has continued to rise slightly: in the 2017/18 academic year, 688 exchange students enrolled at TU Delft (2016/2017: 618). There were 660 outgoing exchange students from TU Delft (2016/2017: 590). Since January 2018, students from twelve universities in the Netherlands and other countries have been able to take online elective subjects at each of these institutions to gain credits. This virtual exchange programme is an initiative of TU Delft and started with a three-year pilot project (until 2020) where the potential for campus students was explored. The partnership also provides an additional connection between the online educational activities of the Delft Extension School and the regular degree programmes. See also section 4.6 for an overview of the international partnerships in the field of education.

2.7 Preparation for a career

The percentage of students that succeed in finding a job in the Dutch job market is on the rise. The services provided focus especially on helping talented international students find their way from TU Delft to the Dutch labour market. One of the projects developed especially for this target group involves making videos available of international alumni who have already taken successful career steps.

The Delft Centre for Entrepreneurship (DCE) provides various courses and minors for those students who want to start their own business. TU Delft supports entrepreneurs in a variety of ways, not only by providing the courses mentioned above but also by helping with investment and coaching, such as via our Yes!Delft business incubator.

The National Alumni Survey, which was conducted in November 2017 among alumni who graduated one or two years ago, shows that there is an average of 2.9 months between graduation and a paid job. The average number of contract hours amounts to 39.1 and the average income to 2,833 euros. Thirty-two per cent of graduates are employed in the industry, trade and transport sectors, 19% at universities and research institutes, 9% in IT, 8% in other commercial services and 22% in other sectors.

Open Education: TU Delft MOOCs: two million enrolled and MicroMaster's programme

TU Delft recorded the two-millionth registration for its free online courses (MOOCs). Solar Energy was the first and has so far had 216,000 registrations. Data Analysis (162,000) and Solving Complex Problems (152,000) are also popular. TU Delft seeks to share its knowledge with people from every part of the globe, and with success: we have participants from nearly every country in the world. For more in-depth knowledge on solar energy, TU Delft also offers a MicroMaster's programme with modules at Master's level and a final project. For some students, this gives them a head-start on their Master's degree programme, as these credits count towards the rest of their degree.

3 Research and innovation

3.1 Introduction

TU Delft has a broad research portfolio and conducts globally recognised research in fields as diverse as quantum-nano and bio-nanotechnology, maritime technology, architecture, transport, water management, aerospace technology and robotics. The strong position of the research conducted at TU Delft (see section 3.5) is accompanied by efforts to increase our societal impact by providing knowledge-intensive, technology-driven solutions to societal problems. Research and innovation, i.e. the utilisation of scientific knowledge in society, go hand in hand at TU Delft; our ambition as an organisation is to not only be good at what we do, but also to be good for something.

In 2018, once again big steps in this direction have been taken. We are consistently connecting our research with societal challenges and enter sustainable public-private partnerships (see section 3.3). One example is all research aimed at the sustainable energy transition, such as within the e-Refinery consortium to electrify and decarbonise the chemicals and energy industry, within the PowerWeb Institute, which focuses on the increasing integration of energy systems, and within the ESP lab, where research into system integration in the energy system is conducted (see section 3.4). Another example is the medical-technological research, such as the research in the HollandPTC proton clinic on the TU Delft campus (see p. 59), the development of technologies for the early detection of cardiovascular diseases (see p. 47) and building a synthetic cell (see p. 65). All are examples of science with great relevance and impact on society.

A part of the research at TU Delft results in innovations and spin-offs. In 2018, for example, TU Delft researchers developed a method for the large-scale rehabilitation of coral in the Great Barrier Reef (see p. 68), a solar charger for cars that can also be used to supply your home with electricity via the vehicle-to-grid concept (see p. 47), the world's first bipolar steerable 3D-printed snake-like tip (see p. 46), DelFly Nimble, the nimblest-ever robot fruit fly (see p. 50), and the first publicly accessible QuTech demonstrator, that you can log in to via the cloud to run quantum algorithms (see p. 52).

3.2 Research and innovation in brief

Science, engineering and design: these are the three cornerstones of the research conducted at TU Delft. Although the emphasis placed on each of these aspects can vary for each field, the research profile of TU Delft as a whole is characterised by a combination of these three mutually reinforcing approaches. The integration of science, engineering and design begins in the design of a research project and continues throughout the research project, up to the potential implementation of its outcomes.

Faculties and departments

The more than 40 technical-scientific disciplines and their many specific specialisms are accommodated within the eight TU Delft faculties (see figure 5). The disciplinary strength of TU Delft is a critical success factor for fruitful multidisciplinary and interdisciplinary cooperation.

Faculty of Architecture and the Built Environment (ABE)
Department
Architecture
Architectural Engineering & Technology
Research for the Built Environment
Management in the Built Environment
Urbanism
Faculty of Civil Engineering and Geosciences (CEG)
Department
Engineering Structures
Geoscience & Engineering
Geoscience & Remote Sensing
Hydraulic Engineering
Materials, Mechanics, Management & Design
Transport & Planning
Water management
Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS)
Department
Applied Mathematics
Electrical Sustainable Energy
Intelligent Systems
Microelectronics
Quantum and Computer Engineering
Software Technology
Faculty of Industrial Design Engineering (IDE)
Department
Design Engineering
Industrial Design
Product Innovation Management

Faculty of Aerospace Engineering (AE)
Department
Aerodynamics, Wind Energy, Flight Performance and Propulsion
Control and Operations
Aerospace Structures & Materials
Space Engineering
Faculty of Technology, Policy & Management (TPM)
Department
Engineering Systems and Services
Multi-Actor Systems
Values, Technology and Innovation
Faculty of Applied Sciences (AS)
Department
Bionanoscience
Biotechnology
Chemical Engineering
Imaging Physics
Quantum Nanoscience
Radiation Science & Technology
Faculty of Mechanical, Maritime and Materials Engineering (3mE)
Department
Biomechanical Engineering
Cognitive Robotics
Delft Center for Systems and Control
Maritime and Transport Technology
Materials Science and Engineering
Precision and Microsystems Engineering
Process and Energy

Figure 5: Faculties and departments – see also appendix 1 (overview as of 31 December 2018)

Academic integrity

TU Delft operates on the basis of shared responsibility for academic integrity. All staff who are involved in research, teaching and impact within the organisation have personal responsibility, but the university has duties of care as well. The university thus complies with the Netherlands Code of Conduct for Research Integrity, which took effect on 1 October 2018. To determine exactly how TU Delft implements this, the Executive Board adopted the TU Delft Vision on Integrity 2018-2024 in September. This integral vision on academic, social and organisational integrity builds on the existing integrity policy, including the Code of Ethics, and the Strategic Framework 2018-2024 (see section 4.4 for further information).

Open Access

TU Delft aims to increase the awareness of researchers regarding Open Science. To encourage Open Access publications, the development of Open Access publishing services was started in 2018. The aim is to support researchers in all publication stages, for example by choosing the most appropriate (Open Access) journal, providing (financial) assistance for Open Access publishing, and applying for ISBN numbers. Since 2018, TU Delft offers the opportunity to publish books and journals on its own Open Access platform.

In addition, TU Delft has set out to lower the cost of Open Access publications, by negotiating with publishers about journal subscriptions. The aim is to make the transition from 'reading rights' to 'publication rights' at the same time. More and more interesting contracts are being concluded, but cost-reduction remains a point of concern. Within the framework of the Association of Universities in the Netherlands (VSNU), the Dutch universities have decided to only renew contracts with major publishers if they allow Open Access publishing without additional costs for researchers. In 2018, Rector Magnificus and president of the TU Delft Executive Board prof.dr.ir. T. van der Hagen led the VSNU team that negotiated with Elsevier. In December, it was decided to extend the current contract with Elsevier by six months. This period will be used to continue the negotiations.

In 2018, TU Delft researchers published more than 63% of their peer reviewed articles Open Access (see figure 6). In 2017, the share of Open Access published articles was still at 52%, so we can speak of a substantial increase. The absolute number of articles published Open Access increased from 1635 in 2017 to 2241 in 2018. This means that TU Delft has achieved the national objective of 60% Open Access as formulated for 2018 by the Ministry of Education, Culture and Science.

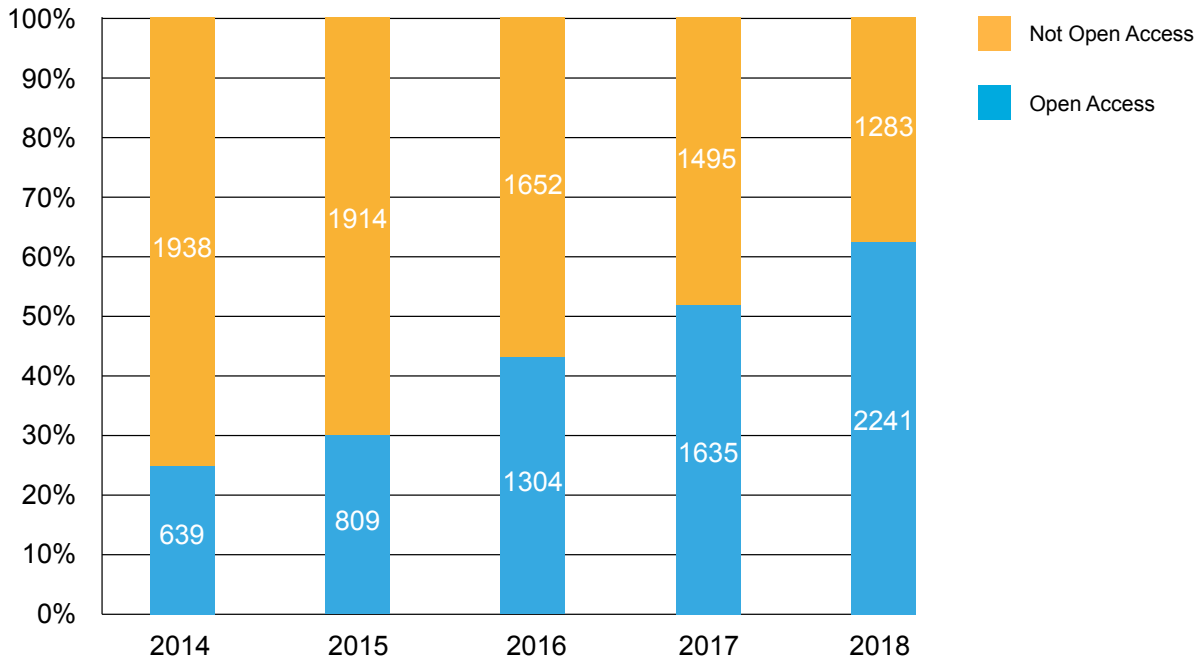


Figure 6: Open Access Monitor 2018

In February 2018, prof.ir. K.C.A.M. Luyben, Rector Magnificus Emeritus of TU Delft, was appointed National Coordinator for Open Science. In addition, in November he was appointed chairman of the European Open Science Cloud, a virtual environment where European researchers can store, manage and reuse data as from 2020.

Data stewardship programme

The data stewardship programme, commenced in 2017, was continued and broadened in 2018 to meet what has proved to be an urgent need. Where last year three faculties had a data steward with a 50% appointment, now every faculty has a full-time data steward. These disciplinary experts form the first point of contact for questions about the planning of data management as well as the backup, organisation, description and publication of research data, also in the framework of the General Data Protection Regulation. Sharing research data where possible is an ambition, but not an obligation. The data stewards also help researchers to meet the requirements of research funders and academic journals.

3.3 Research and innovation collaboration

'Impact for a better society' is the motto of TU Delft's strategic plan. TU Delft creates this impact by systematically organising its research potential in connection with societal challenges. The research questions that emerge from them are often so complex that they can only be answered by joining forces: sometimes by collaborating with researchers from various disciplines, sometimes also by working with colleagues from the industry or with societal partners. This is done in consideration of national research priorities, such as those formulated in the Dutch National Research Agenda and the Top Sector policy, as well as international research priorities, including the EU's Horizon 2020 programme and the UN Sustainable Development Goals. Thematic collaboration takes on a variety of forms, depending on where the necessary expertise can be found: across faculties, regionally, nationally or internationally.

Cross-faculty collaboration

TU Delft promotes multidisciplinary and cross-faculty research that focuses on responsible societal innovation. The research is systematically linked to societal challenges. The research questions that emerge from them are often so complex that they cannot be answered without joining all our forces. The Delft Research-based Initiatives (DRIs) and TU Delft Institutes are cross-faculty partnerships within TU Delft, organised around specific topics.

Delft Research-Based Initiatives

Health, energy, globalisation, and infrastructure & mobility are among the most important themes in today's society. For this reason TU Delft established the Delft Research-based Initiatives (DRIs) in these four areas, see Figure 7. These virtual, multidisciplinary partnerships between various TU Delft faculties contribute to solving the societal issues addressed within these four themes. The DRIs are conversation partners for the government and industry, identify important opportunities and actively showcase innovative science. The main development in 2018 of each DRI is discussed below.

Delft Deltas, Infrastructures & Mobility Initiative (DIMI)

Within the DIMI programme 'Urban Infrastructures', the two large-scale design studies 'City of the Future' (CotF) and 'Stations of the Future' (SotF) are a big step in the application of designing research internationally. With 600 students, 10 multidisciplinary design teams and TU Delft scientists, CotF presented integrated

	Energy	Deltas, Infrastructures & Mobility	Health	Global
Objective	Energy innovation for sustainable energy provision	Vital infrastructures for water safety and smart mobility intrinsic to the natural and built environment	Technological research for medical and health care innovations	Science and Technology for Global Development
Research themes	Urban energy Powerweb: smart grids e-Refinery: electro-chemical conversion and storage of materials Wind energy	Urban infrastructures Airport of the future Urbanising Deltas	Medical imaging & Image guided medicine Interventions & Care Targeted molecular technology Vitality	Healthcare for all Plastic-free rivers Urbanisation Drinking water Disaster resilience and response Internet of things

Figure 7: Overview of Delft Research-Based Initiatives (DRIs)

design visions for 2040, for development and transformation areas in Amsterdam, The Hague, Rotterdam, Utrecht and Eindhoven. In close collaboration with AMS, SotF has produced a variety of results: seminars, a summer school and a white paper including a framework for research, education and consortium-building. For further information, see: www.tudelft.nl/infrastructures

Delft Energy Initiative
While previously, the Delft Energy Initiative mainly served as an umbrella under which many energy-related activities were conducted, meanwhile it has developed into a breeding ground for four major energy themes. These are ‘urban energy’, which also includes the theme ‘heat’; ‘power web’, or smart energy networks; ‘wind’; and ‘e-Refinery’, the electrochemical conversion and storage of materials. Students of the TU Delft Energy Club continue to support the relevant researchers within these themes. For further information, see: www.tudelft.nl/energy

Delft Global Initiative
Delft Global has, since the appointment of 20 PhDs in various fields of research in 2016, grown to become a community of more than 125 TU researchers. They work on a multidisciplinary basis and together with local partners on concrete solutions to global problems, urgent in low-resource settings. It has become clear what the opportunities, experts and priority areas are in science and technology for global development. Last year, the step from projects to programmes was taken. See for further information: www.tudelft.nl/global

Delft Health Initiative
DRI Health is the node where scientific knowledge about medical technology meets societal challenges in the field of health care. HollandPTC is running a technological research programme on proton therapy, and since 2018 cancer patients have access to this new treatment in the Netherlands. In addition, in close collaboration with UMCs, universities, healthcare institutions, government bodies and businesses, research in being conducted into building a synthetic cell, medical instruments, robotic solutions for rehabilitation, technology for the early detection of cardiovascular diseases, medical imaging and the development of electroceuticals. For further information, see: www.tudelft.nl/health

Doctoral defences in 2018

In 2018, 364 doctoral candidates successfully defended their dissertation at TU Delft. These mostly young researchers make an important contribution to the ground-breaking research conducted at TU Delft. To give an impression of the breadth of this doctoral research, one important dissertation project per faculty is highlighted.

Impact catheter for unblocking blood vessels
Dr.ir. A. Sakes (3mE) obtained her doctorate on a new technology to reopen chronically blocked coronary arteries. Inspired by smart striking mechanisms in nature, she developed a series of innovative impact catheters that punch an opening in a chronical occlusion, with the world's first bipolar steerable 3D-printed snake-like grabbing tip and a minuscule biopsy instrument for mammary ductoscopy as spin-offs. Sakes won, among other things, the Medical Delta Young Scientist Award 2017 and an NWO Demonstrator grant for her work.

Natural solutions for reducing heat in cities
Urbanised areas are home to more than half of the world's population and are generally hotter than the rural areas that surround them. The introduction of plants and open water is the best way of combatting extreme heat in our cities, says dr. A. Solcerova (CEG). In her doctoral research, she studied the cooling effect of open water around buildings at locations in Delft according to the 17th-century Japanese tradition of uchimizu, sprinkling water on the streets. The conclusion: uchimizu works.

New techniques for controlling air flows
The PhD work of dr.ir. H.J. Tol (AE) has brought together two separate scientific disciplines: aerodynamics and control technology. By developing new mathematical theories, he was able to model the instability in air flows that cause the transition to turbulent flows, and control devices based on plasma actuators to control these transitions. These techniques were successfully demonstrated by Tol in a wind tunnel. In addition to this breakthrough, Tol's research has led to a new scientific field: the fusion of aerodynamics and control technology.

International price effects of renewable energy sources
Dr.ir. K.K. Iychettira (TPM) obtained her doctorate for her dissertation 'National Renewable Policies in an International Electricity Market', in which she studied the international price effects associated with the large-scale use of renewable energy sources. She demonstrated that this has serious implications for both national prices and subsidy programmes, and that this effect also reaches across borders. The current market structures in Europe are not suited for a future in which renewable energy is generated on a large scale and where the costs and benefits should be shared fairly.

Project-specific value capture strategies of architectural firms
The doctoral research of dr.ir. M. Bos-de Vos (ABE) shows how architectural firms capture different dimensions of value in the projects in which they are involved. Based on this research, a design guide was created for firms to take a more conscious approach as to how they consider and manage their contribution to projects. Also a board game was developed that helps creative professionals to develop a profitable business model for a project that fits in with their professional objectives. The dissertation is the result of the FuturA project and part of the NOW Research Through Design programme.

Improved ultrasound device for carotid artery flow
Dr. M. Shabanimotlagh (AS) has developed a special ultrasound transducer with built-in electronics. This tool can, among other things, be used to make echocardiograms of moving parts of the carotid artery. What is special about this transducer is that it can produce three-dimensional images in rapid succession, up to 1,000 per second, that can for example be used to visualise the flow of blood in the carotid artery. This possibility is important for non-invasive screening for cardiovascular diseases.

Materialising technologies
Dr. H.V. Robbins (IDE) has researched how contemporary technologies, in spite of their complexity, can be made 'legible' to a layperson. She explored how to make the design practice more responsible, so that people not only can understand how the technology works, but can also contribute to its functioning. This is becoming increasingly important with the rise of connected and data-intensive technology. In close collaboration with professional design practitioners, Robbins has contributed to the development of a European grassroots movement to promote the responsible design of complex technologies.

Charging electric cars with solar energy
Dr. G.R. Chanda Mouli (EEMCS) has developed the world's first charger for the direct high-speed charging of electric cars using solar energy. The system works in two directions: the energy from the car's battery can also be used to supply a home with electricity, for instance (the so-called vehicle-to-grid concept). The charger has been developed in cooperation with PRE, a company in Breda, was awarded 'Most Significant Innovation in Electric Vehicles 2018' by IDtechEx, and was featured on the television programme EenVandaag.

TU Delft Institutes

The TU Delft research capacity in specific and often relatively new fields of research is clustered in university-wide partnerships: the TU Delft Institutes. This virtual clustering of high-quality research capacity increases TU Delft's visibility in the relevant field of research. They also put TU Delft in a better position to join (inter)national consortia and research programmes, and to be attractive to scientific talent. Figure 8 contains an overview of the topics the various institutes focus on. Below the main development of each institute in 2018 is discussed. Additional information on the activities of the TU Delft Institutes is available through www.tudelft.nl/en/research/thematic-cooperation/.

TU Delft Bioengineering Institute

Launched in March, the Bioengineering Institute is initially focusing on broadening its internal network. Under the leadership of prof.dr.ir. M. Reinders (EEMCS), it is also working on a follow-up strategy, where the emphasis will be placed on entering external alliances. These are needed to form consortia in order to achieve further successes in areas such as waste water treatment, antibiotic resistance, biofuels and synthetic cell research, as well as the development of highly specialised research instruments for the life sciences and biology.

TU Delft Climate Institute

The Climate Institute debates climate change on the basis of research results. With that, the research infrastructure is a top priority. In April, the Ruisdael Observatory received, as one of the ten certified facilities, a NWO grant from the National Roadmap Large-scale Research Infrastructure. The Ruisdael Observatory – named after the 17th-century painter Van Ruijsdael – combines a nationwide dense network of measuring points with high-resolution simulations in order to map out changes in local weather, climate and air quality. This research facility was officially opened on 27 September.

TU Delft Computational Science and Engineering Institute (DCSE)

In 2018, the DCSE trainings and courses for scientists and interested industry stakeholders were in the spotlight. They included Open Source Field Operation And Manipulation (OpenFOAM) courses, along with courses by visiting professor prof.dr. H. Nilsson. The courses by this expert in Computational Fluid Dynamics are highly valued, not only within various faculties, but also in the international OpenFOAM community. OpenFOAM has proved to be an extremely powerful way to unite research and teaching.

TU Delft Design for Values Institute (DDfV)

The year 2018 saw the first death caused by a fully self-steering car, an incident that raised questions about accountability. It was also the year in which the Facebook/ Cambridge Analytica scandal put privacy high on the public agenda. These examples make clear that the ethical design of new technologies, products, services and spaces is more important than ever. In its second year of existence, DDfV therefore attracted much attention, among other things with a new website, seed project financing, various events and a research consultancy project about digital platforms and democracy.

Dutch Optics Centre (DOC)

Internationally recognised as a photonic hotspot, the Dutch Optics Centre promotes applied research, bridges the gap between research, development and innovation and results in substantial national research programmes (such as the NWO Perspective Programme SYNOPTICS). DOC has played a leading role in the coordination of the national photonics agenda: a guideline for the government that defines the opportunities in photonics within the Netherlands for the years ahead. A binational optics track will soon be offered in cooperation with Friedrich Schiller University Jena (Germany).

Name	Focus	Start	Faculties
Bioengineering	Biomass based products Environmental bioengineering Bioengineering for health	2016	3mE, AS, CEG, EEMCS
Climate	Urban Climate Ice and Sea-level Change Water Cycle (Engineering the) Radiation Balance Negative Emissions	2012	ABE, AE, CEG, EEMCS, TPM (3mE, AS)
Computational Science & Engineering (DSCE)	Dynamics Structures Solids Socioeconomics & Life	2016	3mE, AS, AE, CEG, EEMCS, TPM
Design for Values (DDFV)	Responsible innovation Value operationalization Value assessment Value conflicts Value dynamics	2017	ABE, EEMCS, IDE, TPM
Optics Centre (DOC)	Spectrometry Imaging Metrology Next generation optical instruments	2017	3mE, AE, AS (partner: TNO)
Process Technology (DPTI)	Biochemical process engineering Process intensification Process technology for advanced materials	2012	3mE, AS
Robotics	Swarm robotics Robots that work Interactive robots	2012	3mE, ABE, AE, EEMCS, IDE, TPM
Safety & Security (DSyS)	Industrial safety and security Smart technology and Societal needs (Cyber) Security and Safety management	2013	3mE, ABE, AE, AS, CEG, EEMCS, IDE, TPM
Space (DSI)	Sensing from space Space robotics Distributed space systems	2015	3mE, AE, AS, CEG, EEMCS
Sports Engineering	Aero- and hydrodynamics Biomechanics, materials and human/ material interaction Measurement, feedback and simulation Motivation Sports infrastructures and facilities	2014	3mE, AE, EEMCS, IDE, TPM
Transport	Coordinated, cooperative and automated transport Urban mobility & active modes Transport policy & behaviour Logistics & freight transport Railways	2012	3mE, CEG, EEMCS, TPM
Wind Energy (DUWIND)	Social responsible innovation System integration Wind farm and wind turbine design Asset management and big data Airborne Wind Energy	2012	3mE, AE, CEG, EEMCS, TPM (AS, IDE)

Figure 8: TU Delft Institutes

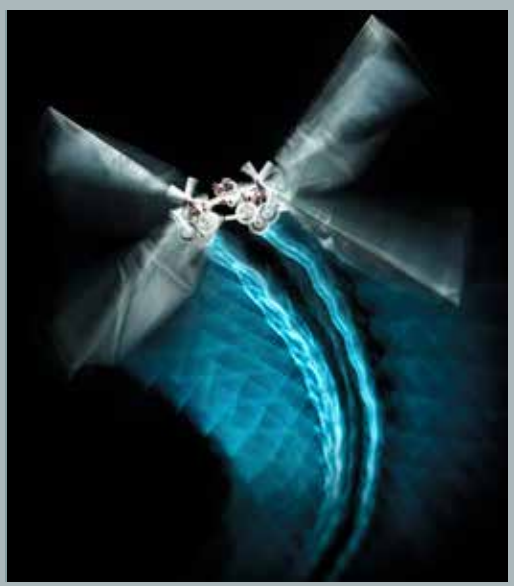
TU Delft Process Technology Institute (DPTI)
Energy was the main area of attention for DPTI in 2018. DPTI was at the basis of e-Refinery, and co-developed the NWO Perspective Programme Electrons to Chemical Bonds, that was recently granted. The DPTI strategy was updated in 2018 and will be implemented by a young, new board. The organisation will be run more from the bottom up, with five clusters (pharma, water, energy, materials and powder/liquid mechanics), in which young academic staff members from four faculties will play a leading role. DPTI will work even more as a research incubator.

TU Delft Robotics Institute
The aim of the Robotics Institute is to bring together the various robotics disciplines. The emphasis on valorisation will diminish, as RoboValley is now ever more focusing on this. Instead, academic support is emphasized, for example for ERC applications, resulting in the Starting Grant for dr.ir. J. Kober (3mE), high-impact papers such as the Science publication by dr.ir. G.C.H.E. de Croon (AE), and the monthly AI&Robotics Seminar Series. At a technical level, there is a stronger focus on Artificial Intelligence, in order to strenghten TU Delft's profile in this area.

TU Delft Safety and Security Institute (DSyS)
The focus of DSys was originally on coordination of the TU Delft fields of research in which safety and security play an important role, and on its function as a window to the outside world. Meanwhile, DSys is developing as a national knowledge partner in the field of safety and security. Examples are the development of a knowledge alliance with the Netherlands Organisation for Applied Scientific Research (TNO) and the National Police on security innovation and the recently signed partnership among the government, (petro)chemical industry and science under the name of Safety Delta Netherlands.

New flying robot mimics flight of insects

Researchers at TU Delft's Micro Air Vehicle Laboratory (MAVLab) have developed a flying robot inspired by insects. The performance of the DelFly Nimble is almost unparalleled, yet it is still fairly easy to make. The robot's wings flap 17 times per second. This provides the necessary lift to keep the robot in the air. It can be steered by making small adjustments to its wing movements. The robot's steering mechanism is very effective, just like with a fruit fly. In addition to being able to hover and fly in all directions, it's also extremely nimble. The development of this robot opens the door to new research of the flight movements of insects. The robot's phenomenal flying properties also make all kinds of new applications for drones imaginable. The DelFly Nimble was voted one of the ten top robotic technologies of 2018 by Science Magazine.



TU Delft Space Institute
In 2018, it was announced that TU Delft delivered two of the three ideas competing for the tenth ESA Earth Explorer mission in 2027-2028, that focusses on the observation of the earth. STEREOID, with dr.ir. J.F. Lopez-Dekker as the lead researcher, concerns measuring movements on the sea surface, glaciers and the earth's surface. Prof.dr.ir. R.F. Hanssen is involved in G-CLASS, which seeks to better forecast how much precipitation will fall during heavy storms. After feasibility studies, one idea will be executed in space.

TU Delft Sports Engineering Institute
In the run-up to the 2020 Olympic Games, this year the Sports Engineering Institute set up the Tokyo Innovation Fund for innovation projects with sports associations and businesses. Together with partners, including KNWU, KOGA, Actiflow and Pontis Engineering, different disciplines are working on the development of the ultimate track bike - one that is light, aerodynamic and tailored to the individual athlete. Aerodynamics specialists help think about the reduction of air resistance, and experts in lightweight materials are studying the optimal rigidity with minimal weight.

TU Delft Transport Institute
In 2018, the Transport Institute strengthened its research basis by acquiring ERC grants and its cooperation with other scientific institutes as well as regional partners via new consortia. Funding was granted to the Urban Mobility Observatory (NWO Large-Scale Infrastructure) and SUMMALab projects, and two NWO Crossover proposals were submitted. The institute worked with the Future Mobility Movement and SmartPort in the The Hague-Rotterdam region, and with the AMS Institute in the Amsterdam region. Its communication was also improved via newsletters and a lecture series.

TU Delft Wind Energy Institute (DUWIND)
In 2018, DUWIND focused via GROW and PhD@Sea on making the necessary contacts to develop a more interactive and clearer national academic network, in order to better support the Dutch wind energy market. It was also decided to do more to bring TU Delft's wind energy research to the public eye, with stands at major international conferences, closer ties to the city of Delft and a greater role in European networks, such as by hosting the TORQUE2020 conference.

Future TU Delft Institute: Powerweb
In mid-2018, the Executive Board decided to start a new TU Delft Institute: PowerWeb, which will focus on the increasing integration of energy systems. Partly because of the energy transition, the operation of electricity, gas and heat networks is becoming more and more intertwined. This calls for a multidisciplinary and coordinated approach of the related technical challenges. Physical assets, digitisation, markets and policies are the main research themes in this respect. Although originally a partnership within EEMCS, PowerWeb has grown to become a cross-faculty platform, in close collaboration with DRI Energy. As from 2019, PowerWeb will be an independent research institute.

Other forms of cross-faculty collaboration

In addition to the DRIs and institutes, there are many other forms of cross-faculty collaboration. For instance, the faculties of AS, 3mE, TPM and EEMCS are working together in the e-Refinery consortium in order to electrify and decarbonise the chemicals and energy industry. In AiTech, academics from various faculties work together in the field of autonomous technology and human responsibility in the digital society. And the AS and EEMCS faculties have been working with TNO in QuTech, an advanced research centre in quantum computing and quantum internet.

QuTech

QuTech is the international leading institute of TNO and TU Delft aimed at the development of a full-stack quantum computer and quantum internet, established in 2014. In the past year, major strides were made in research to accomplish this mission. For QuTech, 2018 was also about making its accumulated knowledge available to a wider public and strengthening its international partnerships and business development. The QuTech Academy has been expanded to become an outreach platform with online and on-campus Master's courses. Demonstrators have also been developed to familiarise the public with the quantum technology developed. The Quantum Inspire, the first publicly accessible QuTech demonstrator that you can log in to via the cloud in order to run quantum algorithms, went live in the summer on www.quantum-inspire.com. In addition, a trail has been blazed for advanced business development. To encourage collaboration with public and private parties, TU Delft gave the go-ahead in 2018 to realise a Delft Quantum Campus: a local innovation community where in addition to QuTech also other entities such as Microsoft, BlueFors and a number of start-ups will settle. In October 2018, the European Commission gave the green light for the Quantum Internet Alliance, led by QuTech, to develop a blueprint for the future quantum internet. This alliance is made up of a consortium of twelve leading university research groups from eight different countries, in close collaboration with businesses and institutes. In order to continue promoting and supporting the growth of QuTech, it was decided to revise the governance structure. As of December 2018, QuTech is managed by a team of three board members. Finally, preparations are made for the first midterm evaluation of the research conducted by QuTech. This will be followed by a site visit by the international evaluation committee, headed by prof.dr. R.H. Dijkgraaf, in early 2019.

X!Delft

Open innovation, thinking outside the box and active experimentation are key assets for companies. X!Delft is an initiative of TU Delft and Roland Berger strategic consultants created to take such responsive action. X!Delft connects academia, corporations, start-ups and students through a range of tailored programmes, giving them access to the knowledge, expertise and capacities of TU Delft and Roland Berger. Collaboration offers opportunities for short pilot programmes, demonstrations and longer research projects within a long-term partnership. By the end of 2018, eight companies were in the process of becoming X!Delft partners.

Regional alliances

TU Delft is situated in a densely populated, dynamic region that is leading in both the sciences and industry, with partners such as the municipality of Delft, the province of South Holland, the port of Rotterdam, the Metropolitan region, the South Wing and the InnovationQuarter and our colleagues at the The Hague University of Applied Sciences and LDE partners in Leiden and Rotterdam. Paramount in our activities is our global ambition, yet we are at the same time keenly aware of our national and local roots: a strong connection to the people around us is of key importance in this respect.

Research collaboration within the LDE alliance

In 2018, forty post-doctoral researchers were selected in the second round of the LEaDing Fellows Programme, in collaboration with Leiden University and Erasmus University Rotterdam (LDE). Also five full professors from LDE were appointed as leaders of themes within the VSNU Digital Society programme. To support the business community of South Holland in the transition to a circular economy, the LDE Centre for Sustainability and the province of Zuid-Holland together with VNO-NCW West and Wageningen University & Research launched the ACCEZ ('Accelerating Circular Economy Zuid-Holland') innovation programme. ACCEZ is aimed at addressing circular

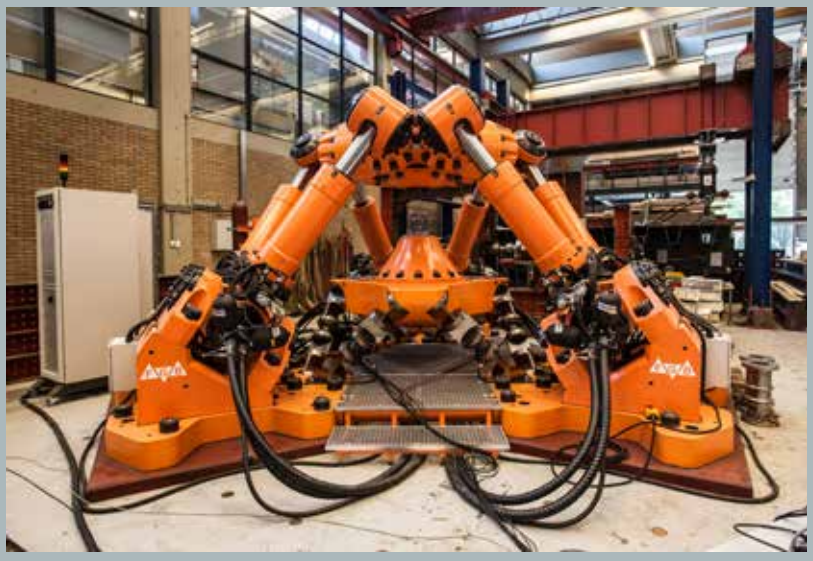
transition challenges, with parties tackling shared problems together, such as closing material cycles, renewable materials and new business models. The first programme is the research programme led by TU Delft to make the Binckhorst neighbourhood in The Hague circular.

Living labs in the region

The region is home to many living labs for scientific research: places where teaching and research are integral elements of working to address societal challenges.

The Green Village on the campus of TU Delft is the living lab for sustainable innovations. This outdoor laboratory, where people also live and work, is used by researchers and entrepreneurs to build, test and demonstrate their experimental innovations. These are technologies that have an impact on people's physical environment, such as sustainable energy, water, circularity and mobility. In 2018, various research and innovation projects made their way to the living lab including DC Connected Homes, the circular garage, Office Vitae and DC Office. In addition, a start was made on the Hydrogen Street, to deal with the challenge of reusing the existing natural gas network for sustainable alternatives. A conventional natural gas network was placed and is now being made suitable for hydrogen. May 2018 the WaterStreet opened, a programme in collaboration with the Delfland water Board and VPdelta. Entrepreneurs, researchers and area managers are working together on the Waterstreet on new innovative products to deal more effectively with climate change-related excessive rainfall in the Netherlands. For example, roads with water-permeable pavement, water buffers, smart rainwater containers or water storage facilities on roofs.

TU Delft's 'beast' is ready for action



The hexapod, weighing 60 tonnes and measuring 6x5x3 metres, is the latest test facility at TU Delft that can exert forces of 100 tonnes in all six directions – up, down, left, right, front and back. One of the things the device can do is to replicate, in four weeks, the fatigue in welded parts of ships of twenty years at sea. Prof.dr.ir. M.L. Kaminski wants to improve the design method used for ships, in order to make them more sustainable, effective and economical, which is where this unique testing facility can help. Also, the hexapod is a universal device, that allows for testing of in principle all load-bearing constructions: for example aircrafts in turbulence, bridges with lorry traffic, buildings during earthquakes or windmills in the wind. TU Delft provided half of the investment, a quarter came from the government and the other quarter was provided by 23 companies; practically the entire offshore industry took part.

Medical Delta is the medical-technological consortium of Leiden University, TU Delft and Erasmus University Rotterdam, the Erasmus MC and the Leiden University Medical Centre, plus government bodies, science parks and some 150 companies. The various Medical Delta Living Labs are part of this consortium. TU Delft also collaborates with the Leiden University Medical Centre and the Erasmus Medical Centre in HollandPTC, an independent clinic and proton therapy research centre on the campus of TU Delft. The Delft Research Lab for Automated Driving (RADDelft) has been established in cooperation with the Municipality of Delft, the Rotterdam/The Hague Metropolitan Area and the province of Zuid-Holland; this lab, which is situated on the campus of TU Delft, provides a place for experimenting on automated transport in real-life situations.

In 2018 the new living lab **RoboHouse** opened, where companies can discover and test new robotics applications. RoboHouse is an initiative of TU Delft, RoboValley, Festo, ABB, InnovationQuarter, Netherlands Organisation for Applied Scientific Research and The Hague University of Applied Sciences. It is part of the regional SMITZH network of living labs for the manufacturing industry.

Regional innovation clusters

In addition to these living labs, TU Delft is also part of various regional innovation clusters. RoboValley is home to more than 170 robotics researchers with different specialisations who work with other experts, entrepreneurs and policy-makers in the public and private sectors: a unique network with the TU Delft Robotics Institute at its heart. The Bioprocess Pilot Facility B.V. (BPF) on the Biotech Campus Delft is an open-access facility where knowledge institutions and companies design new, sustainable production processes. Scientific research is promoted for and by companies in the port of Rotterdam within SmartPort, a partnership between TU Delft and the Port of Rotterdam Authority, Deltalinqs, City of Rotterdam, Netherlands Organisation for Applied Scientific Research, Deltares and Erasmus University Rotterdam. Within Clean Tech Delta, TU Delft works with other knowledge institutions, universities, cities and companies on clean tech initiatives. In Greenport West-Holland, TU Delft works with entrepreneurs, government bodies and knowledge institution on a sustainable and bright future for the regional horticulture cluster. The Hague Security Delta is a network of knowledge institution, government bodies and companies in the area of innovation and safety.

National cooperation

TU Delft cooperates intensively with other organisations at the national level. This cooperation takes many shapes, from one-off exchanges to joint research projects and shared research institutes. The examples mentioned below are therefore certainly not exhaustive. In these and other areas, various teams within the university are developing strategic partnerships with other universities, as well as with private and societal partners. In its choice of subject matter, TU Delft aligns itself with the national agenda concerning science and innovation policy. The policies of NWO and the Top Sectors are important drivers in this respect. The questions and routes of the National Research Agenda also play a leading role in the organisation of our thematic research.

Research collaboration within the 4TU framework

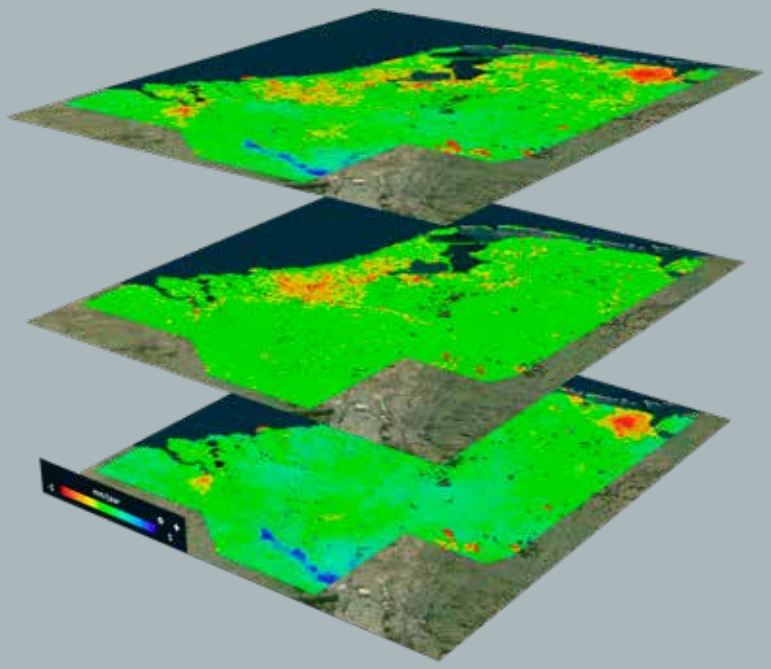
In 2018, the 4TU.Federation gave a strong boost to sustainable technology research with the allocation of a total of 22 million euros to five research programmes within the theme ‘High Tech for a Sustainable Future’. In each of the five programmes the four universities of technology collaborate in multidisciplinary teams. As many as 43 new tenure trackers are being appointed, who teach and conduct research. They will be studying

personalised medicine, disease prevention and treatment, ‘smart’ industry, more resilient societies and the global food demand. The research proposals are thus aligned with the focus areas of the government’s Top Sector policy, the Dutch National Research Agenda and the United Nations’ Sustainable Development Goals.

Research schools

A research school combines research with the education of researchers in a given scientific area. The school contributes to the national coordination of research programmes within specific disciplines, and it plays a particularly important role in providing the third category of the TU Delft doctoral programme: professional skills. In 2018, TU Delft was the coordinating university for five research schools: the Advanced School for Computing & Imaging (ASCI), Centre for Technical Geoscience (CTG), Dutch Institute of Systems and Control (DISC), J.M. Burgerscentrum – Research School for Fluid Dynamics (JMBC) and Transport Infrastructure and Logistics (TRAIL). TU Delft has long-term financial arrangements with each of these research schools, that were in effect in 2018.

Subsidence in the Netherlands greater than expected



Although we had suspected that land in the Netherlands was subsiding, this has now been measured nationwide for the first time. The new Land Subsidence Map, which was published in November by a team of researchers headed by prof.dr.ir. R.F. Hanssen, also shows that the land in the western part of the country in particular is sinking much more than expected. Because the map not only shows the different types of soil in the Netherlands, but also the location of oil and gas fields, it clearly reveals the causes of the subsidence observed.
The map is based on three different kinds of measurement data: satellite radars, GPS and gravity measurements. The interactive map at www.bodemdalingskaart.nl is kept up to date using new satellite data that is released on a daily basis. This makes it possible, for example, to track whether subsidence decreases if less gas is extracted in Groningen. If the subsidence continues at its current pace, the damage to the Dutch landscape can run up to 22 million euros by 2050, according to the Netherlands Environmental Assessment Agency. The good news, however, is that water authorities can use the measurements to improve their water level management, for example, by anticipating periods of drought more effectively.

In addition, TU Delft participated in the following research schools:

- Casimir Research School
- Graduate School on Engineering Mechanics (EM)
- Institute for Programming Research and Algorithmics (IPA)
- Netherlands Graduate School of Urban and Regional Research (NETHUR)
- Netherlands Institute for Catalysis Research (NIOK)
- Netherlands Institute of Government (NIG)
- Research School in Process Technology (OSPT)
- Dutch Research School of Philosophy (OZSW);
- Netherlands Research School for Information and Knowledge Systems (SIKS)
- Netherlands Graduate Research School for Science, Technology and Modern Culture (WTMC)

National innovation programmes and research institutes

TU Delft works with national partners in leading research centres such as the **Institute for Advanced Metropolitan Solutions (AMS)** – a scientific institute in Amsterdam, initiated by the city of Amsterdam where TU Delft works with Wageningen University, MIT and TNO. With a focus on urban issues such as water, energy, waste, food, data and mobility, innovative solutions are being sought for challenges that cities around the world are facing. This is done through studies, experiments and living labs in the Amsterdam metropolitan region. As of 2018, a total of 57 students have been part of the Master's programme in Metropolitan Analysis Design and Engineering (MSc MADE) – a joint degree master's programme between TU Delft and WUR.

The Netherlands Institute for Conservation Art and Science (NICAS) - a collaboration between TU Delft and the University of Amsterdam, the Rijksmuseum and RCE – brings together research within art history, conservation and restoration and the sciences. The public-private partnership **CatchBio**, 'Catalysis for Sustainable Chemicals for Biomass', with Dutch universities, research institutes and the business community aims to produce fuel, chemicals and materials from inedible biomass in a clean way. Various research groups at TU Delft participate in the **Institute for Human Organ and Disease Model Technologies (hDMT)**. Within this non-profit R&D research consortium, partners in science, applied knowledge-intensive organisations and companies are working together on the development and validation of chip-based models for human organs and diseases. In the research and investment programme **ADEM**, the Energy Research Centre of the Netherlands (ECN), three partner universities of technology (TU Delft, TU Eindhoven and the University of Twente), government bodies and industrial partners have joined forces to give the development and use of energy technology in the Netherlands a significant boost. **GROW** is a research consortium of about twenty Dutch companies and research institutes in the offshore wind sector, working together on innovation and reducing the cost of offshore wind energy. The **Mainport Innovation Fonds II** focuses on innovation in logistics, transport and aviation, including the increased sustainability of the infrastructure and materials. Within **Climate Campus**, a partnership among more than 40 parties - government bodies, education institution, companies and social organisations - knowledge and technology are being applied and developed to make the IJssel-Vecht delta resilient to climate change.

In 2018, TU Delft and Leiden University won the bid to house **SRON**, the space research institute of the Netherlands Organisation for Scientific Research, through an invitation to tender from the Netherlands Organisation for Scientific Research. SRON constructs state-of-the-art technological instruments for astronomical research, earth-oriented research and research into exoplanets. This means that TU Delft, Leiden University, SRON and other aerospace engineering partners will be sharing research

facilities in Zuid-Holland and working together more closely. The concentration of Dutch aerospace engineering in Zuid-Holland will strengthen the research position of TU Delft in this area.

International cooperation

TU Delft collaborates with an extensive network of international partners on research and innovation at world-class level, which is vital for solving global challenges and contributing to the Sustainable Development Goals, both regionally and internationally. By taking part in exclusive alliances and networks, TU Delft continually strives to have impact and remain visible as an academic institution that belongs to both local and global ecosystems with the same focus to create worldwide impact. The basis of each partnership is formed by relationships among researchers that have been carefully forged from the bottom up and which are based on a common quest for knowledge and complementary expertise. Some partnerships have grown to become joint theme-based research programmes on both a European and global scale. These initiatives provide access to funding, research infrastructure and talented young researchers. In addition, TU Delft is part of European university networks, such as IDEA League and CESAER (see section 4.6 for more information).

Global Engagement Framework

The current global playing field for research, education and innovation calls for a resilient organisation that can respond effectively to the effects of global developments, such as the impact of the digital society, the growing demand for worldwide higher education and the recruitment of academic talent. In addition, the TU Delft community must be able to interact effectively in an international environment, both on the campus and in other countries, in order to achieve its goals. The Global Engagement Framework 2018-2024 sets out the aspects which are vital for further development within the three cornerstones of global engagement: global visibility, global partnerships and global community.

Joint worldwide research initiatives

For its worldwide engagement portfolio, TU Delft is continually developing joint research initiatives and related networks. The scope of these efforts extends beyond Europe to Brazil, China, India and Sub-Saharan Africa. The Executive Board has appointed prominent academics as TU Delft Ambassadors for these areas. In these regions there is momentum for developing collaborations in the area of science, industrial innovation and education. These regions also offer opportunities for frugal and reverse innovation, which could contribute to societal challenges such as the UN Sustainable Development Goals.

3.4 Research facilities

TU Delft disposes of state-of-the-art research infrastructure in order to attract scientific talent, conduct ground-breaking scientific research and train new generations of engineers. Some of these facilities are unique in the Netherlands or even worldwide, and are therefore of key importance. TU Delft's research facilities are crucial in order to reinforce collaborations with other knowledge institutions and businesses. In 2018, TU Delft started with the development of a strategic framework for research facilities: a university-wide framework for investments in, maintenance of and access to large-scale research infrastructure.

Developments

For major investments in research infrastructure, TU Delft is dependent on the funding instruments in this area. In 2018, it was announced how investment funds would be allocated for the National Roadmap Large-scale Research Infrastructure, which maps out research infrastructure of national importance. TU Delft takes part in three of the projects that received funding: the Ruisdael Observatory (as coordinating university), EPOS-NL and NEMI. Following an internal pre-proposal application procedure, an Investment Grant NWO Large – that focuses on scientifically innovative equipment or data collection in the national or international interest - was awarded to the Urban Mobility Observatory as well. Construction work also took place in the Industrial Catalysis Lab, a facility for high-pressure research. Furthermore, it was decided to renovate the Electrical Sustainable Power lab (ESP lab) in collaboration with TenneT, the system operator of the Dutch high-voltage grid. The ESP lab will become a facility for research on system integration in the energy system, a precondition for the development of the energy system of the future.

Reactor Institute Delft

One of the largest research facilities on the TU Delft campus is the Reactor Institute Delft (RID), the Dutch centre of expertise for radiation-related research and teaching. Instruments that use the research reactor are employed to conduct research into health, sustainable energy and materials. The broad field of application runs from medical isotopes for the diagnosis and treatment of cancer, batteries and solar cells to improving steel quality. In 2018, the focus was on areas such as optimising the use of the instruments, by setting up an instrument group. This increases the visibility of the institute in the academic world and creates stronger ties with industry.

Collaboration in living labs

TU Delft initiates and implements projects and programmes that are aimed at accelerating innovation and bringing knowledge to the market. Efforts to this end include the organisation of living labs for testing and demonstrating innovations, with spin-offs and start-ups often playing an important role. In 2018, TU Delft ended in twelfth place in Reuter’s ranking of Europe’s most innovative universities. Several of these living labs are described in the section ‘Living labs in de region’ (see p. 53).

HollandPTC’s first patient successfully treated with proton radiation

In September, HollandPTC’s first patient was successfully treated with proton radiation. HollandPTC is an independent outpatient centre for proton therapy, scientific research and education, founded by the Erasmus MC, LUMC and TU Delft. HollandPTC is housed on the TU Delft campus, where it treats patients from throughout the Netherlands. After an intensive preparatory period, the number of patients will be gradually increased to 600 in 2020. Thanks to HollandPTC, more and more cancer patients in the Netherlands can receive proton radiation treatment.
The main advantage of this technology is that it causes less damage to the tissue surrounding the tumour. The dose of radiation in the healthy tissue and the risks of side effects are therefore lower. Proton therapy could possibly also be used to administer a higher dose of radiation than is possible with photon therapy. HollandPTC has three treatment rooms, the first of which is now in use and the second of which will become operational in early 2019. The third room, the only one in the Netherlands to be set up for treating patients with eye cancer, will become operational in the course of 2019 as well.

3.5 Research quality

Research quality assurance

All research units at TU Delft are assessed once every six years by an independent international committee, in order to evaluate the quality of the research and identify possible areas for improvement. The assessments are conducted in accordance with the Standard Evaluation Protocol (SEP) 2015-2021, which is established by the Royal Netherlands Academy of Arts and Sciences (KNAW), the Netherlands Organisation for Scientific Research (NWO) and the Association of Universities in the Netherlands (VSNU). In addition, the TU Delft Research Assessments Protocol sets out the roles and responsibilities of all TU Delft actors within the framework of the SEP. At TU Delft, assessments are conducted as much as possible in a benchmark with comparable research at another Dutch or foreign university. TU Delft aims for a score in the range 1 ('world leading/excellent') to 2 ('very good') on the three criteria ('research quality', 'societal relevance' and 'viability'). The committee bases its findings on an internal evaluation written by the departments concerned, as well as on the knowledge acquired during a site visit. The reports of the assessment committees are published on www.tudelft.nl/en/research/our-research-vision/quality-assurance/ as is the 'position document' in which the Executive Board reacts to the committee's findings. The findings are then used to refine the faculty strategy and long-term planning. Since 2018, the folloe-up of research assessments (and education assessments) is also integrated into the Planning and Evaluation Cycle.

Research assessments in 2018

In 2018, the assessment reports on Civil Engineering and the Electrical Engineering were published. In addition, preparations for the assessments of the 3mE, IDE, and AE faculties began; the site visits by the committees will take place in 2020.

The committee's report on the 3TU research assessment Electrical Engineering was published in February. The site visit had already taken place in December 2017. The committee evaluated the quality of research within the Electrical Engineering domain of TU Delft as very good, with peaks of excellence. The committee also concluded that the societal relevance of Electrical Engineering is clear. The committee mentioned some points of attention, such as the scientific and technological vision of the Faculty and their familiarity with research themes, the funding and development of research facilities, the PhD graduation rate and the male/female ratio of permanent staff.

The site visit of the departments within the Civil Engineering domain of the CEG faculty took place in February 2018; the report was published in July. The committee assessed the research quality, relevance to society and viability of the research within the relevant departments as very good, and even largely as world leading/excellent. The committee concluded that Civil Engineering is recognised internationally as a centre of excellence in research, has exceptional societal relevance, and is innovative and enterprising. Nevertheless, a number of points of attention were mentioned, such as the strategy for societal impact, the number of female academic staff members (also in leadership positions) and the PhD graduation rate, concerning botj the average PhD duration as well as drop-outs during the PhD programmes.

International rankings

Several organisations try to provide insight into the relative quality and positioning of universities via international rankings. Such rankings do not provide an objective

picture of the performance of universities, because they are based on subjective choices for indicators, definitions and weighting factors, and are subject to methodological shortcomings. Nevertheless, these rankings give a rough indication of the relative performance of TU Delft, as a whole or within a specific discipline. Based on its position in the various rankings, especially those in the field of Engineering and Technology, it can be concluded that TU Delft is among the best in Europe and in the world. TU Delft uses international rankings in its recruitment and internationalisation policy in an appropriate manner. For the international positioning of TU Delft the results of the rankings listed below are particularly relevant, see also Figures 9-11.

QS World University Ranking

In 2018, TU Delft rose in the QS World University Ranking for the eighth year in a row: it currently occupies the 52nd place worldwide (54th in 2017). Just like last year, TU Delft is ranked as the best Dutch university. The ranking is based on a combination of six indicators: academic reputation, employer reputation, faculty/student ratio, citation per faculty, international faculty ratio and international student ratio. In addition, TU Delft is in the top 25 in six subject rankings: Architecture (3), Civil Engineering (4), Mechanical Engineering (13), Environmental Sciences (14), Chemical Engineering (18), Material Sciences (24), and in 22nd place, in the broader research domain of Engineering & Technology. In the QS Graduate Employability Ranking, TU Delft is in 41st place.

Academic Ranking of World Universities (Shanghai Ranking)

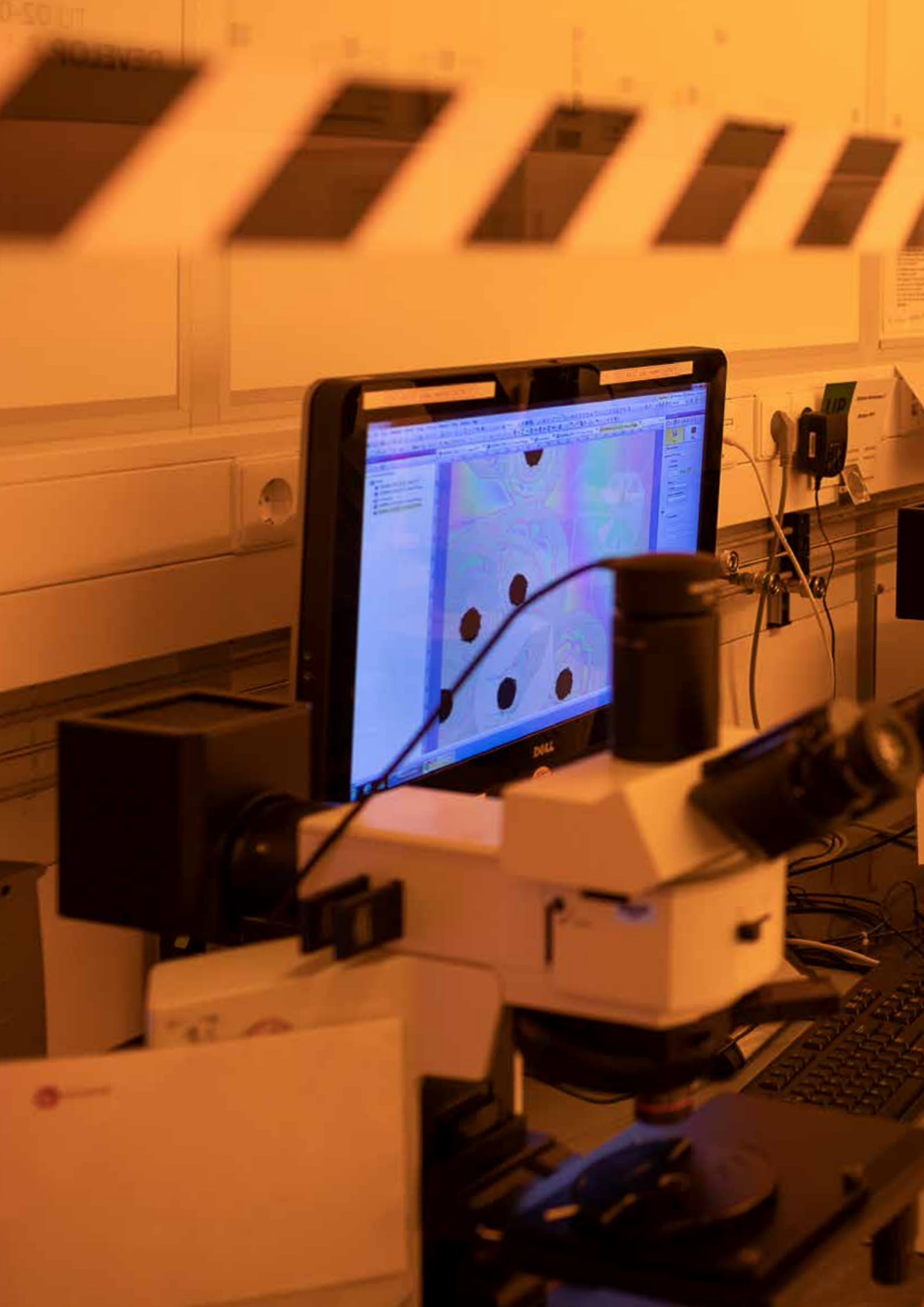
In the 2018 Shanghai Ranking, TU Delft occupies a shared position of 151-200 (stable since 2016). The ranking is compiled methodologically, based on the number of Nobel prizes awarded to staff members and alumni, the number of highly cited researchers, articles published and articles in Nature and Science. TU Delft is ranked in no fewer than 34 of the 54 published subject rankings. The university is in the top 50 worldwide in twelve subject rankings, and the top 10 in four subject rankings.

Times Higher Education World University Ranking (THE Ranking)

In 2018, TU Delft came in 58th place in the world university ranking. Last year, the university occupied the 63rd place. That makes TU Delft also the first Dutch university in this list. In the more specialised THE Top 100 Engineering & Technology ranking, TU Delft occupies the 19th place. In the THE's reputation ranking, TU Delft occupies a place between the positions 51 and 60 for the fourth year in a row. In addition, TU Delft is ranked 18th in the THE Most International Universities in the World Top 200 and 55th in the THE Global University Employability Ranking.

CWTS Leiden Ranking

The 2018 CWTS Leiden ranking describes the scientific impact of more than 900 leading universities throughout the world, based on bibliometric data. In the 'All Sciences', category TU Delft occupies the 34th place, with 2% of all TU Delft publications in the 1% most cited publications (the 'PP top 1%'). Of all TU Delft publications, 14.7% are in the top 10% most cited publications, earning it the 83rd place in the PP top 10%. On collaboration with industry, TU Delft is in 19th place, with 11% of its publications written in collaboration with industry.



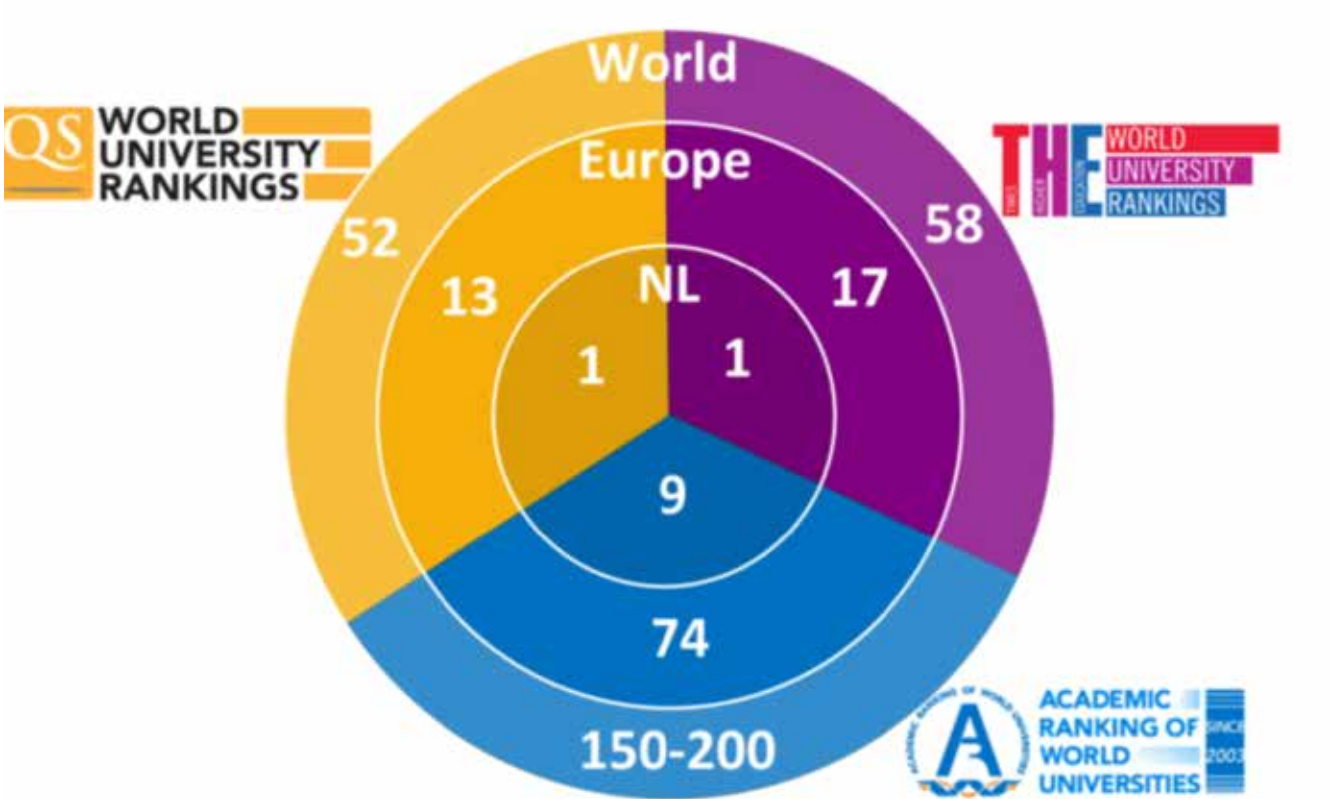


Figure 9: Position TU Delft in World University Rankings

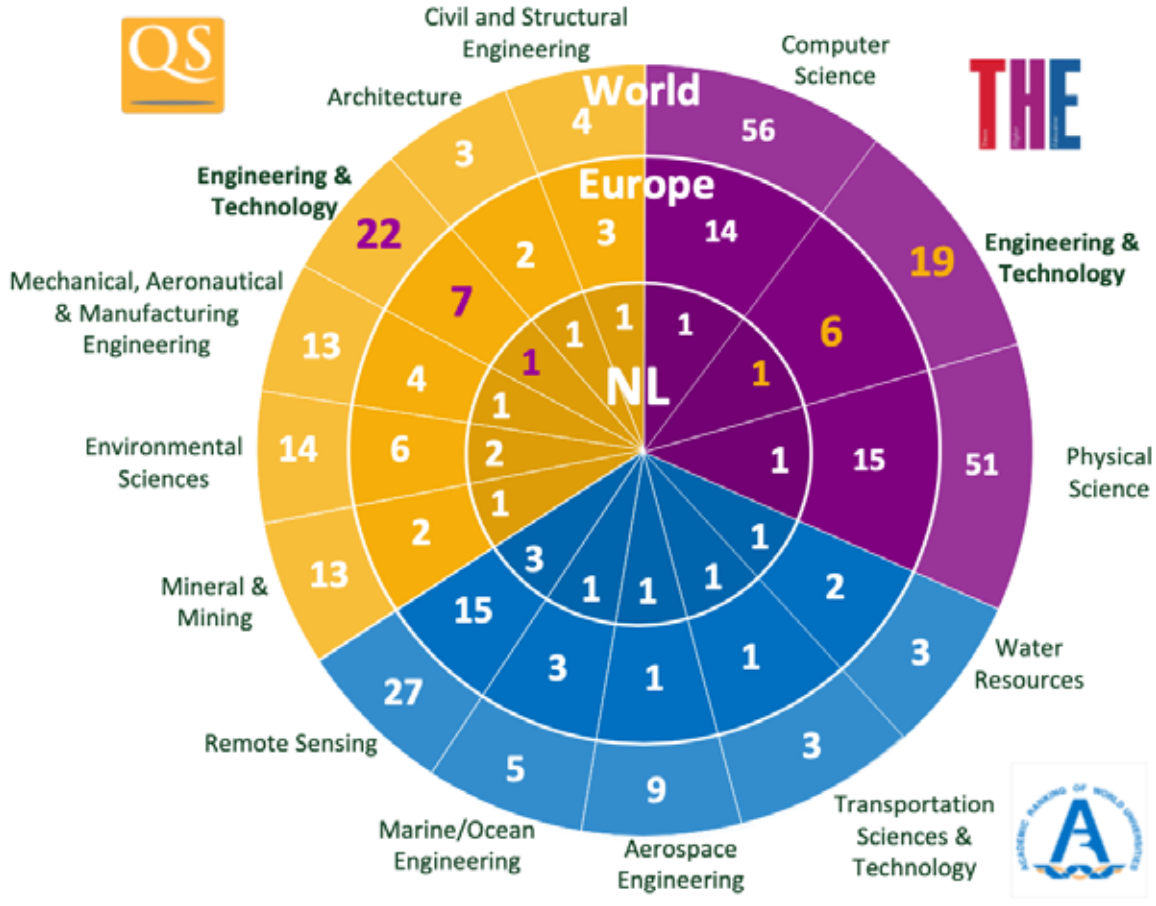


Figure 10: Position of TU Delft in Subject Rankings

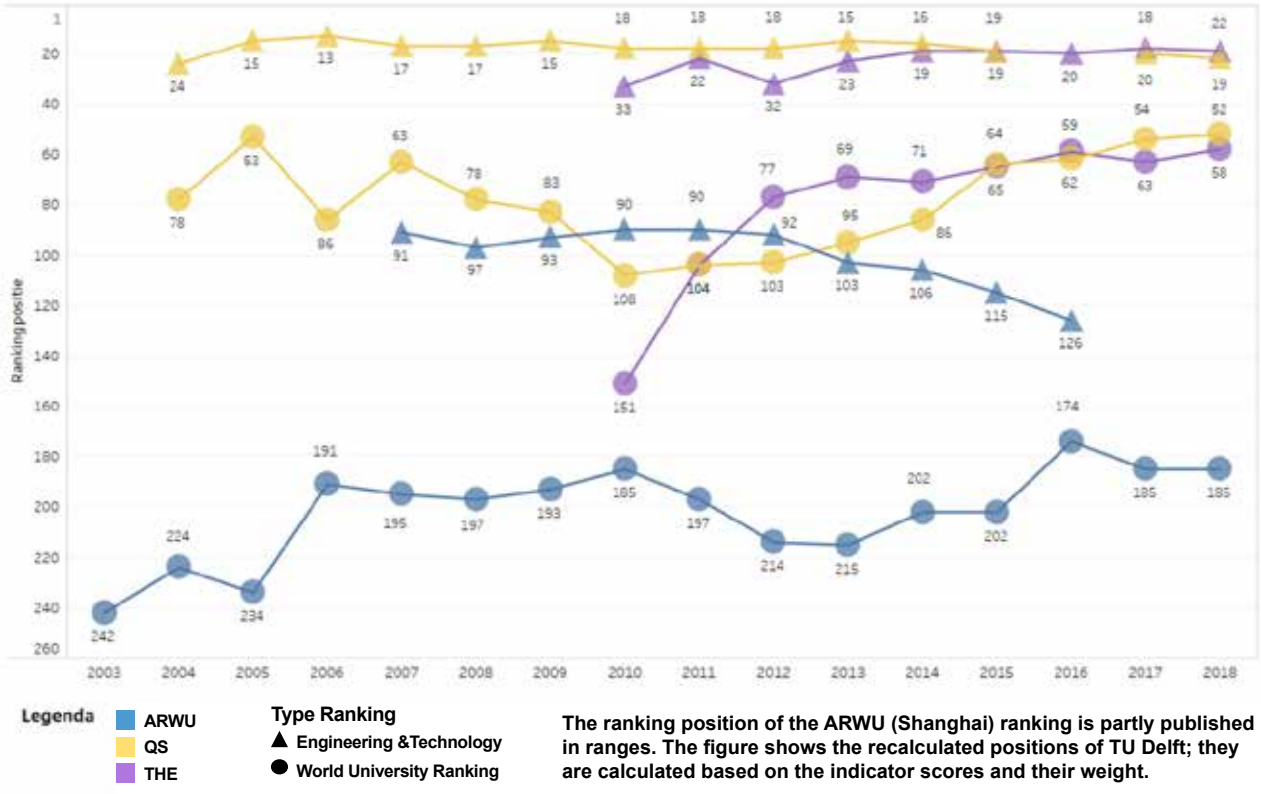


Figure 11: Trends of TU Delft in the QS, and Times Higher Education and Shanghai Ranking, the World University Rankings and Engineering & Technology Rankings, respectively

3.6 Research funding

This section includes several examples of research projects that were awarded funding in 2018 from Dutch or European sources, from grants or contract research. This income is classified as indirect or contract funding.

Income from government funding 2018	504.1 million euros
Income from indirect funding 2018	58.4 million euros
Income from contract funding 2018	151.6 million euros

Funding from sources in the Netherlands

In 2018, TU Delft succeeded in securing a number of large and prestigious Dutch research grants.

NWO grants

NWO Large
The Urban Mobility Observatory (UMO) project was awarded €1,950,000 from the NWO Large programme, aimed at the construction of large scientific support facilities. Over a long-term period, UMO will collect many details on urban mobility in the Netherlands.

Spinoza Prize
On 12 September, Marileen Dogterom, Professor of Bio nanoscience, received the NWO Spinoza Prize, which was presented to her by Minister Ingrid van Engelshoven. The Spinoza Prize, the highest award in Dutch science, amounts to 2.5 million euros. Dogterom is carrying out research into the dynamics in living cells and leads a consortium which is aiming to build an entirely artificial cell. This work helps scientists

understand how fundamental cell processes work.

National Roadmap for Large-Scale Research Infrastructure
The Ruisdael Observatory was awarded one of the ten certificates issued for the National Roadmap for Large-Scale Research Facilities. The Netherlands Organisation for Scientific Research has set aside 18 million euros for the development of this research facility for atmospheric research. More information about this facility can be found in section 3.3.

Innovative Research Incentives Scheme grants and the Rubicon programme
The NWO Innovative Research Incentives Scheme provides personal grants to talented researchers for the purpose of ground-breaking research on topics of their own choosing. There are three types of funding: Veni (250,000 euros), Vidi (800,000 euros) and Vici (1.5 million euros). In 2018, thirteen TU Delft researchers received a grant from the Netherlands Organisation for Scientific Research within the VI programme (seven Venis, five Vidis and one Vici).

Rubicon programme
The NWO Rubicon programme offers researchers who recently completed their doctorates the opportunity to conduct research at a leading research institute abroad, in the country of their choice. Four young scientists from TU Delft received Rubicon grants in 2018.

Perspective for the top sectors
TU Delft is involved in five of the six Perspective programmes that were granted funding in 2018 by the Netherlands Organisation for Scientific Research. The programme provides large consortiums of companies and knowledge institutions with the opportunity to conduct large-scale research programmes. TU Delft leads two of these programmes:
- Making chemicals and fuels with sustainable power (E2CB)
  Project leader: Prof. B. Dam
- Higher resolution and sensitivity of optical devices (SYNOPTICS)
  Project leader: Prof. H.P. Urbach

DEEP NL
Since November, TU Delft has been the coordinating university for five of the eight projects approved in the DEEP NL programme by the Netherlands Organisation for Scientific Research. The projects have received four million euros for research into processes in the deep subsurface of the Netherlands. With DEEP NL, the Netherlands Organisation for Scientific Research follows the advice of the Dutch Safety Board to create a structural research programme into gas extraction-associated problems in the province of Groningen.

Take-off
The Take-off funding instrument encourages business and entrepreneurship by Dutch knowledge institutions. A Take-off grant enables academic entrepreneurs to bring their innovative research results to the market. Applications for Take-Off funding can be submitted for Phase 1 (feasibility study, €40,000) and Phase 2 (early-phase track, risk-bearing monetary loan of €250,000). In 2018, eleven Take-Off feasibility studies were awarded to TU Delft researchers. Seven entrepreneurs were granted early-phase trajectory funding on the basis of research conducted at TU Delft.

Open Technology Programme (OTP)
Five scientists at TU Delft received funding from the Open Technology Programme (OTP) of the Netherlands Organisation for Scientific Research. OTP offers companies and other organisations an accessible way to join in scientific research aimed at making knowledge applicable.

HTSM
In the annual High Tech Systems and Materials (HTSM) grants round, scientists can apply for funding for research in this top sector. Three grants were awarded to TU Delft this year.
Materials for Sustainability (MAT4SUS)
Four scientists at TU Delft secured funding in the Materials for Sustainability programme (MAT4SUS). Two of the grants are for public-private consortiums, in which companies contribute to the research. The other two projects are focused on long-term, fundamental research.

Other Netherlands Organisation for Scientific Research grants
TU Delft also secured grants in a variety of other Netherlands Organisation for Scientific Research programmes: Socially Responsible Innovation (one grant), Physical Sciences TOP (three grants), Start Up (three grants), JPI Cultural Heritage (one grant), Joint U.S. - Netherlands Cyber Security Research Programme (one grant), Sustainable Urbanisation Global Initiative (SUGI, one grant), NICAS (Scientific Study and Conservation of Art, one grant), Energy System Integration & Big Data (one grant), collaboration with Brazil - Biobased Economy (two grants), collaboration with China - programme for research in supramolecular chemistry and catalysis (one grant), Open Mind (two grants).

Public-Private Partnership Allowance (PPP allowance)
In 2018, TU Delft applied for 5.5 million euros in PPS programme allowance, 4.5 million euros of which TU Delft will receive as a direct allowance. TU Delft will use these resources for new PPS programmes.

European Funding

European research funding is vital for TU Delft to implement the 2018-2024 Strategic Framework. In 2018, TU Delft raised 45.6 million euros for its participation in European projects. This comprises a significant number of ERC grants coordinating roles. In addition, a considerable number of projects were generated in the KIC initiatives and the regional European programmes. Several of these are highlighted here.

Horizon2020
The Horizon2020 programme of the European Union provides opportunities, until end 2020, for funding research and innovation in Europe and beyond. In 2018, TU Delft made the most of these opportunities: since the launch of the programme at the beginning of 2014, the university has acquired 289 projects valued at 184 million euros. That puts TU Delft in first place in the Netherlands and 12th place in the EU for participation in Horizon2020 projects.

Knowledge & Innovation Communities (KICs)
The knowledge and innovation communities (KIC) of the EIT (European Institute of Innovation & Technology) are partnerships between companies, research institutes and universities. In 2018, TU Delft became the main partner in Made By Europe KIC (also known as EIT Manufacturing) and a member of the Mobilus KIC via the Advanced Metropolitan Solutions Institute (AMS). The Mobilus KIC focuses on innovation, education and entrepreneurship in urban mobility, and the Made By Europe KIC on the advanced manufacturing of high-quality products. TU Delft aims to coordinate large projects more often. Acquisition of projects within the Knowledge Innovation Communities has been intensified to this end. This also applies for KICs where TU Delft is already a member, such as Health, Climate, Raw Materials and Digital. All six KICs aim to bring together companies, research institutions and universities in projects focusing on innovation, education and entrepreneurship.

Regional EM programmes

TU Delft also had a successful year of project acquisitions in 2018, within the regional EM programmes, Opportunities for West (Kansen voor West), InterREG, North-Western Europe and 2Zeeen. The growing number of living labs, such as SAM XL, Robo House, UnManned Valley and Green Village, are one such outcome.

Management of large-scale EU projects

TU Delft coordinates various large-scale EU projects; two important projects in 2018 are highlighted below.

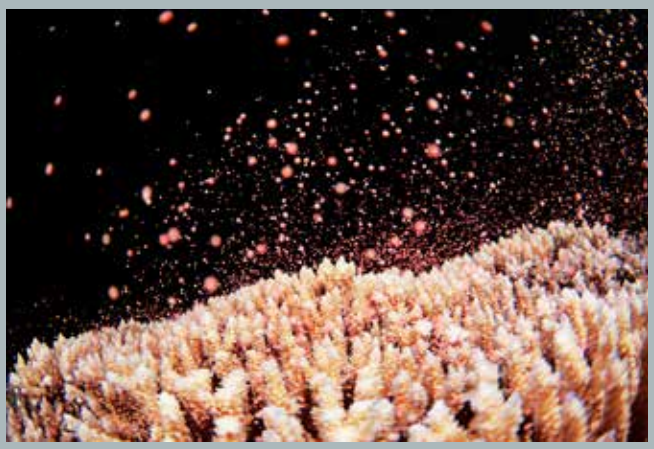
ReMAP

In 2018, the ReMAP (Real-time Condition-based Maintenance for Adaptive Aircraft Maintenance Planning) project proposal was rewarded with a Horizon2020 grant of 6.8 million euros. With this project, researchers hope to pave the way towards a radically new perspective on aircraft maintenance, which could save up to 700 million euros a year for Europe alone. Four tenure trackers from TU Delft's faculty of Aerospace Engineering expect that the terabytes of data that a modern aeroplane generates can be used to determine the maintenance condition of each part of the aeroplane, from the wheels and brakes to the air conditioning system and structural integrity of the aircraft itself.

LEaDing Fellows

The LEaDing Fellows postdoc programme gives 90 postdoctoral researchers from across the world the opportunity to obtain two years' working experience in the multidisciplinary environment offered by the Leiden-Delft-Erasmus partners and the university medical centres of Rotterdam and Leiden The programme is supported by a Horizon2020 Marie Sklodowska-Curie COFUND grants of 6.3 million euros. TU Delft is the coordinating university for the programme, which runs until the end of 2021. In the meantime, 60 researchers have been selected: 10 have been appointed at Leiden University, 11 at the Leiden University Medical Centre, 10 at Erasmus University Rotterdam, 8 at the Erasmus Medical Centre, and 21 at TU Delft.

Coral recovery



In November, a team of researchers from TU Delft, Van Oord and the Australian research institute CSIRO started to test a new method for the large-scale rehabilitation of coral in the Great Barrier Reef off the coast of Australia. In this rehabilitation method, coral eggs are collected from healthy parts of the reef, and the resulting larvae are later returned to locations where coral has to grow again. Working with coral eggs has already been tried and tested on a small scale and in special tanks. The team is now testing on location whether this process can be scaled up by collecting coral eggs using adapted pumping installations, which are also used by dredgers. If the pumps and tanks prove to be a successful method of collecting and storing coral eggs on a large scale, so that they can be released later to settle on the reef, that will be a big step forward for the large-scale rehabilitation of coral reefs.

3.7 Valorisation indicators

The Dutch universities formulated their valorisation objectives in their performance agreements with the Ministry of Education, Culture and Science in 2012. Following on from this, each university has developed its own valorisation indicators to measure performance. The following valorisation indicators were established in 2015, along with the other Dutch universities of technology, and they have been published in the annual report since 2016. This set of indicators provides a quantitative overview of the valorisation activities TU Delft. Qualitative images are available at the TU Delft website and in the Home of Innovation magazine: www.tudelft.nl/en/technology-transfer/.

Proportion of funding	
Government funding	504,1 M€
Indirect funding	58,4 M€
Contract funding	151,6 M€

Internships and graduation projects for non- university institutions	
Master	780
PDEng	27

Co-publications with companies	
CWTS Leiden Ranking – University Industry Co-publications	#19
Proportion of publications with one or more companies as co-author	11%

Intellectual property	
Number of invention disclosures	77
Number of patent applications	46
Number of transfers	8
Number of licenses	7

Business activity	
TU Delft spin-off with TU Delft IP	3
Startups – TU Delft founded, without TU Delft IP	18
Startups – by third parties, with TU Delft IP	0

Ancillary activities	
Number of professors with non-academic ancillary activities	159

Entrepreneurship education	
Entrepreneurship minors (30 EC)	186 students / 5580 EC
Additional Entrepreneurship courses (5-8 EC each)	402 students / 2155 EC
Total EC entrepreneurship education	588 students / 7735 EC

Alumni careers	
Percentage of alumni employed by non-academic organisations	81,8%

Intellectual property

Scientific research often results in new technological processes, findings and designs. Intellectual Property (IP) rights play an important role in this respect. TU Delft guides researchers in the application for, management and marketing of patents, in addition to providing legal and other types of advice, information and support for business development with regard to licences and national or international contracts, including software and mark/model registration.

Patents

A selection of patents is available on the website www.patent.tudelft.nl. In 2018, 77 inventions were reported internally, and 46 new patent applications were submitted. In addition, 7 licences and 8 transfer agreements were concluded on the basis of one or more patents from the TU Delft patent portfolio and 11 patents were commercialised.

Licences

In 2018, the Intellectual Property of TU Delft led again to valorisation results via licences and the other transfer of rights. One good example is Battolyser B.V. (a joint venture of TU Delft and Proton Ventures), which received a grant this year from Waddenfonds. In addition, in 2018 a contribution was made to the negotiation project for various research contracts and partnerships. Examples of partnership in robotics can be found between TU Delft, RoboValley, YES!Delft and Ahold Delhaize and the alliance between TU Delft and ProRail for issues concerning the railway. In addition, Intellectual Property played a role in 2018 in the admission of the Quantum Internet Alliance project by professor S.D.C. Wehner to the EU quantum flagship.

Entrepreneurship

Delft Centre for Entrepreneurship

Entrepreneurship training is provided by the Delft Centre for Entrepreneurship, see section 2.

Delft Enterprises

Delft Enterprises B.V. (DE) is TU Delft's holding company. It invests in start-up companies based on TU Delft knowledge in exchange for an equity interest. Investments can take the form of financial and/or non-financial contributions from DE or TU Delft, including expertise, intellectual property rights, facilities, support and start-up capital. The DE philosophy is to connect promising ideas from TU Delft to talented students and staff members, entrepreneurs from alumni and other networks and funding (e.g. the UNIQ 'proof-of-concept' fund) in order to bring valuable knowledge from the university to market.

By late 2018, DE owned shares in 57 spin-out companies. Many of these companies are housed in the YES!Delft business incubator, RoboValley, the Bouwcampus Delft or at other locations in the vicinity of the TU Delft campus. In 2018, it had an interest in five companies: Polderdak, Battolyser, Innatera Nanosystems, Stokhos and MU-G Knowledge Management. The year 2018 also saw a partial exit, and income was received from an earn-out scheme from a past exit. Part of this income was fed back to the relevant faculties. DE's exit policy was tightened in 2018 with the approval of the Supervisory Board. For those companies that have developed favourably and therefore have higher exit potential, a commercial analysis will be used to plan their exit. Companies that have stopped making progress for some time will leave earlier. TU Delft's valorisation objective remains leading in this respect.

Startup Voucher

Since 2014, the TU Delft valorisation centre has been offering a start-up voucher in cooperation with several faculties and DEI. Enterprising students can use this to cover the initial development cost of their innovative idea or product. Since the launch of the scheme in 2014, more than 50 starting entrepreneurs have been given the opportunity to develop their ideas, which has led to more than 30 business start-ups. Companies whose founders used the voucher include Somnox, Inkless, CloudCuddle and SolarMonkey.

Micro-CT scanner unravels surprise prehistoric eggs

A couple of years ago, archaeologists found thirteen egg-shaped objects at a building site in Tilburg. Geoscientist dr.ir. D.J.M. Ngan-Tillard has now succeeded in looking inside the eggs with a micro CT scanner. These 3D images show interesting imprints in their shells. After an initial study and a chemical analysis of the shells, archaeologists concluded that the eggs are crucibles from the Middle Iron Age (about 450 BC). Crucibles were used for melting iron objects, in order to use the liquid metal to produce new objects. Ngan-Tillard was asked to find out exactly what was melted, and whether there were signs of those objects inside the still intact crucibles. The images inside the crucibles show lines with different fold-like shapes. The archaeologists believe that they come from coat pins and pieces used to repair kettles or pails.

4 People and Community

4.1 Introduction

People are at the heart of TU Delft. Everything we do begins and ends with the people involved. For this reason, we attach a great deal of importance to attracting people who are a match for our university and our ambitions, and to the openness and diversity of our university community. In 2018, we continued our commitment to a culture where our staff and students feel challenged, have the time and means to take pleasure in their work and where diversity (see section 4.3) and integrity (see section 4.4) are important core values.

The TU Delft community is wider than the students and staff on the campus. At TU Delft, we work for our research and education with partners from all around the world, but also close to home: with the Municipality of Delft, the Economic Board Zuid-Holland (EBZ), InnovationQuarter and our LDE partners in Leiden and Rotterdam and international networks (see section 4.5). We have also been actively working to strengthen the ties with our alumni and to further boost community spirit among staff, students and alumni.

4.2 Personnel changes

Executive Board

As of 1 January 2018, TU Delft has a new governance model in place that combines the position of Rector Magnificus and the role of President of the Executive Board. TU Delft's Executive Board continues to operate on the principle of a joint management body and will continue to consists of three members: a Rector Magnificus/President of the Executive Board, a Vice-Rector Magnificus /Vice-President for Education and a Vice-President for Operations. Strategic considerations underlying the decision to adjust the administrative model include the rise in student numbers, TU Delft's complex real-estate challenges, the provision of transparent management of the support services and boosting international recognisability.

The former Rector Magnificus Professor Karel Luyben – who has held this position for 8 years – retired on 1 January 2018. During TU Delft's 176th Foundation Day, on

12 January, Karel Luyben formally handed over the rectorship to his successor, Professor Tim van der Hagen, who was appointed Rector Magnificus/President of the Executive Board as of 1 January 2018.

The Supervisory Board took this decision in consultation with the Executive Board, the Council of Professors, the Deans of the Faculties and the Directors of University Services. The Supervisory Board formally requested advice from the combined Participation bodies (Works Council and Student Council), partly in view of the Enhanced Governance Powers (Educational Institutions) Act, and they issued a positive recommendation on this matter.

Nicoly Vermeulen new Vice-President Operations

The Supervisory Board has appointed Nicoly Vermeulen Vice-President Operations (VPO) in the Executive Board of TU Delft from 1 January 2018.

Prof. Rob Mudde new Vice-Rector Magnificus /Vice-President for Education

The Supervisory Board has appointed Prof. Rob Mudde Vice-Rector Magnificus/ Vice-President for Education (VRM/VPE), also Vice-President of the Executive Board of TU Delft from 1 March 2018.

Deans and directors

Appointment of deans

The Executive Board has appointed Professor Jan Dirk Jansen as dean of the Faculty of Civil Engineering and Geosciences (CEG) with effect from 1 May 2018. Jansen succeeds Professor Bert Geerken, who retired in May 2018. On 1 June, Prof. Peter Russell, stepped down from his position as dean of Architecture and the Built Environment (A+BE). He was succeeded by Prof. Bert Geerken as interim dean until 1 April 2019 at the latest. Prof. Hans Wamelink stepped down from his position as dean of the Faculty of Technology, Policy and Management (TPM) and was succeeded on 8 October by Prof. Eric Fischer as interim dean.

Karin Hubert appointed new Director of Finance

The Executive Board appointed Karin Hubert Director of Finance with effect from 15 October. Hubert succeeds Jacqueline Schut, who left TU Delft in July.

4.3 Personnel management

Diversity & inclusion

Openness and diversity are important basic principles for TU Delft. We consider diversity to be a precondition for excellence and innovation. At TU Delft in particular, where teamwork is so important, everyone understands the value of a diverse team that combines the specific strengths of all team members. It is hard to overestimate the value of diversity. At TU Delft, we strive to create a population of students and staff that is balanced in terms of gender, age and cultural background.

The Diversity Office, headed by Professor Rinze Benedictus, Diversity Officer and professor at the Faculty of Aerospace Engineering, is working on a TU Delft-wide vision on diversity and inclusion and the resulting policy. The Diversity Office is supported in this effort by a team of students and staff from the entire organisation who actively put this policy into place in their regular work. Terms of reference and a work programme were drawn up in 2018 and are expected to be approved in 2019. The programme outlines seven areas for special attention for the coming two years.

#tudelft

TU Delft as seen through the eyes of students, staff members and visitors: a selection of #tudelft on Instagram in 2018.


Delfly Micro

Inclusive introduction week

TU Delft sees diversity as a precondition for excellence and innovation. It therefore strives for a balanced and well integrated community. This is one reason why it was decided this year to organise a joint introduction programme for national and international students during the Welcoming Week (Owee).

Coming Out Day

Because TU Delft strives for everyone to feel free and supported in being who they are, regardless of sexual orientation, Coming Out Day was celebrated again in 2018 on the TU Delft campus. This day in October is a worldwide opportunity to put the acceptance of lesbian, gay, bisexual, transgender and intersex (LGBT+) people in the spotlight. A wide range of activities were organised, such as workshops, a photo exhibition in the library and a colourful parade through the campus.

Leading female academics

TU Delft makes an effort to achieve a better ratio of males to females at all levels of the organisation, specifically to increase the number of leading female academics and female full professors. Another Delft Technology Fellowship recruitment round was therefore held in the autumn of 2017 and in early 2018. The fellowships offer tenure track positions to high-profile female academics within research fields at TU Delft. Delft Technology Fellows have an opportunity to design their own research programme at top international level, including a start-up grant. The fellowships are granted at Assistant Professor, Associate Professor and Full Professor level. This brought as many as thirteen new talents on board at TU Delft. The next recruitment round for this programme will start in autumn 2019. The male-to-female ratio in academia is a point of special attention at a national level as well. In early 2017, Minister Bussemaker announced the allocation of €5 million for the appointment of 100 additional women professors at the Dutch universities. TU Delft was asked to appoint six women as full professors in the period from 10 February 2017 to 10 February 2018 – the ‘Westerdijk Year’. Ultimately, TU Delft appointed nine full professors in the framework of the Westerdijk year, seven of which on the basis of the grant awarded by the minister.

Perception of work

Every three years, a survey is conducted at TU Delft on the staff’s perception of their work, vitality and internal support: the TU Delft Employee Survey. The 2017 Employee Survey showed work pressure to be an important point of attention. Based on the results, a university-wide plan of action was drawn up in 2018 which includes six TU Delft-wide priorities. These priorities relate to e.g. a code of behaviour, team spirit and culture, leadership/employee ownership and training and career opportunities versus requirements.

Plan of action based on employee survey

All faculties and departments have drawn up their own plan of action to reduce the pressure of work. These plans are anchored in Lab Servant, a progress monitoring system. The progress of the plans of action is a structural topic of discussion between the faculties and departments and the Executive Board. The plans of action of the faculties/departments feature themes such as leadership, pressure of work, social safety and the working environment. The actions resulting from these plans of action are faculty- and department-specific and are aimed at addressing the most urgent issues within the various organisational units. Some examples of actions from the plans of action are the ‘Good and healthy working’ pilot project in the Faculty of AE, where action teams receive advice on how to reduce the stress and pressure of work and

undesirable behaviour, and to create a more positive working environment. The Faculty of 3mE has launched a pilot training project called ‘Balanced life’, which focuses on the work-life balance of tenure trackers. An overall programme on social safety has also been launched with the participation of various faculties and departments.

Inspection Inspectorate SZW

On 8 May, the inspectorate from the Ministry of Social Affairs and Employment (SZW) paid a visit to TU Delft. The inspection assessed the extent to which TU Delft controls the risks for its staff in the area of Work-Related Psychosocial Stress. The result shows that TU Delft is well on its way with the university-wide Plan of Action.

4.4 Integrity

Vision on Integrity 2018-2024

How do we address our responsibilities towards each other and to society? It is important that we remain in consultation on this issue and take any necessary action. This is why the Executive Board approved the ‘TU Delft Vision on Integrity 2018-2024’ on 25 September 2018. This vision builds on the existing integrity policy, the TU Delft Strategic Framework 2018-2024 and the new Dutch Code of Conduct for Academic Integrity, which took effect on 1 October. The cornerstones of the integrity policy are ‘academic integrity’, ‘social integrity’ and ‘organisational integrity’. The Vision contains a set of principles that apply to everyone at TU Delft, a proposal for a revised infrastructure for existing and new initiatives concerning integrity, and four agendas. The agendas encompass a broad range of plans for updating the Code of Ethics and increasing staff and student awareness, for example. Four working groups have been established to develop and implement the plan per work agenda. The Executive Board has asked a university steering committee (Integrity Board) to monitor the development and implementation of the agendas.

Human Research Ethics Committee

The interfaculty Human Research Ethics Committee (HREC) safeguards the ethics of research where test subjects are involved. Frameworks in this respect include the new data protection act, the GDPR, and TU Delft’s approved integrity policy. In 2018, a great deal of attention was focused on further awareness, also among students, and the clear embedding of the safeguards within the frameworks. This involves the close collaboration of the faculty data stewards and privacy team. More than 300 requests for an ethics review were received in 2018, which represents an increase of approximately 40%.

4.5 Community

TU Delft is working on a TU Delft community for life on the basis of shared interests and common goals. The idea is to strengthen the ties with alumni and boost the community spirit so that the ‘blue heart’ keeps beating in everyone who is, and once was, part of TU Delft.

Alumni

The more than 100,000 alumni include not only graduates with an MSc but also people holding a doctor’s degree, PDEng alumni and retired professors. There is something that binds this community together: knowledge and experience once acquired in Delft is used to do what TU Delft engineers are good at, which is to use technology to make a difference in the world. This community spirit is promoted through the alumni programme. The objective of the alumni programme entitled ‘TU Delft for Life’ is to build a valuable mutual relationship between TU Delft and its alumni, with alumni being part of a community of people who are able to look back on their time at TU Delft with pleasure and who are proud of their alma mater and the role that TU Delft plays in society. One part of the programme is the online platform TUDelftforLife.nl, where events in the Netherlands and abroad, as well as people from the same year or country, can be found. Alumni are also offered various online courses, in line with TU Delft’s aim to offer students not only training but also a partnership for permanent education.

4.6 Administrative collaboration

TU Delft plays an active role in various committees and works with many other institutions and organisations in the Netherlands as well as abroad.

Regional alliances

TU Delft is an active partner with entities including the Economic Board Zuid-Holland (EBZ), which is also known as the ‘board of boards’ – an organisation in which companies, economic clusters, knowledge institutions, institutes of vocational education, local and regional governments come to the table to join forces in terms of knowledge, networks and administration. The joint ambition is to promote economic growth and employment in Zuid-Holland. In this regard, the EBZ focuses on initiatives within the following research priorities; Port in Transition; Feeding and Greening Megacities; Life Sciences and Health; Cybersecurity, and Smart Industry. Rector Magnificus Emeritus Karel Luyben is a member of the executive committee of the EBZ. In addition, TU Delft is collaborating within the InnovationQuarter, the regional economic development agency, on finding solutions to challenges in society and strengthen the regional economy in West Holland.

Collaborating with the Municipality of Delft

In 2016, TU Delft signed a covenant with the Municipality of Delft. Within this covenant, TU Delft and the Municipality of Delft work together on tasks such as mobility, campus development, urban planning and international and staff member accommodation, as well as reinforcing the university’s social responsibility towards its environment. Last year, three collaborative agendas were added to the covenant; this year saw the continuation and strengthening of collaboration with the Municipality of Delft. This fits in with the vision for a ‘Delft UniverCity’ that improves the collaboration between the university and its surroundings, with innovation as driving force to create a smart, sustainable and inclusive society. The collaborative agendas ‘city as campus, campus as city’, ‘ecosystem of knowledge and economics’ and ‘the connection between the

university community, city and residents' have resulted in structural consultation and collaboration on these themes. In the context of connection, TU Delft supports several student initiatives, such as Student Volunteer work en Delft (SVD), a broad-based platform where students are matched to areas where the city could use some help. In addition, various student associations initiate activities in and for the city, such as the 'open refectories' where elderly and singles from outside the association are welcome to sit at the table. In the autumn, TU Delft and the Municipality of Delft together appointed a programme coordinator in order to implement and promote collaboration.

Leiden-Delft-Erasmus (LDE)

Leiden University, TU Delft and Erasmus University Rotterdam have a strategic alliance in which they collaborate in the areas of education, research and valorisation. In 2018, the LDE steering committee defined the LDE strategy for 2019-2024. In June, the LDE steering committee decided, on the basis of an evaluation of the 2013-2018 period, to close down the LDE Centre for Metropolis and Mainport, LDE Centre for Safety and Security and European Research Centre for Economic and Financial Governance. The LDE Centre for Frugal Innovation in Africa, LDE Centre for Global Heritage and Development, LDE Centre for Sustainability, LDE Centre for Education and Learning and LDE Centre for BOLD Cities will be continued.

National cooperation

4TU.Federation

The 4TU.Federation is the partnership of the four universities of technology in the Netherlands: TU Delft, TU Eindhoven, Twente University and Wageningen University. In addition to collaboration on research and teaching, intensive joint efforts have included searching for solutions to address the inadequate funding of technical and scientific programmes. In April, about 60 experts met to discuss the growing shortage of engineers in the job market. At the request of 4TU and entrepreneurs' organisation FME, they sought scenarios to turn the tide in the Netherlands. For education in relation to 4TU, see section 3 of the annual report, for research in relation to 4TU, see section 2 of the annual report.

European university networks

TU Delft is an active member of a number of European university networks with the aim of seeking out best practices for the diversity of organisational and management issues within universities. The IDEA League is a strategic collaboration between five leading European universities of technology: TU Delft, RWTH Aachen, ETH Zurich, Chalmers University and Politecnico di Milano. TU Delft is also a member of the European Universities Association (EUA). As one of its founders, TU Delft is an active member of the Conference of European Schools for Advanced Engineering Education and Research (CESAER), an international non-profit association of 51 prominent European universities of technology and institutes of technology in 26 European countries. The Bachelor's and Master's degree programmes and students benefit from TU Delft's participation in programmes such as the Global Engineering and Education Exchange (GlobalE3) and UNITECH. In addition, TU Delft is an active member of the European Society for Engineering Education (SEFI), the largest network of institutions of technical education in Europe.

Global networks

TU Delft is a member of the Open Education Consortium. This is a global network of institutions involved in open education. Willem van Valkenburg is vice-president of the board on behalf of TU Delft. Since 2013, TU Delft has been a member of the edX Consortium, where Vice-Rector Magnificus Prof. Rob Mudde sits on the University Advisory Board. TU Delft, with its large range of MOOCs and innovative activities, is one of the most prominent institutions in this consortium.

Pop-up lectures for Delft residents

Under its covenant with the Municipality of Delft, TU Delft is committed to a stronger focus on Delft. The third pillar of the covenant concentrates on the university's connection with the whole city of Delft. The programme aims to enable academics and students to use their brainpower for the challenges facing Delft, while also encouraging students to act as volunteers. TU Delft sees this as a way to contribute teaching and research to address societal challenges in Delft. In addition, the university recognises the importance of training engineers with a broad orientation towards society and thus the value of activities that take place outside the 'bubble'. Moreover, the city is the scene of various new TU Delft pop-up activities for all residents. Impact for a better society thus starts in the city of Delft itself. One of the pop-up activities in unexpected places in Delft was the meeting between Dr. Julia Cramer and children of Delft to talk about the quantum internet in de Sultan Ahmet mosque in Delft's Buitenhof neighbourhood.

5 Campus & Services

5.1 Introduction

One of TU Delft's challenges is to redevelop the campus. The need to innovate stems from the growth in the number of students and the outdated buildings, as well as the vision of an attractive, lively campus for the future: a campus that inspires people to work, use their mind and be creative. This means that the campus must not only be equipped with excellent facilities for teaching, research and innovation but that it must also have a vibrant core: a hub that connects the primary process with a range of social activities. The vision is to create a 'Delft UniverCity' that improves the collaboration between the university and its surroundings, with economic, social and technological innovation as driving forces for a smart, sustainable and inclusive society. In its realisation, we are guided by strict principles for sustainability (see section 5.3) and safety (see section 5.4). Pulse, the energy-neutral teaching building opened this year, is a case in point. The building also serves as a showroom for our work: various research groups were involved in Pulse's development (see section 5.2).

To provide optimal support to our people, one of our priorities is also to continue improving our professional services. This is a long-term project, just like the redevelopment of the campus. The third quarter of 2018 saw the start of the design phase of the TU Delft Service Quality programme. The aim of the programme is to improve the quality and integration of operations and services (see section 5.5). Whether providing services to students, facilities management, IT or library services: a university that seeks to deliver excellence, today and tomorrow, needs top-notch support services that are both effective and efficient.

5.2 Campus and real estate

In September, Pulse, the new interfaculty and energy-neutral teaching building with more than 1,000 teaching rooms, 200 study spaces and a food market, was opened. Across from Pulse, Coffee & Bikes was built. This two-storey bike garage has capacity for about 1,850 bicycles and includes a coffee bar and a bike repairer. The most important part of the new building for Sport and Culture was also completed in 2018. The complex had its grand opening in September and was given a new name: X. The two separate buildings are now connected by a light, transparent entrance hall. The

connecting building also houses a concept store, a student kitchen and a student living room.

The positioning of the TU Delft Science Park was also reviewed this year. The new guiding principle is that all areas of the campus, TU North, Central and South, must accommodate the three core tasks (research, education and valorisation) of the university. The concept of a separate business community in TU South has now been abandoned in favour of an inclusive ecosystem where it will be easier for businesses and others in the TU Delft community to work together. To support this integrated approach, from now on the whole campus will go by a single name: TU Delft Campus.

New energy-neutral teaching building: Pulse

The new Pulse teaching building opened at the start of the academic year. Pulse is the first energy-neutral building on the TU Delft campus. The building has an A++++ energy rating. Its roof has 490 solar panels (750 m2) that generate 150,000 kWh per annum. The panels generate sufficient energy to supply the whole building with electricity. In addition, Pulse has an underground geothermal storage system and is fitted with extra insulating glass. An intelligent building management system controls the ventilation, lighting, cooling and heating at room level. Researchers from TU Delft were involved in the development of Pulse, in such areas as distributed systems, energy conversion & storage and climate design & sustainability. The building has thirteen teaching rooms for motivational teaching, 275 study spaces and a food market. The building meets the needs of teaching facilities for motivational teaching methods, such as working in groups, blended learning, seminars and video conferencing. Lecturers and students were involved in its entire development, and the building is open for use to all faculties. Pulse is equipped with state-of-the-art AV technology. The first lectures with more than 1,000 people spread across seven or more rooms went well. When there is no teaching in the rooms, they can be used for meetings or study; the latter is popular at weekends.

To attract the right partners to the campus, in 2018 an assessment framework was developed for companies interested in settling on the TU Delft Campus. Interested parties will be assessed to see whether they meet certain criteria in the Strategic Consultation on Partner Business Location, a multidisciplinary team including the Vice-President Operations and a dean, before discussing the possibility of setting up office. Criteria include whether the company shares the same ideas about sustainability, innovation and social responsibility, whether its requirements for setting up office fit in with the spatial vision for the campus and whether there is any collaboration with TU Delft in a broad sense, such as in research or living labs. One company that meets the above criteria is Swedish-Swiss technology company ABB; construction of its building on the TU Delft Campus began in 2018. The Finnish Bluefors has also decided to join the quantum knowledge cluster at TU Delft. Fieldlab SamXL has likewise set up office on the campus (see section 5.7).

Management & maintenance

Less visible but just as important is the regular management and maintenance of the buildings and the outdoor areas, both above and below the ground. The phasing out of gas consumption – to meet the energy targets – means that there is extra demand for electricity. The arrival of new collaborative partners also leads to a higher demand for electricity. That is why the electricity supply system (10 kV) was extended on a large part of the campus.

The Getty Foundation in Los Angeles, which focuses on the international conservation of unique 20th-century architecture, has awarded TU Delft a grant of 146,000 euros for its Keeping It Modern initiative for research into the possible restoration and modernisation of the Aula Building. Completed on behalf of the Government Buildings Agency (Rijksgebouwendienst) in 1966, TU Delft's auditorium is a textbook example of Brutalism in the Netherlands, because of its style and the use of unpolished concrete construction.

Living campus

Following the arrival of new catering operator Cormet Enjoy the Good Life in July 2018, work was done to update the catering facilities. To bring these into line with the catering vision and concepts, existing catering locations at different places on the campus were renovated or redesigned in 2018. Cormet collaborates with local businesses to ensure a more diverse selection on offer and products in more price categories. The permanent staff of predecessor Sodexo was taken over by Cormet.

Mobility vision

In July 2018, the Executive Board approved the vision on Mobility and Accessibility. TU Delft seeks to better meet the transportation needs of the approximately 27,000 daily visitors to the campus. Public transport, cyclists and pedestrians take priority in the policy, which aims for a 10% reduction in car use by 2025. The vision takes account of the aim to be a CO2-neutral university in 2030. Other principles are to use scarce space and resources smartly and to promote the desired mobility-related behaviour.

5.3 Sustainability

TU Delft aims to be a CO2 neutral and circular campus in 2030. Professor Andy van den Dobbelsteen's (Faculty of Architecture and the Built Environment) Climate Design & Sustainability Chair is developing a road map outlining how TU Delft can make a step-by-step transition to sustainable energy sources and a CO2 neutral campus. A vision and goal for sustainable practices have been defined, where sustainability is made part of area development and other developments and projects. The focus in this respect is on CO2 neutrality, circularity and the health and well-being of users. Rather than standing alone, buildings must be integrated per area to contribute as much as possible to a sustainable campus. Pulse, the energy-neutral teaching building that was opened this year with an A++++ energy rating, is a good example of this.

Energy-saving measures

The transition to LED lighting – inside and outside the buildings – continued in 2018. In 2018, 8,800 strip light fittings were replaced with LED fittings. This will save approximately 1,600 MWh of electricity annually. A total of 50% of the lighting has now been adapted to LED lighting; the other half will follow in the coming two years. In addition to the switch to LED lighting, business installations have been optimised as well. Energy-saving measures were carried out in some buildings, such as insulation, repair and cleaning and adjusting the ventilation. In 2018, a pilot project was started with 'BREEAM in use' to identify the energy-saving potential of existing buildings via quick scans. TU Delft's heat-and-power co-generator is switched off for several months during summer due to the limited demand for heating in the summer period. On the basis of the weather forecast, the heat-and-power co-generator was switched off earlier in 2018 than in previous years. As a result, it is estimated that about 42,000 m³ less gas was used for heat generation. This equals the amount used by about 28 households in a whole year and CO2 emissions of about 75,000 kg (75 tonnes).

Green Office renewal

The TU Delft Green Office is a separate organisational unit, aimed at increasing awareness of sustainability in education, research and in the operation of the university. The funding period for the TU Delft Green Office ended on 1 January 2019. The last half of 2018 was dedicated to the development of a new strategy for sustainability activities on the campus, the hallmarks of which are a stronger focus on student activities, sustainability in education, strengthening the regional alliances and setting up living labs for sustainability initiatives. Installed in September, until September 2019 the student board of the Green Office will focus on areas such as creating more awareness of sustainability in education. For instance, Green-mE, a student initiative within the Faculty of 3mE, has written a guide on how to better incorporate new sustainability insights into the teaching curriculum. It will be determined whether this initiative can be applied in other faculties as well.

Work in progress on campus

In 2018, a great deal of work and construction took place on campus.

Waste separation and circular use

More than 2,000 tonnes of waste are collected on the TU Delft campus every year. The percentage of general waste in this total waste flow is about 45%. The remaining waste is collected separately and processed. Thanks to its separate collection, 43% of the waste on the campus is reused as raw material, 46% of the waste is incinerated, with energy recovery, and 12% is left over as waste from which metals are recovered, and the remaining bottom ash is used to the greatest extent possible as a construction material for roads, for example TU Delft is always looking for new ways to further reduce the amount of general waste. In 2018, two pilot projects were started for the more sustainable processing of waste flows. One of these involves the collection of plastic cutlery in order to examine the possibilities of using this plastic as filament for 3D printers. A pilot project was also started to collect coffee grounds, which could possibly be used as soil for cultivating oyster mushrooms.

5.4 Safety

TU Delft is committed to providing a pleasant, safe and secure environment in which to work and study. Integrated Safety and Security is an approach for managing all incidents and risks. The main assessment instruments are the Safety Profile and the Progress Report, which are drawn up every year. The overall risk seems to have decreased slightly, just like in previous years. The focus on safety and security is also forward-looking: in 2018, a programme was started for campus-related design safety, to organise safety in relation to campus development at an early stage.

Safety and the TU Delft community

Together with the Municipality of Delft, the Haaglanden Safety Region, fire brigade and IT, this year student associations were asked to turn their attention to safety in the living and working environment, burglary and fire safety and IT security. Since 2018, the community police officer is available once a week in the Aula Building to answer questions from staff and students. Other areas for special attention were travel safety training for students, nuclear security, fraud, screening, crisis training, classroom safety, and a safe Welcoming Week. In the third quarter of 2018, a ‘social safety’ programme was started as well, with the aim to tackle undesirable behaviour by working together on a positive and safe working environment for everyone. The programme focuses on managers, teams and professionals who are often the first point of contact for staff who experience undesirable behaviour

Data security and privacy

The GDPR (General Data Protection Regulation)
took effect on 25 May 2018. The GDPR replaces the current Data Protection Act and ensures harmonisation of current privacy legislation within Europe, while improving privacy protection of citizens. The implications for TU Delft have been identified by a centralised privacy team. Various formal measures have been taken, such as creating a register containing details of the processing of personal data, ensuring that privacy-sensitive processes are in line with the GDPR and drawing up a TU Delft-wide privacy statement. Efforts were made to create awareness regarding the use of personal data. The privacy team assists and facilitates and faculties and service departments in the implementation of the GDPR.

The threat of cyber attacks is on the rise worldwide. Partly because of these developments, IT capacity has been increased to bring security and privacy up to

speed. In addition, a start was made on the implementation of a security monitoring service department for the detection of safety and security issues in real time.

5.5 Operational management and services

Whether providing services to students, facilities management, electronic and mechanical support or library services: a university that seeks to deliver excellence, today and tomorrow, needs top-notch support services that are effective and efficient. The end of 2018 saw the start of the design phase of the TU Delft Service Quality programme. The aim of the programme is to improve the quality and integration of operations and services. This means increasing the capacity to address domain-transcending operational issues and putting an end to non-functional patterns in the relations between University Services departments and between University Services and the faculties. The motto of TU Delft Service Quality is working together on excellent services Learning how to work better together leads to improved services and contributes to TU Delft as an excellent university. The programme consists of the following cornerstones: governance, leadership and conduct, innovation, and communication, and focuses on five themes. The themes are financial services, safety and security, building-related services, HR services and campus development. An approach called Service alert has been developed to reduce unnecessary bureaucracy. Staff and students can report such issues to an online help centre. A team then determines which report should be given priority and monitors to ensure that the people assigned to handle the case take quick action and provide a solution. Various steering committees have been established for this purpose, consisting of representatives from University Services and faculties.

Reorganisation of Facility Management

As of 1 January 2018, the Facility Management department, formerly part of FMRE, has become part of the IT department. This concerns the staff and activities of the catering, events, hospitality, services and services teams. The purpose of the transition is to have a fully integrated ICT & FM department as of 1 January 2019, so that the provision of services is as efficient and streamlined as possible. In January 2018, the former Facility Management & Real Estate (FMRE) department was renamed Campus & Real Estate (CRE).

Restructuring of E&SA

In 2018, Education and Student Affairs was reorganised as a matrix organisation, where strategic programmes such as the Graduate School and the Extension School are embedded in the organisation. The department is now known as Education & Student Affairs (E&SA). A development programme aims at harmonising and further digitising business processes. This will meet the increasing demand for support as a result of the growing number of students and doctoral candidates, making work more efficient and improving services. As extra support, a Digital Excellence programme was initiated, aimed at the further automation of services to students, doctoral candidates and instructors.

Services: One-stop shop

The aim of TU Delft is to provide customers – students, staff and external customers – with a clear point of contact. Although this one-stop shop for services is intended to guarantee simplicity and efficiency, customisation and personal attention are of at least equal importance. In 2018, the opportunities to further promote integrated services were explored in greater depth. One result is that the Service Desks are now equipped to answer HR-related questions. For example, you can ask about your salary slips, enquire about the status of a requested change or apply for an employer’s declaration.

Business Intelligence

In 2018, steps were taken to develop and implement a new business intelligence environment for TU Delft: Management information in FOCUS (MIFOCUS). MIFOCUS will make strategic and tactical management information available through easily accessible and interactive dashboards. One important part of this new environment is the data warehouse, where access will provide access to the main source systems of different departments. Within the environment, the data warehouse will supply the underlying data for most of the dashboards. MIFOCUS is expected to go live at the beginning of 2019.

Pilot project with Staff Ombudsman

Based on an initiative put forward by the Works Council, the Executive Board approved a Staff Ombudsman pilot project on 1 September 2018. An external and independent expert who will report to the Executive Board will be hired in for one year for this purpose. The Staff Ombudsman makes staff feel comfortable in discussing personal dilemmas, and work-related questions and impasses, and asking for advice. The Staff Ombudsman will act as a 'gateway' in questions relating to work, undesirable behaviour, managerial integrity, conflicts of interest and neglect of duties.

5.6 Legal affairs

Revised schemes

The models for the Teaching and Examination Regulations (OER) and the Rules and Guidelines for the Board of Examiners (RRvE) have been completely revised for the 2018/2019 academic year. The models for the Bachelor's degree programme and for the Master's degree programme have been consolidated into one model. The RRvE model describes the tasks and powers of the Board of Examiners as well as the measures that the Board of Examiners may take. In consultation with representatives of the Central Student Council, the student charter for the 2018/2019 academic year has been updated and made more succinct. The student charter provides an overview of the rights and obligations of students. This includes the Profiling Fund Scheme that has replaced the old Graduation Support Scheme (RAS) and the new Enrolment and Tuition Fee Regulations. Various model contracts have been prepared to ensure contract uniformity: a model Academic and Scientific Cooperation agreement and a model contract for joint doctoral supervision and dual degrees. A large number of model contracts have been developed for the faculty contract managers for research and made accessible via a central database. Since 2018, the research contracts have been recorded in a central database for all faculties as well. An Intellectual Property Guidance Document has also been developed.

Letters of objection and appeals

Any student or employee of TU Delft may file a complaint or an appeal against the university's decisions. The number of settled objection and appeals are included in Appendix 5, along with an overview of all complaints.

5.7 Holdings: TU Delft Services BV and Delft Enterprises BV

TU Delft has two holdings: TU Delft Services and Delft Enterprises. The TU Delft Holdings contribute to the realisation of the university's objectives insofar as their implementation occurs through its own legal entities.

TU Delft Services

The activities of TU Delft Services B.V. (TUDS) support the activities of TU Delft that best match a limited company structure or other private entity. Tax reasons, risk management and control can be decisive in TU Delft's choice to place activities in an entity under TUDS. TUDS sets up and manages the entities with the help of the Finance and Legal Services departments. The EB supervises the implementation of TUDS' policy via the director of TUDS. Entities of TUDS include the Holland PTC proton clinic, which officially opened on 30 November, the Bioprocess Pilot Facility (BPF), the YES!Delft business incubator, and FlexDelft, the internal payroll & secondment agency. These are entities for which there is no exit strategy. SAM|XL was added in 2018.

Launch of X

In August 2018, the former Sport & Culture transformed into X. During its grand opening, X launched a partly refurbished and partly new building, a new name and a new goal: a place on the campus geared to the needs of for young people studying at TU Delft: 'Xplore yourself. Xpand your playground.' The building and its programming were designed together with students. The result is a place where people can meet up and explore, where the programming is much broader than in Sport & Culture. The complex has sport facilities and creative studios as well as a concept store, student kitchen and living room, a lab for experimenting with art, engineering and technology and a campus farm with vegetable gardens for students. This building promotes TU Delft's living campus goal.

SAM|XL

SAM|XL is the living lab on the TU Delft campus where TU Delft, businesses, the Netherlands Organisation for Applied Scientific Research and universities of applied science are working together on the automation of the manufacture, assembly and inspection of light-weight constructions such as aircraft, boats and wind turbine blades. On the part of TU Delft, the Faculty of AE and the Delft Robotics Institute are closely involved in SAM|XL. SAM|XL was established as a TU Delft Foundation with a participation model, which makes it possible for partner companies to exert their influence on the strategy to be pursued and the acquisition of common infrastructure. In addition, SAM|XL forms a community of researchers and businesses, which accelerates the preparation and submission of European grant proposals and increases the chance of success. Experts from businesses and knowledge institutions will be working together – supported where possible by students from universities and universities of applied sciences – to accelerate the development of knowledge while building the workforce of the future at the same time.

Delft Enterprises

Delft Enterprises B.V. (DE) is TU Delft's holding company. It invests in start-up companies based on TU Delft knowledge in exchange for an equity interest. The investment can take the form of financial and/or non-financial contributions from DE or TU Delft, including expertise, intellectual property rights, facilities, support and (limited) start-up capital. As a shareholder, DE is actively involved in the start-ups. The DE philosophy is to connect promising ideas to entrepreneurship (talented students and staff members, and entrepreneurs from alumni and other networks) and funding (e.g. the UNIQ 'proof-of-concept' fund) in order to bring valuable knowledge from the university to market. In doing so, DE contributes to achieving TU Delft's valorisation objectives.

It also holds shares in TU Delft spin-out companies. By late 2018, DE owned shares in 57 companies. Many of these companies are housed in the YES!Delft business incubator, RoboValley, the Construction Campus or at other locations in the vicinity of the campus. In 2018, it took an interest in five new companies: Polderdak, Battolyser, Innatera Nanosystems, Stokhos and MU-G Knowledge Management. These companies were established based on knowledge development from the faculties at TU Delft. Some companies are patent-based. The year 2018 saw a partial exit, and income was received from an earn-out scheme from a past exit. Part of this income was fed back to the relevant faculties. DE's exit policy was tightened in 2018 with the approval of the Supervisory Board. For those companies that have developed favourably and therefore have higher exit potential, a commercial analysis will be used to plan their exit. Companies that have stopped making progress for some time will leave earlier. TU Delft's valorisation objective remains leading in DE's activities.

6 Financial report

6.1 Financial developments

The financial context within which TU Delft operates is characterised by increasing numbers of students, with government funding lagging behind, and the need for real-estate innovation. This continues to add to the financial pressure.

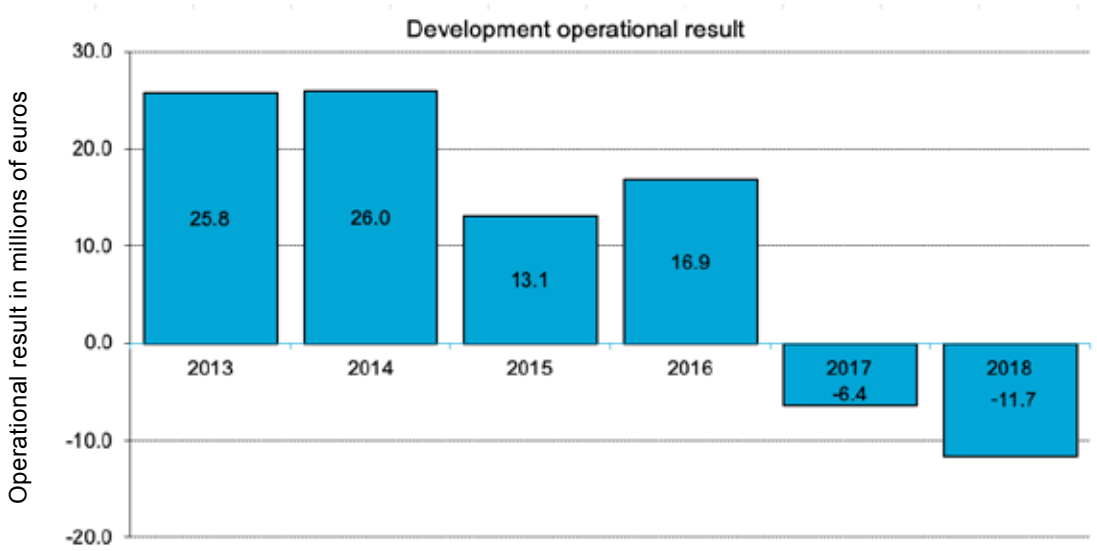
Managing strictly on the basis of financial ratios paints a seemingly healthy picture of the situation. However, because government funding has consistently lagged behind, there was insufficient spending in recent years on the development of the real estate and to safeguard the quality of education. This means greater challenges for the future.

In 2018, TU Delft achieved a result of -/- €11.7 million, compared with a budgeted result of -/- €10.9 million. This is the second year in a row that TU Delft has closed with a negative operating result. The financial result does not yet reflect all the challenges facing TU Delft; only asbestos and sewer costs have been anticipated, while real estate-related depreciation has increased on the back of the investment programme.

Several exceptional items had an effect on the result in 2018. To provide an accurate picture of the trend in results in the past few years, exceptional items have not been taken into account, and the chart below shows the movements in the operating result. Positive results were recorded up to and including 2016, some of which was saved for future investments in real estate. Annual results have been negative since 2017. Because of the increase in the number of students, with government funding lagging behind, the challenges appear to be greater than we had expected. This is addressed in more detail in the continuity section.

Pre-investment for the student loan system

In 2018, a sum of €8 million was made available to the faculties for pre-investment ahead of the introduction of the student loan system. These resources were used to improve the quality of education. The entire budget was spent in 2018. In addition, the faculties together spent an extra €0.7 million to implement the approved plans for the student loan system. A number of extra projects were also launched which will be funded with resources left over from 2016 and 2017. Additional information on the expenditure of these resources is provided in page 24 of this annual report.



Gravitation programmes

At the end of 2012, the Ministry of Education, Culture and Science approved an application for the 'Frontiers of Nanoscience' (Nanofront) proposal as part of its 'Gravitation' (Zwaartekracht) programme. A total sum of €37.0 million was awarded to the entire consortium for the 2012-2021 period. In 2017, a sum of €19.2 million was awarded to the proposal entitled Building a Synthetic Cell for the 2017-2026 period. Given the fact that the cash flow from the government contribution is not equal to the expenditure, 10.8 million euros (2017: 12.4 million euros) of the amount received was included in the balance sheet at the end of 2018. The expenditure proceeds in line with internal plans and as coordinated with the ministry.

Treasury Policy & Investment, Loan and Derivatives Regulations

TU Delft carries out its treasury transactions in accordance with the TU Delft treasury charter. The treasury policy focuses mainly on identifying – and, where necessary, covering – risks relating to temporary surplus liquid assets, and maximising the interest earned on these. The content of the treasury charter was amended in accordance with the Investment, Loan and Derivatives Regulations for Educational and Research Institutions 2016, which were finalised by the Ministry of Education, Culture and Science on 6 June 2016. Due to the fact that transparent separation of temporary surplus liquid assets cannot be made uniform, TU Delft has chosen not to make any distinction between public and private resources in its financial accounting. The private resources that have been allocated to the specific affiliated and consolidated legal entities of TU Delft are an exception. All temporary liquidity surplus stemming from the core activities of education, research and knowledge valorisation at TU Delft are public funds and are invested by TU Delft in savings products at various Dutch commercial banks with at least an A rating. The total balance of liquid assets is available in the short term (within 30 days) and is invested in the most risk-adverse and flexible manner possible. Optimisation of interest is pursued within this framework. The Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) has a research group known as the Delft Blockchain Lab (DBL), which focuses on research and education in the field of blockchain technology. Within this framework, it participates in the national partnership known as the Dutch Blockchain Coalition. To enable the investigation of the technology underlying the blockchain, TU Delft has been holding a limited number of bitcoins as of the balance date. Given the high volatility of this cryptocurrency, they are valued according to their purchase price. TU Delft issues loans exclusively to legal entities that have close ties to the university or one of its

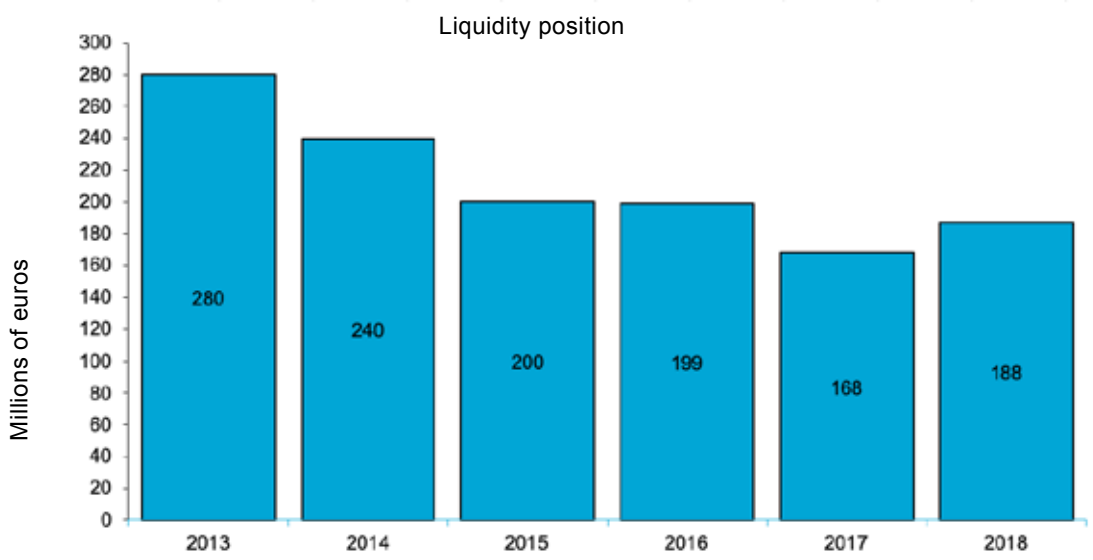
core tasks (e.g. student associations and TU Delft Services B.V.). The loans issued are included by balance date under the heading of financial fixed assets. In 2015, in order to sharply reduce substantial financial risks, TU Delft concluded a number of forward exchange contracts that relate directly to future funding that will be received from external parties in a foreign currency (USD). Such forward exchange contracts are concluded only if a number of criteria have been met. It is particularly important that there is certainty regarding the actual receipt of the funding and the dates on which it will be received, and that these funds are spent in Euros in their entirety. For its financial statements, TU Delft applies cost-price hedge accounting, in accordance with Guideline 290 of the Annual Reporting Guidelines. The foreign exchange position and strategy are evaluated periodically. Securities amounting to a total of 17.9 million euros are accounted for in the 2018 financial statements on the balance sheet date. These investments involve private resources belonging to the following consolidated legal entities included in the TU Delft financial statements: the Stichting Justus & Louise van Effen Fonds, Stichting Nanoscience TU Delft and Stichting Het Lammingafonds. These legal entities have their own financial administrations, receive no public funds, and therefore do not fall under the Investment, Loan and Derivatives Regulations for Educational and Research Institutions 2016 issued by the Ministry of Education, Culture and Science. The full securities portfolios of these consolidated legal entities have been transferred to external asset managers, with the asset management tying in with the objective of the legal entities and the long-term investment horizon. In concrete terms, this results in securities portfolios that are managed by external asset managers with a risk profile that can generally be regarded as neutral.

6.2 Liquidity position

At the end of 2018, the liquidity position of TU Delft was €187.5 million (€168.3 million at the end of 2017). The increase in liquid assets was caused by the liquidity of affiliated parties, especially among consolidated parties TU Delft Services B.V. And Delft Enterprises B.V. (+€ 12.3 million).

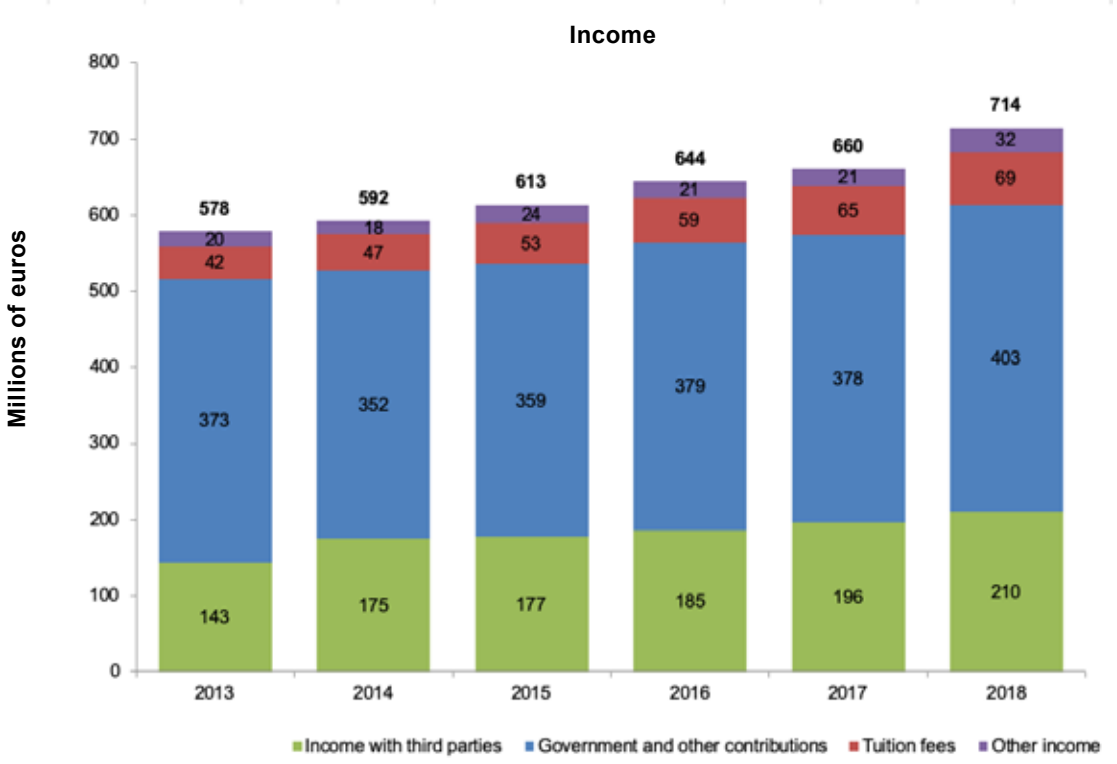
The position at year-end 2018 includes a sum of €13.4 million (2017: €14.7 million) in advance payments received for coordination activities. These amounts do not actually belong to TU Delft, and must be passed on to other participants in indirect and contract funding projects.

The surplus of liquid assets is temporary and necessary to fund the necessary investments in real-estate strategy, innovation in education and research, and the appointment of new staff as a result of increasing student numbers in the coming years. The long-term financial estimate shows that the liquidity position will diminish in the coming years and that external funding will be required in the foreseeable future as a result. This is explained in the continuity section.



6.3 Income analysis

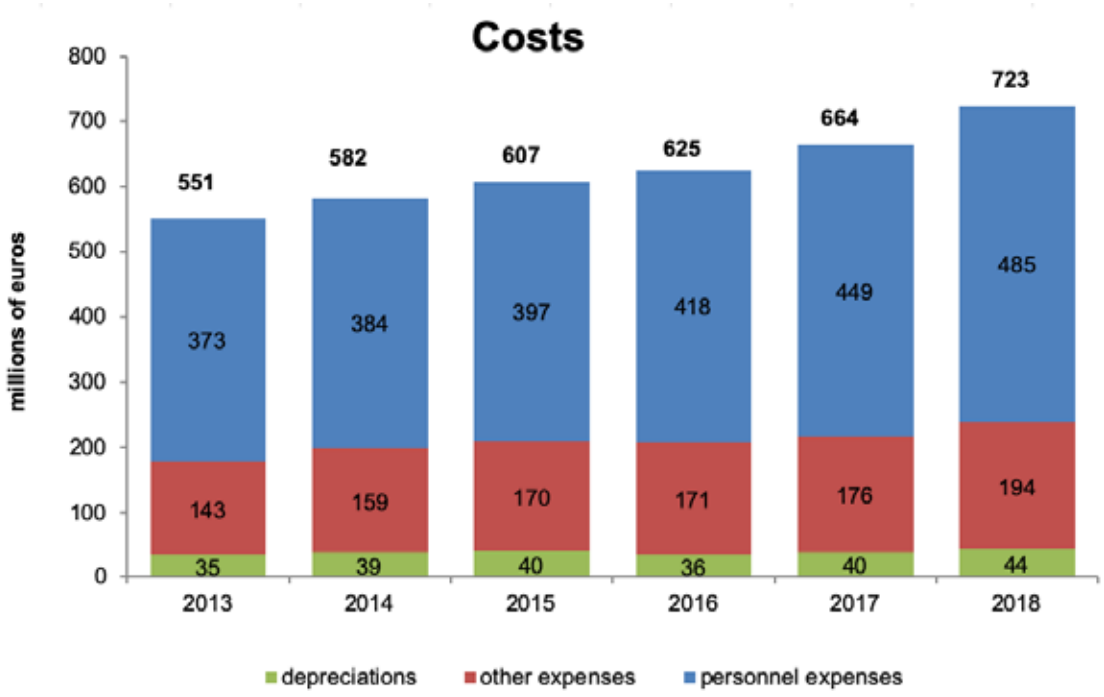
Total income (excluding financial income and the result from participating interests) in 2018 increased by €54.0 million to a level of €714.1 million. The chart below shows the development of income per category for the 2013-2018 period.



Government and other contributions increased by €25.1 million to 403.1 million euros in 2018; besides the wage and price compensation, this includes compensation for reducing the tuition fee for first-year students by half. Income from projects in collaboration with third parties increased by €14.3 million to reach €210.0 million in 2018. This upward trend seen in recent years is in line with the growth of the institution. The tuition fees realised in 2018 amounted to €69.4 million, compared to €65.1 million in 2017. This was due to the increase in the student population. About 10% of all students paid the institutional rate, with about 90% paying the statutory rate.

6.4 Expenditure analysis

Total expenses, excluding financial income and expenses, increased by €59.3 million to €723.8 million in 2018. Personnel expenses increased by €37.2 million, while depreciation expenses increased by €4.0 million. Other expenses (including accommodation expenses) increased by €18.6 million in comparison with 2017.



Personnel expenses

A breakdown of personnel expenses results in the following picture:

Personel expenses		
in millions of euros	**2017**	**2018**
Internal personnel expenses	361,2	388,5
Third-party personnel	63,3	63,3
Change in provisions	5,6	16,5
Other personnel expenses	18,4	16,9
Total	**448,5**	**485,2**

University personnel expenses

The increase in total university personnel expenses from €361.2 million to €388.5 million is due to the increased number of FTEs and the salary increase of 2% with effect from 1 May 2018, as specified in the Collective Labour Agreement, and a non-recurring payment of 0.6% of the gross wage, also as specified in the Collective Labour Agreement.

At the end of 2018, the institution's staff amounted to a total of 5,421 FTE, representing an increase of 233 FTE compared to year-end 2017. Academic staff increased by 171 FTE, from 3,063 FTE in 2017 to 3,234 FTE in 2018. Administrative and support staff increased by 62 FTE, from 2,125 FTE in 2017 to 2,187 FTE in 2018.

On the one hand, the increase in academic staff follows from the increasing number of students. In the category of professors, associate professors, assistant professors and lecturers, the number of FTEs increased by 49 compared to 2017. The appointment of even more staff (+79 FTE) had been budgeted for, but it remains difficult to recruit good staff in the current job market. In the category of researchers, doctoral candidate, designers and other academic staff, we see an increase of 123 FTE in comparison with 2017. This increase is directly related to the increase in income from projects with third parties. The FTE increase in the administrative and support staff is largely the result of the formation of a robust real-estate organisation and the expansion of university services.

Third-party personnel expenses

Hiring of third-party personnel in 2018 remained the same as in 2017. The specification is as follows:

Third-party personnel		
in millions of euros	**2017**	**2018**
Education (hiring of full professors & guest lecturers)	2,2	1,5
Temporary agency workers	10,1	7,0
Payment for services rendered by third parties	29,5	36,0
Travel and accommodation expenses of third parties	3,0	2,5
Government funding for personnel of third parties	**44,8**	**47,0**
Contract and indirect funding for personnel of third partie	**18,5**	**16,3**
Total	**63,3**	**63,3**

In absolute terms, the cost of third-party personnel paid for with government funding has risen over the years. Compared with the total personnel expenses, the proportion remains stable at about 10%.

Depreciation

Depreciation increased by €4.0 million to €43.6 million. This increase is due entirely to depreciation of equipment and inventory. Depreciation of buildings, land and roads in 2018 remained at the same level as in 2017.

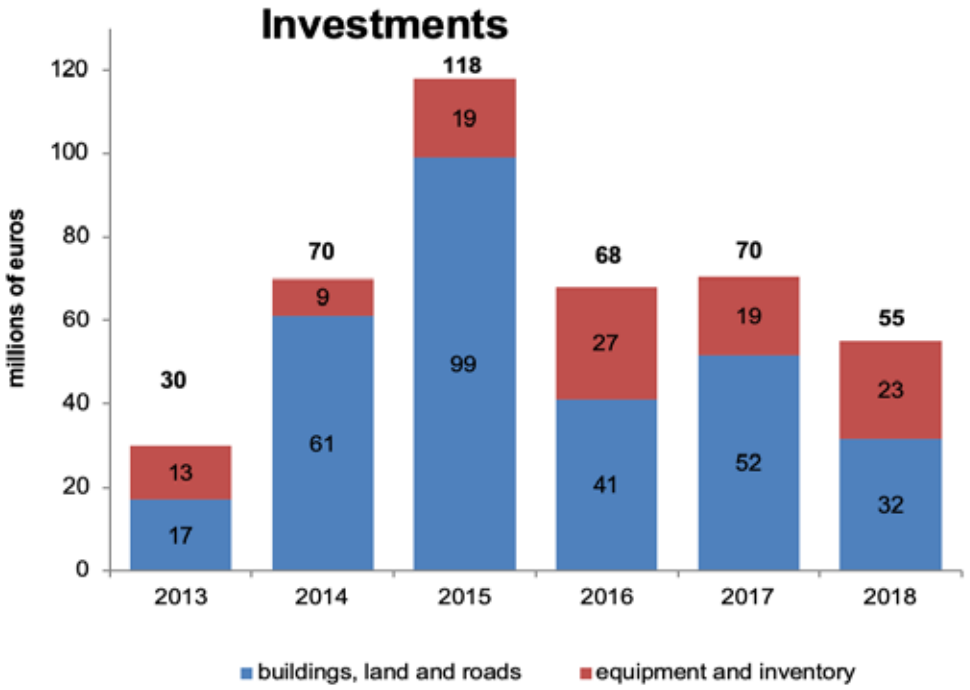
Other expenses (including accommodation expenses)

Other expenses (including accommodation expenses) in 2018 increased by €18.6 million in comparison with 2017. Accommodation expenses increased by €14.5 million. This includes an allocation to the asbestos provision (€15.6 million). The need to create this provision had already been known, but the right amount of the allocation was analysed and accounted for in 2018.

6.5 Investments

Total investments decreased in 2018 compared to 2017 (€15.2 million). Investment in buildings, land and roads decreased by €20.1 million, in particular. The main investments in 2018 related to the Pulse teaching building, development of the accommodations for the faculty of EEMCS, the Catalysis Lab and renovation of the Leeghwaterstraat area. In the course of 2018, various scenarios for the real-estate

strategy were worked out for the coming years. This is explained in more detail in the continuity section. This explains the temporary decline in the volume of investment. The chart below shows the level of investment during the 2013-2018 period. The peak in 2015 can be explained by the investment of €61.7 million in the new building for the Faculty of Applied Sciences.



6.6 Provisions

In 2018, total provisions increased by 21.5 million, from 61.4 million at the start of the year to 82.9 million euros at the end of the year. Staff provisions have increased mainly owing to the growth of the reorganisation provision (+€2.9 million) and the transition provision (+€3.8 million). The other provisions were mainly affected by the increase in the asbestos provision (+€12.6 million). In 2018, €3.0 million were withdrawn from the asbestos provision, and €15.6 million allocated. The substantial allocation is the result of the further analysis of and accounting for the asbestos obligations, which took place in 2018.

in millions of euros	**year end 2017**		**changes 2018**		**year end 2018**
		allocation	*release*	*withdrawal*	
Staff provisions	28,2	17,8	1,3	6,9	37,7
Student provisions	2,1	1,2	0,0	1,9	1,4
Other provisions	31,1	20,1	0,0	7,5	43,7
Total	**61,4**	**39,1**	**1,3**	**16,3**	**82,9**

Profiling Fund

The aforementioned student facilities relate to the Profiling Fund. Through the Profiling Fund, certain students can apply for financial support if they experience delays in the progress of their studies due to special circumstances. In 2018, payments made from the Profiling Fund totalled €1,930 thousand. The payments are shown in the table below, by type:

2018	Type of payment	
Total realised	exceptional circumstances	administrative duties
k€ 1.930	k€ 1.079	k€ 851

In 2018, Profiling Fund payments were made to a total of 1,354 students. The number of grant months paid out was 5,457, an average of 4.0 months per student in 2018. Standard payments, excluding any individual additional amounts, for exceptional circumstances were set at €291.61 per month, and payments for administration were set at €262.45 per month.

The table below shows payments made, specified for EU and non-EU students:

2018	EU	non-EU	Total
Number of students	1,166	188	1.354
Total amount RAS	k€ 1.100	k€ 830	k€ 1.930

During the 2017/2018 academic year, 1,493 Profiling Fund applications were submitted. Of these applications, 551 concerned circumstances beyond the student's control, while 942 concerned administrative duties. Applications and actual payments do not necessarily occur in the same accounting year. This is taken into account in the formation of the facility. The applications and the number of months allocated are specified in the tables below:

Applications Profiling fund 2017/2018 exceptional circumstances

	Files						Months		
2017/2018	applications	granted	DUO	TUD	rejected	under onsideration	months allocated	months DUO	months TUD
Illness	423	396	211	185	19	8	5,291	4,060	1,231
Family circumstances	42	39	11	28	3	0	340	198	142
Handicap	7	6	6	0	1	0	120	120	0
Educational ascendancy	69	60	0	60	8	1	155	0	155
Topsports	4	4	1	3	0	0	90	60	30
Pregnancy	3	3	1	2	0	0	24	18	6
Hardship clause	3	1	0	1	2	0	12	0	12
Total	**551**	**509**	**230**	**279**	**33**	**9**	**6,032**	**4,456**	**1,576**

Applications Profiling fund 2017/2018 administrative duties

	Files				Months
2017/2018	applications	granted	rejected	under consideration	months allocated
Box 1 (social associations)	341	302	39	0	1,171
Box 2a (student associations)	316	293	23	0	1,053
Box 2b (societies)	0	0	0	0	0
Box 3 (sports and culture)	103	91	12	0	373
Box 4 (governance and interests)	112	102	10	0	322
Box 5 (projects)	70	63	7	0	372
Total	**942**	**851**	**91**	**0**	**3,291**

6.7 Capital position

Group equity decreased by €8.7 million in comparison with year-end 2017. In addition to the amount transferred from the operating result for 2018 (€11.7 million) to group equity, a non-recurring allocation of €3.0 million was made. This concerns the allocation of the capital of the M2i foundation, in which TU Delft Services BV acquired dominant control in 2018.

6.8 Financial key indicators

in millions of euros	**Financial key indicators**				
	2018	**2017**	**2016**	**2015**	**2014**
Income	714,1	660,2	644,4	612,8	591,6
Government and other contributions	403,1	378,0	378,6	358,6	352,3
Work with third parties	210,0	195,7	184,8	177,1	175,4
Expenditure	723,2	664,0	625,1	606,7	582,0
Financial income and expenditure	-1,4	0,7	0,3	1,5	3,7
Result	-11,7	-4,7	19,5	5,8	12,1
Depreciation on fixed assets	43,6	39,6	36,3	39,9	38,7
Investments in fixed assets	55,1	70,4	67,7	117,6	70,2
Net cash flow	19,2	-30,5	-0,1	-40,2	-39,6
Liquidity position	187,5	168,3	198,8	199,8	240,0
Fixed assets	484,5	476,3	447,1	419,1	334,0
Working capital	-49,7	-57,4	-23,2	-20,2	53,8
Equity capital	369,8	378,4	383,1	363,6	357,9
Provisions	82,9	61,4	61,9	57,6	52,9

	Ratios					
	OCW	**2018**	**2017**	**2016**	**2015**	**2014**
Total income growth	n.a.	+8,2%	+2,5%	+5,2%	+3,6%	+2,3%
Work with third parties growth	n.a.	+7,3%	+5,9%	+7,0%	+2,5%	+22,5%
Total expenditure growth	n.a.	+8,9%	+6,2%	+3,0%	+3,9%	+5,6%
Government contribution/total income	n.a.	56,4%	57,3%	58,8%	58,6%	59,6%
Work with third parties/total income	n.a.	29,4%	29,7%	29,8%	29,3%	29,6%
Personnel expenses/total expenses	n.a.	67,5%	67,8%	66,9%	64,8%	66,1%
Solvency ratio I	n.a.	44,6%	46,4%	47,5%	47,9%	49,4%
Solvency ratio II	30,0%	54,6%	54,3%	55,1%	55,4%	56,7%
Current ratio	0,5	0,9	0,9	1,0	1,0	1,2

The solvency ratio II ((equity capital + provisions) / total capital) is above the trigger ratio set by the Ministry of Education, Culture and Science (at least 30%). The current ratio of 0.9 is also above the trigger ratio of 0.5.

6.9 Summarised financial statements

Consolidated balance sheet as at 31 December 2018

Amounts in thousands of euros (after processing the result appropriation proposal).

Assets	**2018**		**2017**	
Fixed assets	k€	%	k€	%
Intangible fixed assets	0	0	0	0
Tangible fixed assets	473,062	57	463,904	57
Financial fixed assets	11,426	1	12,396	1
	484,488	**58**	**476,300**	**58**
Current assets				
Inventories	277	0	401	0
Receivables	139,575	17	143,988	18
Securities	17,858	2	20,942	3
Cash and cash equivalents	187,481	23	168,302	21
	345,191	42	333,633	42
Total assets	**829,679**	**100**	**809,933**	**100**

Liabilities	**2018**		**2017**	
	k€	%	k€	%
Equity capital	369,813	45	378,438	46
Provisions	82,868	10	61,397	8
Long-term liabilities	0	0	0	0
Current liabilities	376,998	45	370,098	46
Total liabilities	**829,679**	**100**	**809,933**	**100**

Consolidated statement of income and expenditure 2018

amounts in thousands of euros	2018	2017	Budget 2018
Income			
Government contribution	403,040	377,968	382,500
Other government contributions and subsidies	44	63	0
Tuition and examination fees	69,490	65,142	69,900
Revenues from work with third parties	210,011	195,708	197,290
Other income	31,558	21,282	22,486
Total revenues	**714,143**	**660,163**	**672,176**
Expenditure			
Personnel expenses	485,187	448,533	450,859
Depreciation	43,613	39,648	42,361
Accommodation costs	79,534	65,483	65,008
Other expenses	114,890	110,294	124,791
Total expenses	**723,224**	**663,958**	**683,019**
Balance of income and expenditure	**-9,081**	**-3,795**	**-10,843**
Financial income and expenditure	-1,399	717	30
Result	**-10,480**	**-3,078**	**-10,813**
Taxes	746	-53	-5
Result from participating interests	-1,921	-1,540	0
Result after taxes	**-11,655**	**-4,671**	**-10,818**
Third-party interest in consolidated parties	-51	-56	-94
Net result	**-11,706**	**-4,727**	**-10,912**

6.10 Rights and obligations not included in the balance sheet

Technopolis

Under the name of Technopolis, the TU Zuid area will be transformed into an international Research & Development park, which will also accommodate knowledge-intensive companies and start-ups. The first phase of the real estate development for this project is expected to last 20 years. This project will not lead to financial obligations

for TU Delft for the time being. In December, the Executive Board of TU Delft formally decided to stop using the name Technopolis. The Technopolis area will be consolidated into the campus of TU Delft and continue under the joint new name TU Delft Campus.

Reactor Institute Delft

TU Delft is the licence holder of the Reactor Institute Delft (RID), in accordance with Section 15b of the Nuclear Energy Act. On 1 April 2011, an amendment to the Nuclear Energy Act took effect, which (among other things) obliges licence holders of nuclear plants and reactors to provide financial security for the costs related to the shutdown and dismantlement of the nuclear plant or reactor by the licence holder. For the purpose of this financial security, two buildings of TU Delft have been secured by a mortgage. At the end of 2018, a provision of €20.3 million for the future dismantling of the RID was included in the financial statements, to which an annual allocation will be made, proportional to the period of use.

The extended life of the RID as a result of the OYSTER investment project will lead to new quantities of radioactive waste which cannot be stored under the existing contract with COVRA. Together with EPZ en ECN, TU Delft has drawn up a new basic customer agreement with COVRA on the storage of the additional quantities of high-level radioactive waste. The new contract includes a structural annual contribution of €0.1 million to cover the costs of operating the COVRA facility. The annual contribution is subject to indexation.

Asbestos

TU Delft has included a provision for asbestos removal whereby the amount is based on an inventory of the whole TU campus, with costs calculated per building on the basis of empirical data for each type of asbestos. Actual expenditure relating to asbestos depends on the coordination of asbestos removal with demolition and renovation programmes that are still at the decision-making stage.

Investment obligations

At the end of the financial year, TU Delft had outstanding investment obligations equivalent to 3.4 million euros.

Mapper Lithography Holding B.V.

Until the end of 2016, TU Delft had a conversion agreement with Mapper Lithography Holding B.V. In accordance with this agreement, the services from TU Delft were converted into shares in Mapper Lithography Holding B.V. With effect from 1 January 2017, this conversion agreement was discontinued, and said company now has a normal creditor status.

On 28 December 2018, Mapper Lithography B.V. was declared insolvent after the suspension of payments had been terminated. TU Delft's equity interest in Mapper Lithography Holding B.V. at year-end 2018 was about 1%, which is the same as its equity interest at year-end 2017. The insolvency has had no financial impact on the financial figures of TU Delft, because the participating interest had been valued at nil in the past few years. The financial settlement of the insolvency will take place in February 2019.'

Guarantee for Technology Promotion Foundation

For the operation of Stichting Techniek Promotie ('Technology Promotion Foundation'), it has been agreed that a guarantee amounting to €0.3 million will be made from the funds of the 4TU Technology Sector Plan, to be distributed evenly among three of the four institutions (TU Delft, TU Eindhoven and the University of Twente). In 2014, TU Delft paid the guarantee of €0.1 million to the financial management foundation of the 4TU.Federation.

Forward exchange contract

In order to sharply reduce financial risks, TU Delft has concluded a number of forward exchange contracts that relate directly to future funding that will be received from external parties in US dollars. This is in accordance with the TU Delft treasury charter.

The total value of the hedged item was 8.1 million US dollars at the end of 2018 (2017: USD 13.9 million), corresponding to the contribution from external parties laid down contractually. These future incoming funds will be received in the years 2019 and 2020. The value adjustment of the transactions of the hedged items amounted to €11,000 at year-end 2018. (2017: €767,000).

For its financial statements, TU Delft applies cost-price hedge accounting, in accordance with Guideline 290 of the Annual Reporting Guidelines. The foreign exchange position and strategy are evaluated periodically.

Guarantee for HollandPTC

TU Delft is a guarantor for one-third of the actual loans granted to HollandPTC BV by the European Investment Bank (EIB). In the guarantee agreement, each shareholder acts as a guarantor for 33.33% of the outstanding obligations (interest and repayments). This entails a maximum of €38.5 million per shareholder. HollandPTC BV and TU Delft have made agreements for the fee for TU Delft's issuing the guarantee to the EIB. At year-end 2018, HollandPTC had taken out a total of €89.6 million in loans from the EIB. This corresponds to €29.9 million in guarantees per shareholder.

Quantum Technology (QuTech)

TU Delft, the Minister of Economic Affairs, the Minister of Education, Culture and Science, the Netherlands Organisation for Applied Scientific Research (TNO), the Netherlands Organisation for Scientific Research (NWO) and Stichting TKI HTSM (Top Consortium for Knowledge and Innovation - High Tech Systems and Materials sector) have signed a covenant on strategic partnership in the field of quantum technology (QuTech). The covenant is valid until 1 July 2025. The resulting financial obligation for TU Delft is an in-kind contribution of €3 million per year and a cash contribution of €2 million per year.

6.11 Explanatory notes to the consolidated balance sheet and statement of income and expenditure

Activities

On the basis of Section 1.2 of Book 2 of the Dutch Civil Code and Section 1.8 of the Higher Education and Research Act (WHW), Delft University of Technology has been

granted legal personality. The statutory duty of the university is described in Section 1.3.1 of the WHW: Universities are responsible for providing university education and conducting scientific research. In any case they provide initial degree programmes in university education, conduct scientific research, train scientific researchers and technical designers and transfer knowledge for the benefit of society.

Business address, legal form and trade register number

Delft University of Technology is located at Stevinweg 1, 2628 CN in Delft and is registered with the Chamber of Commerce, entry number 27364265.

Continuity

The accounting policies and determination of profit/loss used in these financial statements are based on the assumption of continuity of the institution.

Consolidation

The consolidation incorporates the financial data of the institution, its group companies and other institutes of which it has dominant control or which are under its central management. Group companies are legal entities over which the institution can exercise dominant control, directly or indirectly, due to the fact that it holds the majority of the voting rights or can control the financial and operational activities in any other way. Potential voting rights that can directly be exercised on the balance sheet date are also taken into account. The group is headed by TU Delft in Delft. The financial statements of the institute are included in the consolidated financial statements of TU Delft in Delft.

The group companies and other legal entities over which the institution can exercise dominant control or which are under its central management are fully consolidated. The third-party interest in the group equity and the group result is stated separately. Participating interests over which no ultimate control can be exercised (associates) are not included in the consolidation.

In the event of an interest in a joint venture, the relevant interest is proportionally consolidated. A joint venture is deemed to exist if, as a result of a collaboration agreement, the control is exercised jointly by the participants.

Intercompany transactions, intercompany profits and mutual claims and debts between group companies and other consolidated legal entities are eliminated, insofar as the results have not been realised through transactions with third parties outside the group. Unrealised losses on intercompany transactions are also eliminated unless there is an impairment. Accounting policies of group companies and other consolidated legal entities have, where needed, been amended in order to conform with the current accounting policies for the group.

Along with associates, several participating interests which are individually and jointly of immaterial significance are not included in the consolidation.

Affiliated parties

All legal entities over which dominant control, joint control or significant influence can be exercised are considered affiliated parties. Legal entities which can exercise dominant control are also considered to be affiliated parties. The members of the Board under the articles of association, other key officials in the institution's management and

close relatives are also affiliated parties.
Significant transactions with affiliated parties are clarified insofar as they have not been concluded under normal market conditions. In this respect, the nature and size of the transaction are clarified, as well as other information that is needed to provide insight. For an overview of affiliated parties, see Model E: Affiliated parties in this annual financial report.

Acquisitions and divestments of group companies

With effect from the acquisition date, the results and the identifiable assets and liabilities of the acquired institution are included in the consolidated financial statements. The acquisition date is the date from which dominant control can be exercised over the institution concerned. The acquisition price is the sum of money (or equivalent) agreed for the acquisition of the institution, plus any directly allocatable costs. If the acquisition price is higher than the net fair value of the identifiable assets and liabilities, the excess amount will be capitalised as goodwill under intangible fixed assets. If the acquisition price is lower than the net fair value of the identifiable assets and liabilities, the difference (negative goodwill) will be recorded under accrued liabilities. The companies involved in the consolidation will remain in the consolidation until they are sold; deconsolidation takes place when decisive control is transferred.

Cash flow statement

The cash flow statement has been drawn up according to the indirect method. The cash amounts in the cash flow statement consist of the liquid assets, with the exception of deposits with a term of more than three months. Cash flows in foreign currencies have been converted at an estimated average rate. Receipts and expenses on account of interest and received dividends have been included in the cash flow from operational activities. The acquired financial interests have been included in the cash flow from investment activities.

Estimates

In order to be able to apply the policies and rules for preparing the financial statements, the management of the institution must form an opinion on various matters, and the management must make estimates which can be essential for the amounts included in the financial statements. If necessary for providing the insight required in Book 2, Section 362, paragraph 1 of the Dutch Civil Code, the nature of these opinions and estimates, including the corresponding assumptions, has been included in the notes to the relevant items of the financial statements.
TU Delft is embarking on an extensive investment programme for renewal of its educational and research facilities. A decision to sell off or demolish a building has implications for the valuation of these existing buildings.

Foreign currency

Assets and liabilities denominated in foreign currency are translated into euros at the exchange rate prevailing on the balance sheet date. Gains and losses arising from transactions in foreign currencies are translated at the exchange rate prevailing on the transaction date. All exchange rate differences are accounted for in the statement of income and expenditure.

6.12 Accounting policies for the valuation of assets and liabilities

General

The consolidated financial statements have been drawn up in accordance with the provisions of the Annual Reporting Regulations for Education, Part 9, Book 2 of the Dutch Civil Code, and Section 660 of the Annual Reporting Guidelines and the authoritative statements in the other sections of the Annual Reporting Guidelines, issued by the Council for Annual Reporting, and with the provisions of the Senior Officials in the Public and Semi-Public Sector (Standards for Remuneration) Act (WNT). Assets and liabilities are generally stated at their acquisition or manufacturing price or current value. If no specific accounting policy is given, valuation is based on the acquisition price. References are included in the balance sheet, the statement of income and expenditure and the cash flow statement. These references refer to the explanatory notes. The financial statements are presented in Euros and in thousands, unless stated otherwise.

Comparison with previous reporting year

The accounting policies and determination of profit/loss have not changed compared to the previous reporting year.

Intangible fixed assets

Intangible fixed assets are stated at their acquisition price including directly allocatable costs, less straight-line depreciation throughout the expected useful life. Impairments expected at the balance sheet date have been taken into account. For an explanation on how to determine whether an intangible fixed asset concerns an impairment, refer to the paragraph below: Impairments of fixed assets.

Tangible fixed assets

Buildings and land are stated at their acquisition price, including additional costs or the manufacturing price less straight-line depreciation throughout the estimated useful life. Land is not depreciated. Impairments expected at the balance sheet date have been taken into account. For an explanation on how to determine whether a tangible fixed asset concerns an impairment, refer to the paragraph below: Impairments of fixed assets. Other fixed assets are stated at their acquisition or manufacturing price value including directly allocable costs, less straight-line depreciation throughout the expected useful life. Impairments expected at the balance sheet date have been taken into account. For an explanation on how to determine whether an tangible fixed asset concerns an impairment, refer to the section: Impairments of fixed assets. The manufacturing price consists of the acquisition price of raw materials and consumables including additional (installation) costs which can be attributed directly to the manufacture. If a considerable amount of time is needed to prepare for manufacture, the interest costs are also included in the manufacturing price. Investments in indirect and contract funding projects are capitalised in the year of purchase and are directly and fully part of the cost of the project. Investments in equipment and inventory of less than €12,500, as well as expenditure on books and artworks, are directly accounted for in the statement of income and expenditure. No provision for major repairs and maintenance has been made for the future cost of major repairs and maintenance on buildings. The costs are directly accounted for in the statement of income and expenditure.

Financial fixed assets

Participating interests

Participating interests in which significant influence can be exercised are valued according to the equity accounting method (net asset value method). When 20% or more of the voting rights can be exercised, it may be assumed that there is significant influence. The net asset value is calculated according to the accounting policies that apply for these financial statements; for participating interests about which insufficient details are available for adjustment to these policies, the accounting policies of the participating interest concerned are used. If, according to the net asset value, the valuation of a participating interest is negative, it is set at zero. If and to the extent that the institution guarantees in whole or in part the liabilities of the participating interest, or has the firm intention of enabling the participating interest to settle its debts, a provision is created for this. The initial valuation of purchased participating interests is based on the fair value of the identifiable assets and liabilities at the time of acquisition. For the subsequent valuation, the accounting policies that apply to these financial statements are applied, based on the values of the initial valuation. The result is recorded as the amount by which the book value of the participating interest has changed since the previous financial statements as a consequence of the result achieved by the participating interest. Participating interests in which no significant influence can be exercised are stated at their acquisition price. If there is a permanent impairment, valuation takes place at the realisable value; downward valuation changes are charged to the statement of income and expenditure. The participations of Delft Enterprises B.V. are stated at cost or lower market value. An exit strategy is maintained for the participations. The policy is that the participation will be disposed of in due course (the aim is a period between five and ten years).

Receivables from participating interests

Receivables included under financial fixed assets are initially stated at fair value after deduction of transaction costs (if tangible). These receivables are subsequently stated at amortised cost, taking into account any depreciation.

Securities

Securities are initially stated at fair value. The participations of Delft Enterprises B.V. are stated at cost or lower market value.

Deferred tax assets

Deferred tax assets are recognised for unused tax losses and deductible temporary differences between the value of the assets and liabilities measured for tax purposes and according to the accounting policies applied in these financial statements to the extent that it is probable that future taxable profits will be available against which temporary differences and losses can be utilised.
The deferred tax assets are measured using the tax rates applicable at the end of the reporting year or at the rates applicable in the coming year, insofar as these have been enacted. Deferred tax assets are stated at face value.

Other receivables

Other receivables entered under financial fixed assets include loans granted and other receivables. These receivables are initially stated at fair value. These loans and bonds are stated at amortised cost. Impairments are deducted from the amortised cost and directly accounted for in the statement of income and expenditure.

Impairments of fixed assets

At every balance sheet date, the institution assesses whether there are indications

that a fixed asset is subject to an impairment. If such indications exist, the realisable value of the asset is determined. If it is not possible to determine the realisable value for the individual asset, the realisable value of the cash flow-generating unit to which the asset belongs is determined. An impairment exists if the book value of an asset is higher than the realisable value; the realisable value is the higher of the net realisable value and the value in use. An impairment loss is recorded directly as an expense in the statement of income and expenditure while reducing the book value of the asset concerned. If it is established that a previously recorded impairment no longer exists or has decreased, the increased book value of the asset concerned is set no higher than the book value that would have been determined if no impairment had been recorded for the asset.

Inventories

Inventories are valued at cost or acquisition price according to the FIFO (first in, first out) method or net realisable value, whichever is lower.
The net realisable value is the estimated selling price less directly allocable selling expenses. The unsaleability of the inventories is taken into account when determining the net realisable value.

Crypto currency

The Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) has a research group known as the Delft Blockchain Lab (DBL), which focuses on research and education in the field of blockchain technology. Within this framework, it participates in the national partnership known as the Dutch Blockchain Coalition. To allow the investigation of this blockchain, TU Delft holds a limited number of Bitcoins. Given the high volatility of this cryptocurrency, they are valued according to their purchase price.

Receivables

Receivables are initially stated at the fair value of the consideration. Trade receivables are subsequently stated at amortised cost. Provisions for bad debts are deducted from the book value of the receivable. The balance from projects arising from projects with third parties leads to a receivable or a debt on the balance sheet. Projects with prepaid expenses that exceed the instalments invoiced in advance are included under receivables. Projects with instalments invoiced in advance that exceed the prepaid expenses are included under liabilities. Any provision deemed necessary for a project arising from projects performed with third parties is deducted. The method used for the valuation of balance sheet projects and for the matching of revenues and costs has been further refined since 2015.

Securities

Securities that are part of the trading book are stated at fair value. Changes in value are directly accounted for in the statement of income and expenditure. Securities that are part of the current assets have a term of less than one year.

Liquid assets

Liquid assets consist of cash, bank balances and deposits with a term of less than twelve months. Current account debts with banks are included under current liabilities. Liquid assets are stated at face value.

Equity capital

The equity capital consists of general reserves and special-purpose reserves and/or funds for special purposes. The special-purpose reserves are reserves with a more restricted disbursement of funds, with the restriction imposed by the Board. The funds for special purposes are reserves with a more restricted disbursement of funds, with the restriction imposed by third parties.

Third-party interests

Third-party interests as part of the group equity are stated at the amount of the net interest in the net assets of the group companies concerned. Where the group company concerned has a negative net asset value, the negative value together with any further losses is not charged to third-party interests, unless the third-party shareholders have a constructive obligation and are able to bear the losses. As soon as the net asset value of the group companies becomes positive once again, results are allocated to third-party interests.

Facilities

General

Provisions are formed for legally enforceable or actual liabilities that exist at the balance sheet date, and for which an outflow of resources is likely to be necessary, the amount of which can be reliably estimated.
Provisions are stated at the best estimate of the amounts necessary to settle the liabilities at the balance sheet date. Other provisions are stated at the nominal value of the expenditure expected to be required to settle the liabilities, unless otherwise stated. If a third party is expected to pay the liabilities and if it is highly likely that this payment will be received upon settlement of the liability, this payment will be included as an asset on the balance sheet.

Provision for long-service awards

The provision for long-service awards is included at the cash value of the expected payments in the course of the employment. The expected salary increases and the likelihood to stay are taken into account in the calculation of the provision. In calculating the current value, a discount rate of 1.5% has been applied (2017: 1.5%).

Asbestos provision

In calculating the asbestos provision, a discount rate of 1.5% has been applied.

Sewer system provision

In calculating the sewer-system provision, a discount rate of 1.5% has been applied (2017: 1.5%).

Other provisions

Other provisions are stated at face value of the expenditure deemed necessary for the settlement of the provision.

Current liabilities

Current liabilities are initially stated at fair value. Current liabilities are subsequently stated at amortised cost, being the amount received taking into account premiums or discounts and after deduction of transaction costs. This is usually the face value.

Leasing

Operational leasing

The institution may have lease contracts for which many of the advantages and disadvantages of ownership do not lie with the institution. These lease contracts are recorded as operational leasing. Lease payments are included in the statement of income and expenditure on a linear basis for the duration of the contract, taking into account the payments received from the lessor.

Financial instruments and risk management

Financial instruments comprise investments in shares and bonds, trade and other receivables, cash, loans and other financing obligations, trade and other payables. Financial instruments are initially stated at fair value. Financial instruments that are not part of the trading book are stated at amortised cost on the basis of the effective interest method, less impairment losses.

Currency risk

The institution operates primarily in the Netherlands. The currency risk for the institution relates mainly to positions and future transactions in US dollars. Based on a risk analysis, the Board of the institution has determined that some of these currency risks are to be covered. Forward exchange contracts are used for this purpose.

Interest rate risk and cash flow risk

The institution runs an interest rate risk on the interest-bearing receivables (primarily under financial fixed assets, securities and liquid assets) and interest-bearing long-term and short-term liabilities (including debts to credit institutions).

Credit risk

The institution does not have any significant credit risk concentrations.

6.13 Accounting policies for determination of the result

General

Income and expenditure are allocated to the year to which they apply. Profits are only included insofar as they have been realised at the balance sheet date. Losses and risks originating before the end of the reporting year are observed, provided that they have become known before the financial statements are adopted.

Government contributions

Government contributions are recognised as revenue in the statement of income and expenditure in the year to which the allocation applies.

Other government contributions and subsidies

Operating subsidies are recognised as revenue in the statement of income and expenditure in the year in which the subsidised costs were incurred or revenue was lost, or when a subsidised operating deficit occurred. The revenue is recognised if it is likely to be received and the institution can demonstrate the conditions for receipt. Subsidies related to investments in tangible fixed assets are deducted from the asset

concerned and included as part of the depreciation in the statement of income and expenditure or deferred as amounts received in advance.

Project revenues and project costs

For projects of which the result can be reliably determined, the project costs and the project revenues will be recorded as net turnover and costs in the statement of income and expenditure in proportion to the achievements as of the balance sheet date. The progress of the achievements is determined on the basis of the project costs up to the balance sheet date in proportion to the estimated total project costs. If the result on the balance sheet date cannot be reliably estimated, the revenues will be recorded as net turnover in the statement of income and expenditure up to the amount of the incurred project costs. The result is determined as the difference between project revenues and project costs. Project revenues are the contractually agreed revenues and the revenues from additional and less work, claims and reimbursements, if and to the extent that it is probable that these will be realised and that these can reliably be determined. Project costs are the costs directly related to the project, the costs that are generally attributed to project activities and can be attributed to the project, and other costs contractually attributable to the commissioning party. If the total project costs are likely to exceed the total project revenues, the expected losses will be immediately included in the statement of income and expenditure. For TU Delft, project revenues constitute a structural contribution to the financial result, and the university has a wide variety of types of arrangements. The agreed project conditions serve as guidelines for determining the result.

Revenue recognition

Rendering services

Revenues from the provision of services are accrued in proportion to the services delivered, based on the services rendered up to the balance sheet date in proportion to the total services to be rendered.

Goods sold

Income from the sale of goods is recognised when the significant risks and rewards of ownership of the goods are transferred to the buyer.

Gifts

Income received in the form of goods or services is stated at fair value.

Other income

Other income comprises income from rental, sale, secondment, contribution by third parties and other income.

Depreciation of intangible and tangible fixed assets

Intangible and tangible fixed assets are depreciated from the month following the date of first use over the expected future useful life of the asset. Land is not depreciated. If there is a change in the estimate of the future useful life, the future depreciations are adjusted accordingly. Book profits and losses from the non-recurring sale of material fixed assets are included in the statement of income and expenditure.

Employee benefits

Periodic remuneration

Wages, salaries and social security contributions are included in the statement of income and expenditure on the basis of employment conditions insofar as they are payable to employees or the tax authorities.

Pensions

The institution has a pension scheme with ABP Pension Fund. This pension scheme is subject to the provisions of the Dutch Pensions Act, and contributions are paid by the institution on a compulsory or contractual basis. ABP bases the pensionable salary on the average wages during an employee's working career. ABP tries to raise the pensions each year by the average wage increase in the government and education sectors. If the coverage ratio is less than 110%, no indexation takes place. The contributions are stated as personnel costs when they become payable. Prepaid contributions are included as prepayments if these result in a repayment or a reduction in future payments. Contributions that have not yet been paid are included in the balance sheet as current liabilities. No further liabilities remain after the contributions have been paid. As of 31 December 2018, the policy funding ratio of the ABP Pension Fund is 103.8%.

Exceptional items

Exceptional items are income or expenditure arising from events or transactions that are part of the ordinary operations but which, for the purpose of comparison, are explained separately on the basis of the nature, scope or non-recurring nature of the item.

Financial income and expenditure

Interest income and interest expenses

Interest income and interest expenses are included on a time-proportionate basis, taking into account the effective interest rate of the respective assets and liabilities.

Dividends

Dividends receivable from participating interests not accounted for at net asset value and securities are recognised as soon as TU Delft has acquired the right to these items.

Exchange differences

Exchange differences arising in connection with the settlement or translation of monetary items are recorded in the statement of income and expenditure in the period in which they arise. Transactions in foreign currency carried out during the reporting period are included in the financial statements at the exchange rate applying on the transaction date.

Taxes

Tax on the result is calculated on the result before tax in the statement of income and expenditure, taking into account the available, tax-offsettable losses from previous financial years (unless these are included in deferred tax assets) and exempt profit components and after the addition of non-deductible expenses. Due account is also taken of changes that occur in the deferred tax assets and deferred tax liabilities in respect of changes in the applicable tax rate.

Result from participating interests

The result from participating interests is the amount by which the book value of the participating interest has changed since the previous financial statements as a consequence of the result achieved by the participating interest, insofar as this is attributed to the institution.

Comparison with previous year

A number of comparative figures for the 2017 financial year have been amended to ensure accurate comparison and presentation. This reclassification has no effect on the equity capital or on the results of previous years.

Tangible fixed assets

In the tangible fixed assets item included in the consolidated financial statements, reclassifications have been made between components: land and roads, buildings and installations (finished/under construction), equipment and inventory and payments on account in advance. The total book value of the tangible fixed assets remains unchanged.

Receivables and current liabilities

In the receivables and current liabilities items in both the consolidated and separate financial statements, the provision component has been redistributed between the components: prepaid costs of multi-year projects and amounts received in advance for multi-year projects. The total balance of prepaid costs of multi-year projects and amounts received in advance for multi-year projects remains unchanged.

Equity capital

In the equity capital statement of changes of the consolidated financial statements, reclassifications have been made between the following components: general reserve, special-purpose reserve and fund for special purposes.

6.14 Remuneration of the Executive Board and Supervisory Board

The remuneration of the individual members of the Executive Board and the Supervisory Board was in line with the accountability obligation arising from the Annual Reporting Regulations for Education and was as follows:

Executive Board:

	Prof.dr.ir. T.H.J.J. van der Hagen	**Prof. dr. R.F. Mudde**	**Mw. Drs. N.A. Vermeulen MBA**
Function data	Rector Magnificus/ President	Vice Rector Magnificus/ Vice President	Vice President Operations
Commencement and end date of employment 2018	01/01 –31/12*	01/03 - 31/12*	01/01 - 31/12*
Part-time factor (FTE)	1,0	1,0	1,0
(Fictitious) employment?	yes	yes	yes
Remuneration			
Remuneration plus taxable expense allowances	€ 169,773	€ 137,798	€ 169,376
Employment benefits	€ 19,227	€ 15,828	€ 19,377
Subtotal	**€ 189,000**	**€ 153,626**	**€ 188,753**
Individually applicable remuneration maximum	€ 189,000	€ 158,449	€ 189,000
-/- Unduly paid amount	n.a.	n.a.	n.a.
Total remuneration	**€ 189,000**	**€ 153,626**	**€ 188,753**
Reason why the exceedance is permitted or not	n.a.	n.a.	n.a.
Data 2017			
Commencement and end date of employment 2017	01/01 - 31/12	n.a.	n.a.
Part-time factor (FTE)	1.0		
(Fictitious) employment?	yes		
Remuneration plus taxable expense allowances	€ 162,341		
Employment benefits	€ 18,659		
Total remuneration 2017	**€ 181,000**		
Individually applicable remuneration maximum	€ 181,000		
-/- Unduly paid amount	n.a.		
Total remuneration	**€ 181,000**		

* : still employed at year-end 2018

Supervisory Board:

	Drs.ir. J. van der Veer	Prof.dr. L.L.G. Soete	Mw. ir. L.C.Q.M. Smits van Oyen MBA	Drs. G. de Zoeten	Mw. Drs. C.G. Gehrels
Function data	**President**	**Member**	**Member**	**Member**	**Member**
Commencement and end date of employment 2018	01/01 - 31/12*	01/01 - 31/12*	01/01 - 31/12*	01/01 - 31/12*	01/01 - 31/12*
Renumeration	€ 22,000	€ 15,100	€ 15,100	€ 15,100	€ 15,100
Individually applicable remuneration maximum	€ 28,350	€ 18,900	€ 18,900	€ 18,900	€ 18,900
-/- Unduly paid amount	n.v.t.	n.v.t.	n.v.t.	n.v.t.	n.v.t.
Total remuneration	**€ 22,000**	**€ 15,100**	**€ 15,100**	**€ 15,100**	**€ 15,100**
Reason why the exceedance is permitted or not	n.a.	n.a.	n.a.	n.a.	n.a.
Data 2017					
Commencement and end date of employment 2017	01/01 - 31/12	01/05 - 31/12	01/01 - 31/12	01/01 - 31/12	01/01 - 31/12
Total renumeration 2017	**€ 20,850**	**€ 9,533**	**€ 14,300**	**€ 14,300**	**€ 14,300**
Individually applicable remuneration maximum	€ 27,150	€ 12,067	€ 18,100	€ 18,100	€ 18,100

* : appointment period continues to future year

6.15 Expense claims of Executive Board members

The table below shows the expenses claimed by the Executive Board members, in accordance with the format prescribed by the State Secretary. The State Secretary defines expense claims as reimbursements for expenses incurred or services rendered, for which the individual administrators submitted expense claims to TU Delft. The expenses charged by TU Delft on behalf of the members of the Executive Board in 2018 are presented in the 'by invoice' column.

Overview of all expenses incurred by TU Delft on behalf of the members of the Executive Board in 2018			
Prof.dr.ir. T.H.J.J. van der Hagen	by declaration	by invoice	**total**
Travel expenses within the Netherlands	-	24,713	**24,713**
Travel expenses outside the Netherlands	46	7,227	**7,273**
Representation expense	55	170	**225**
Other expenses	-	-	**-**
	101	**32,109**	**32,210**
Prof.dr. R.F. Mudde	by declaration	by invoice	**total**
Travel expenses within the Netherlands	286	9,654	**9,940**
Travel expenses outside the Netherlands	-	6,576	**6,576**
Representation expense	-	65	**65**
Other expenses	-	851	**851**
	286	**17,146**	**17,432**
Drs. N.A. Vermeulen MBA	by declaration	by invoice	**total**
Travel expenses within the Netherlands	459	17,375	**17,834**
Travel expenses outside the Netherlands	-	-	**-**
Representation expense	91	128	**219**
Other expenses	-	4,500	**4,500**
	550	**22,003**	**22,553**
Totaal	**937**	**71,258**	**72,195**

6.16 Statement of the Executive Board

The Executive Board hereby confirms (in accordance with Article 31, paragraph 1a of the Annual Reporting Guideline for Higher Education and Scientific Research) that all known details relevant to the audit report on the financial statements and the funding data were made available to the auditor of the institution. The Executive Board also declares that it was not involved in irregularities as referred to in the aforementioned Article 31, paragraph 1a.

6.17 Audit report of the independent accountant

Independent auditor's report

To: the Executive Board of Technische Universiteit Delft

The accompanying summary financial statements, which comprise the consolidated balance sheet as at 31 December 2018, the consolidated profit and loss account over the year 2018 and notes, comprising a summary of the significant accounting policies and other explanatory information, as included in chapter 6.9 up to and including 6.14, are derived from the audited consolidated financial statements of Technische Universiteit Delft for the year 2018. We expressed an unqualified audit opinion on those consolidated financial statements in our report dated 24 April 2019. Those consolidated financial statements, and the summary financial statements, do not reflect the effects of events that occurred subsequent to the date of our report on those financial statements.

The summary financial statements do not contain all the disclosures required by the Regeling jaarverslaggeving onderwijs. Reading the summary financial statements, therefore, is not a substitute for reading the audited consolidated financial statements of Technische Universiteit Delft.

Executive Board's responsibility

The Executive Board is responsible for the preparation of a summary of the audited consolidated financial statements in accordance with the Regeling jaarverslaggeving onderwijs.

Auditor's responsibility

Our responsibility is to express an opinion on the condensed summary financial statements and the related explanatory notes based on our procedures, which we conducted in accordance with Dutch Law, including the Dutch Standard 810 "Engagements to report on summary financial statements".

Opinion

In our opinion, the summary financial statements derived from the audited consolidated financial statements of Technische Universiteit Delft for the year 2018 are consistent, in all material respects, with those consolidated financial statements, in accordance with the Regeling jaarverslaggeving onderwijs.

Amsterdam, 8 October 2019

PricewaterhouseCoopers Accountants N.V.

Original has been signed by R. Goldstein RA

7 Continuity section

7.1 Introduction

In accordance with the requirements of the Annual Reporting Regulations for Education (RJO), this section provides insight into the proposed policy in the coming years, along with the expected consequences for the financial position of TU Delft. The data have been derived from the 2019 budget, as approved in the meeting of the Supervisory Board on 21 December 2018.

A Dataset

7.2 Long-term budget (part A2)

One important challenge is to maintain the financial health of TU Delft in the years ahead. The financial pressure is rising as a result of the increasing numbers of students, with government funding lagging behind, necessary investments in real estate and other important investments. Investments in research infrastructure and real estate are urgently needed to maintain the quality of education and research and to facilitate the steadily growing organisation. At this time, 60% of TU Delft's real estate portfolio is in poor or very poor condition. And more necessary maintenance is due to be performed shortly. Scenarios show that at least €650 million need to be invested in the coming ten years. Within its financial policy, TU Delft observes strict financial standards for various ratios, including solvency, current ratio, leverage ratio and interest-coverage ratio. Managing strictly on the basis of these ratios paints a seemingly healthy picture of the situation. With government funding consistently lagged behind in recent years, there has been insufficient spending on the development of the real estate and to safeguard the quality of education. As a result, the challenges have become so big that substantial additional funds are required to protect its quality.

A negative result has been budgeted for 2019, just like for 2017 and 2018. The number of students at TU Delft is increasing more rapidly than previously anticipated. The number of new students has also surpassed the expectations used by the Ministry of Education, Culture and Science in its Reference Frameworks. This is affecting the need for study facilities and other facilities, as well as staff capacity, which puts great

pressure on the limited financial resources.

Investments in campus development have been intensified in recent years. The need to invest is urgent, because of the poor condition of the existing buildings, the related high maintenance and energy costs today and in the future, and the quality and sustainability requirements placed on today's education and research facilities.

The Campus and Real Estate department has developed three business cases:
- Basics Right scenario aims at maintaining the current situation, making only those investments that are absolutely necessary.
- Realistic Optimum scenario aims at what must be done, with the emphasis on what offers the maximum added value.
- Ambition Proof scenario aims at the maximum realisation of ambitions in the area of education and research.

The long-term budget was prepared on the basis on the Realistic Optimum scenario. An investment framework was worked out for the coming years for this purpose. The next step is to take value-based decisions within the chosen scenario between possible alternatives within this framework. These alternatives are currently being assessed by the deans. A risk in developing this scenario, aimed at the maximum added value for the institution, is that there will not be enough budget to meet the needs and statutory requirements for sustainability.

The growing student population is putting more pressure on the quality of education and capacity for research. In various places within the institution, work pressure is found to be too high. To safeguard the quality of education, in the necessary capacity for research, additional investments will be required in teaching staff working towards the desired student/staff ratio.

The long-term budget takes account of a student/staff ratio at the level of the 2019 budget and the Realistic Optimum real estate programme. Costs associated with additional measures to safeguard the quality of education and relieve the pressure of work have not been included in the estimate. Without investments in additional measures, drastic measures to generate additional revenues are already required in order to operate within a balanced budget in the years ahead. The available resources are insufficient to safeguard the quality of education and an acceptable workload for teaching staff. This is being discussed with the Ministry of Education, Culture and Science.

The presented long-term budget in this continuity section is based on the numbers at the time of the budget for 2019 approved by the Supervisory Board in December 2018.

Key points of the budget

The year 2019 will see growth in the number of students and a further increase in staffing.
In 2019, the focus will be on developing and implementing the optimal real estate scenario and the related administrative aspects. Staff intake in relation to increases in student numbers and the quality of education are key areas for special attention.

Special non-recurring costs and tied budget for real-estate maintenance

The budget includes a number of non-recurring accommodation costs. This concerns a total of €5.2 million, mainly the costs of the Tram Line project and non-recurring accommodation costs.

A conditional budget of 5.0 million euros for real-estate maintenance has not yet been taken into account. It is a tied budget, because this part of the maintenance work is included in the plans but has not yet been budgeted. A formal decision on the actual implementation will be taken in the course of 2019.

Investments

The investments in buildings and land are estimated at €52 million, and the investments in equipment and inventory at €25 million. These include investments in the pool of teaching rooms. The real estate-related investments concern a number of current and future projects, such as P-sports and the ESP Lab. The basic principles for planning several projects in 2019 are still being assessed against the frameworks. A final decision on these projects is yet to be reached. These include the ECHO teaching building, STEVIN site redesign, Delft Geothermal Source, Rotterdamseweg car park and Faculty of IDE catering.

Student Loans (Higher Education) Act

TU Delft invests in the quality of its education on an ongoing basis. In addition, TU Delft invests an extra amount in the quality of education in advance of the expected funds from the student loans. Since 2017, this has been €8 million a year. Income from student loans is estimated at €5.4 million in 2019. This amount remains structurally allocated to the units on the basis of long-term budgets.
In 2019, €8.9 million has been budgeted for spending in the framework of the funds from student loans. In addition to the structural €8 million, unspent funds from 2016 and 2017 will also be spent in 2019 (€0.4 million). Starting from 2019, an investment fund for short-term quality projects will be budgeted as well. The Student Council takes the lead in initiating project proposals. TU Delft's expenditure in the framework of the Student Loans (Higher Education) Act is explained in greater detail on page 24.

Tuition fees

Income from the receipt of tuition fees is on the rise. This is attributable to the trend in the number of students, on the one hand, and the price increase, on the other. From 2019 onwards, the increase in the institutional rate for international students will have an effect on the long-term budget.

Long-term budget

An overview of the budget for the period 2019 to 2023 is given below. The effects of wage and price adjustments and the possible compensation from the Ministry of Education, Culture and Science are disregarded in this composition, and the 2019 price level has therefore been used for the 2020-2023 period. This estimate does not yet include the cost of measures to reduce the high pressure of work. Statutory requirements for the sustainability of investments can also put additional financial pressure on the long-term budget.

Multi annual budget

amounts in millions of euros	actual 2018	budget 2019	budget 2020	budget 2021	budget 2022	budget 2023	expected 2030
Income							
Government contribution (including other government contributions and subsidies)	403	407	409	415	420	423	432
Tuition and examination fees	69	71	82	83	84	85	85
Revenues from work with third parties	210	201	203	206	209	211	211
Other income	32	32	26	26	26	26	26
Total revenues	**714**	**711**	**720**	**730**	**739**	**744**	**753**
Expenditure							
Personnel expenses	485	499	504	512	520	526	533
Depreciation	44	42	45	48	52	54	67
Accommodation costs	80	74	68	71	68	70	75
Other expenses	115	109	109	109	109	109	109
Total expenses	**723**	**724**	**726**	**741**	**750**	**759**	**784**
Balance of income and expenditure	**-9**	**-13**	**-6**	**-11**	**-12**	**-15**	**-30**
Financial income and expenditure	-1	0	1	0	-1	-1	-5
Result	**-10**	**-13**	**-5**	**-11**	**-12**	**-16**	**-35**
Result from participating interests and value adjustments to financial fixed assets	-2	-2	0	0	0	0	0
Result before taxes	**-12**	**-15**	**-5**	**-11**	**-12**	**-16**	**-35**
Taxes	1	0	0	0	0	0	0
Result after taxes	**-12**	**-15**	**-5**	**-11**	**-12**	**-16**	**-35**
Third-party interest in consolidated parties	0	0	0	0	0	0	0
Net result	**-12**	**-15**	**-5**	**-11**	**-12**	**-16**	**-35**
Costs workload relieve en quality assurance		**pm**	**pm**	**pm**	**pm**	**pm**	**pm**
Operational measures to be decided		**0**	**0**	**10**	**10**	**15**	**35**
Net result after measures	**-12**	**-15**	**-5**	**-1**	**-2**	**-1**	**0**

The above long-term budget shows that operating measures are needed in the coming years to generate additional revenues of up to €15 million in 2023. After the planning period of five years, the necessary measures will continue to run up to €35 million eventually.

Estimating the cost of measures to reduce the high pressure of work is complex. Taking on more teaching staff to reduce the pressure, as already mentioned, will have an impact on the volume of scientific research, the trend in the number of doctoral candidates and post-doctoral researchers, on the level of support as well as on the necessary infrastructure and facilities. The connection between these developments has since been identified and an indication of the effects on operations has been included in discussions with the Ministry of Education, Culture and Science. The sector plans were not taken into account. Seeing as these additional funds cover new plans only, the addition of these funds will not address the existing financial challenges of TU Delft.
The conclusion is that for a financially healthy institution, where quality is adequately assured, a substantial additional amount will be needed in the coming years to safeguard the necessary quality.

The balance sheet below shows the budget for the period 2019-2023:

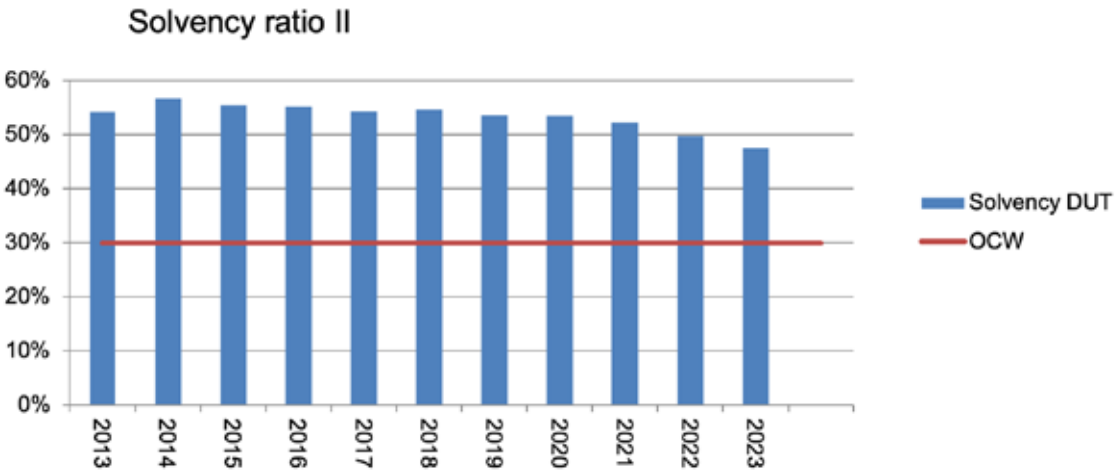
Multi-annual budget balance sheet

Assets	actual 2018	budget 2019	budget 2020	budget 2021	budget 2022	budget 2023
	M€	M€	M€	M€	M€	M€
Fixed assets						
Intangible fixed assets	0	0	0	0	0	0
Tangible fixed assets	473	528	581	629	676	720
Financial fixed assets	11	8	8	8	8	8
	484	**536**	**589**	**637**	**683**	**727**
Current assets						
Inventories	0	0	0	0	0	0
Receivables	140	127	124	122	121	121
Securities	18	18	18	18	18	18
Cash and cash equivalents	187	127	74	50	49	48
	345	**272**	**217**	**190**	**188**	**187**
Total assets	**830**	**808**	**805**	**827**	**872**	**914**

Liabilities	actual 2018	budget 2019	budget 2020	budget 2021	budget 2022	budget 2023
	M€	M€	M€	M€	M€	M€
Equity capital						
General reserve	344	341	336	335	334	333
Special-purpose reserve	-4	-5	-5	-5	-6	-6
Fund for special purposes	30	19	19	19	19	19
	370	**355**	**350**	**349**	**347**	**346**
Provisions	83	78	81	83	86	89
Long-term liabilities	0	0	0	20	64	104
Current liabilities	377	375	375	375	375	375
Total liabilities	**830**	**808**	**805**	**827**	**872**	**914**

Investments in campus development will result in an increase in tangible fixed assets in the coming years. On the other hand, it will also result in decreasing liquid assets. This trend will continue and will lead to TU Delft having to borrow money from 2021 onwards. There will then no longer be a surplus of financial resources. Liquid assets are shown in the chart on the next page.

The solvency II ratio will decrease as a result of negative operating results in the coming years but, as the chart shows, it will remain above the trigger ratio of 30% set by the Ministry of Education, Culture and Science.



Definition of Solvency II: ((equity capital + provisions)/total liabilities)

7.3 Developments in key indicators (part A1)

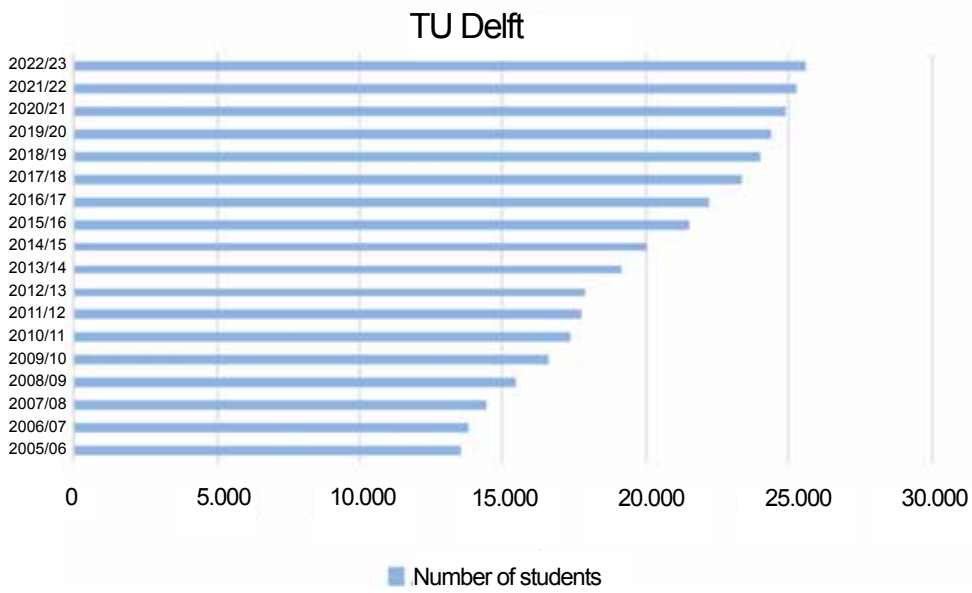
Expected student numbers

The number of students at TU Delft will soon exceed 25,000. The table below shows the expected development of the student population. This concerns the estimated 1 December status figures per year of the students who pay tuition fees to TU Delft. These status figures have been used to estimate the tuition fees for the coming years. The bridging students and students who take part in a joint degree programme in Rotterdam or Leiden and pay tuition fees there come on top of that. These numbers are not included in the table. In 2018, this concerns more than 1,300 students who put pressure on teaching capacity in addition to those students who pay tuition fees.

Table: student numbers

estimated per 1/12	2018	2019	2020	2021	2022	2023
Student numbers	23,900	24,000	24,400	24,900	25,300	25,600
Bridging program students / students shared programmes	1.300	pm	pm	pm	pm	pm

The number of students has grown by 68% in the past ten years. This growth will continue in the coming years. This trend is shown in the chart below.



Concurrent with this growth, the student/staff ratio has worsened in the past ten years from about 15 to 1 to about 19 (budgeted for in 2019) to 1. We apply the definition[1] as used in connection with the Association of Universities in the Netherlands. Most staff in these categories are responsible for conducting scientific research in addition to teaching. The ratio stated above is an average for the entire institution. In some places in the organisation the ratio is nearly 35 to 1.

Expected staff numbers

The table below shows the expected development of the FTE numbers with an appointment at TU Delft. A distinction is made between the job groups ‘academic staff’, ‘administrative and support staff’ and ‘student assistants’. This division is consistent with the usual system within TU Delft.

Note: At TU Delft, at year-end 2018 there were about 5,400 people employed either on a full-time or part-time basis who were not on the payroll and who have access to support staff for academic staff, general support and facilities.

In 2018, teaching-staff appointments were less than expected. The shortage on the jobs market makes it difficult to recruit suitable staff. As the number of students continues to rise, teaching staff capacity will need to be increased in the years ahead. The figures reflecting the expected trend in teaching staff (full professors, associate professors, assistant professors, lecturers) take account of the same student/staff ratio

[1] Number of enrolled students/number of teaching-related staff in FTEs (full professors, associate professors, assistant professors and other lecturers)

FTE development							
	Actual	**Budget**	**Budget**	**Budget**	**Budget**	**Budget**	**Budget**
	2018 (year end)	2018 (average)	2019 (average)	2020 (average)	2021 (average)	2022 (average)	2023 (average)
Academic staff (WP)	**3,234**	**3,138**	**3,274**	**3,318**	**3,386**	**3,441**	**3,482**
Professor, university professor, university teacher, teacher	*1,224*	*1,202*	*1,280*	*1,301*	*1,328*	*1,349*	*1,365*
Researcher, PhD students, other scientific personnel	*2,010*	*1,936*	*1,994*	*2,017*	*2,058*	*2,091*	*2,116*
Administrative and support staff (OBP)	**2,149**	**2,118**	**2,221**	**2,223**	**2,269**	**2,305**	**2,333**
SA	**38**	**36**	**33**	**34**	**34**	**34**	**34**
Total	**5,421**	**5,292**	**5,528**	**5,576**	**5,689**	**5,780**	**5,848**

as in the 2019 budget. The job groups of researchers, doctoral candidates and other academic staff and administrative and support staff have been extrapolated to future years on the basis of historical ratios.

Because of the high pressure of work in several places within the institution, the quality of education is under pressure. To take appropriate measures for this (such as improving the student/staff ratio), greater capacity will be needed than in the above estimate. The scope of the necessary measures is very difficult to gauge. Appointing more teaching staff will lead to more research and more indirect and contract funding, which will also lead to an increase in the number of post-doctoral researchers and doctoral candidates. This, in turn, will have an effect on the necessary infrastructure (e.g. accommodation) and on the necessary support by IT, legal services, finance and other support staff. The result: an overall larger TU Delft.

B Other reports

7.4 Report on the presence and operation of the internal risk management and control system (part B1)

The internal risk-management system within TU Delft specifically addresses the reality of the university organisation. Inspired by the COSO framework and Simons' 'Levers of Control', a specific frame of reference was created for the design of management control and risk management within a university context. The pragmatic interpretation and application of these models has been shown to best match the complex organisational context.

Nature of the university organisation

The university is characterised by the decentralised organisation of science, with a high level of autonomy for scientists and faculties. The university's primary tasks – academic

research and teaching, and the valorisation of research, as described in the Higher Education and Research Act – are carried out by the faculties. Moreover, universities are open network organisations. The academic staff is connected to global academic networks and thereby also to the social and economic environment. Because of these complex networks, coordination and decision-making processes within the university are complicated.

Broad control instruments

Universities are largely publicly financed organisations that are required to give proper account of their actions. To achieve the proper planning and accountability within this complex organisation, it is essential that the many internal processes which keep the university in operation are well controlled. By virtue of the university's organisational character, TU Delft devotes attention to both hard management instruments (e.g. rules and monitoring reports) and soft management aspects (e.g. shared values and dialogue). To this end, the control instruments are organised into four groups:

- Culture, conduct and integrity
  What core values are part of the culture of the organisation? For example, delivering top academic quality in view of academic integrity.

- Communication
  What strategic plans, risks, opportunities, uncertainties and global developments are discussed in various formal and informal meetings?

- Policy and regulations
  What policy guidelines and regulations are in place to assess activities and to avoid risks?

- Monitoring and reporting
  What quantitative and qualitative administrative information and information systems are used to monitor the progress and effectiveness of the strategic plans? Are we on the right track or are adjustments necessary?

Planning and evaluation cycle

The TU Delft internal risk management and control system is an ongoing process, which also has a place within the planning and evaluation cycle (P&E cycle). The P&E cycle consists of the cycle of administrative consultation between the Executive Board, the Dean and the management teams of the faculties and the University Services. It is a framework that enables the administration and management of the university to formulate strategic and derived policy objectives, to identify risks, to monitor processes and to adjust them in a timely manner. Within the P&E cycle, the strategic planning and internal process management is analysed and discussed from the four aforementioned perspectives. It is a structured working method, supported by a system of instruments, systems and agreements, and driven by values, standards and regulations aimed at the realisation of the strategic objectives.

Decentralised risk management and control

In addition to the central risk management and the continuous dialogue in the P&E cycle, risk management tools (including risk matrices) are used in several relevant supporting domains for the systematic monitoring of risks and special developments.

Specific bodies

Internal Audit

Internal Audit is an independent and objective function that delivers added value by carrying out audits and advisory assignments in a consistent and structured manner through assurance (providing certainty) and advice (making recommendations suggesting actions for improvement). The services of Internal Audit are intended for internal use within TU Delft, focusing on operations. Assurance and advice are directed towards governance, risk management and internal planning and management with regard to operations and IT. Internal Audit supports the Executive Board, the Deans and the directors of TU Delft by providing them with analyses, findings, evaluations, assessments and recommendations concerning the activities that have been investigated. In doing so, Internal Audit plays an important supporting role for the Executive Board, the management and the Deans of TU Delft, helping them to be in control in implementing, improving and accounting for their activities.

Audit Committee

The Audit Committee of the Supervisory Board monitors the TU Delft risk management and control system. In addition, the committee conducts a risk analysis each year, based on the input from the P&E cycle. The outcomes of these analyses are discussed with the Executive Board in the annual strategy meeting.

External accountant

The external accountant is an important link in the internal risk-management and control system. The audit report of the external accountant is intended to assess the legitimacy of the financial statement and whether it provides a true and fair view of the financial situation. The certainty that the external accountant provides with this report is important for the discharge procedure, and it supports the Supervisory Board in exercising its responsibility. In addition to the audit report, the external accountant provides an accountant's report and a report of interim findings. In these documents, the external accountant reports independently on the quality of the internal management and provides recommendations for improvements to be made. As a basis for the audit of the financial statements, the external accountant conducts an annual risk analysis, in dialogue with TU Delft. The external accountant consults periodically with the Audit Committee of the Supervisory Board, the Executive Board, Internal Audit and the Finance department.

Changes and ambitions for the risk management and control system

The governance model of TU Delft has been revised as of 1 January 2018. In this new 'combination model', the position of Rector Magnificus will be combined with the role of President of the Executive Board. The positions of Vice-President Education – in the current Executive Board also Vice-Rector Magnificus – and a Vice-President for Operations have also been provided. The administrative reform was partly motivated by the increasing importance of and attention for internal management. In view of the complexity and long turnaround time of the university's real-estate assignment, the associated risks for the university, and the need to retain the priority of the primary processes, the Supervisory Board considered it desirable to design the inherent weight and complexity of the portfolio in such a way that internal operations demand the full attention and care of a single Board member: the new position of a Vice-President for Operations enables this.

The Strategic Framework for 2018-2024 also includes the ambition to develop a risk and compliance policy, in which risks at various organisational levels and for various risk categories are identified, managed and monitored in a more systematic manner, with the aim to responsibly address risks and opportunities in the realisation of the

institution's objectives. In this risk management method, risks are assessed for likelihood of occurrence, as well as for the impact that they would have if they were to occur. This makes it possible to ensure that the risk management measures to be taken will be as appropriate as possible.

7.5 Description of the most important risks and uncertainties (Part B2)

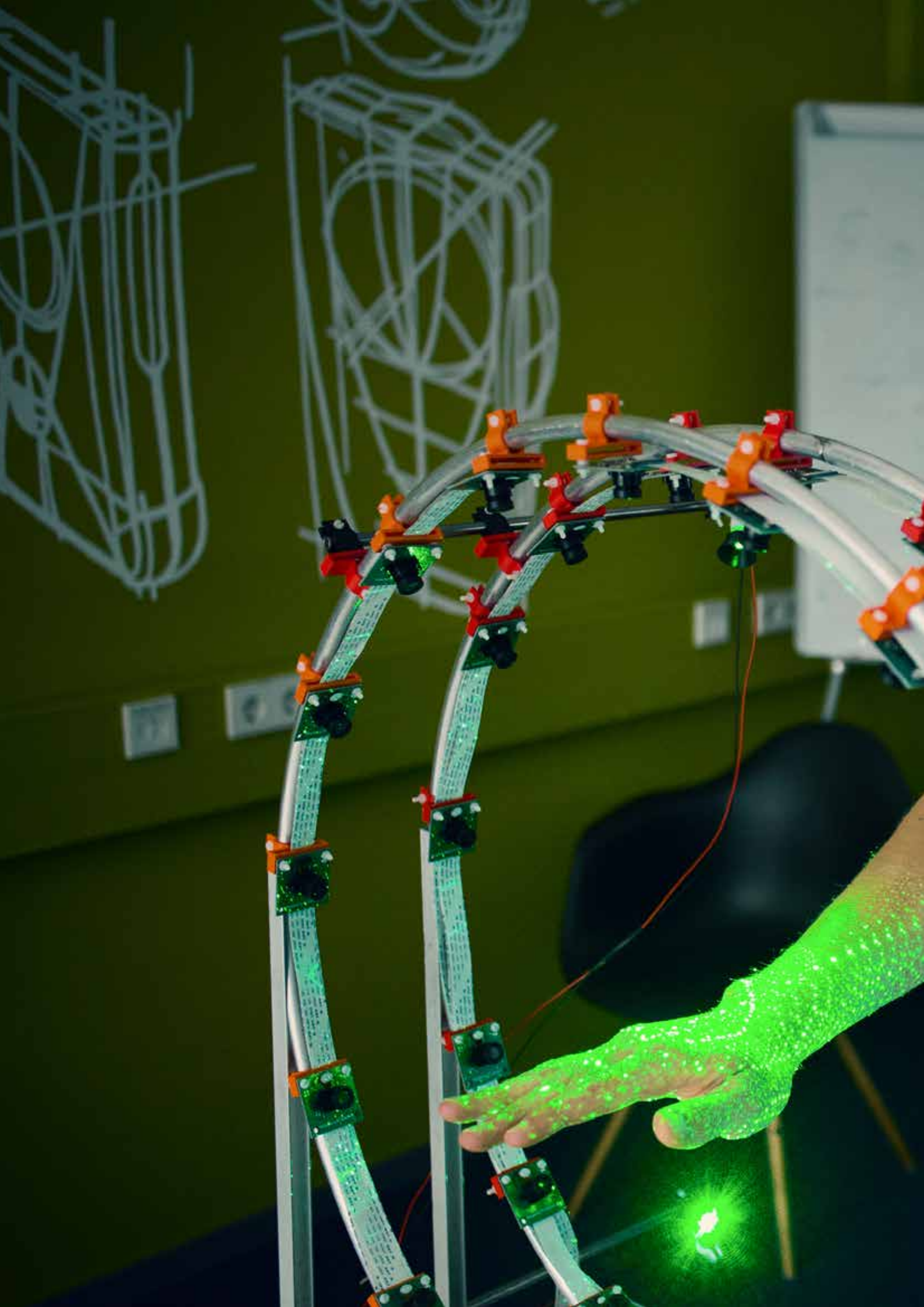
In 2018, the new strategic plan was presented within TU Delft for the 2018-2024 period: the Strategic Framework for 2018-2024. Within this framework, a SWOT analysis was conducted for each of the four operational areas into which the core activities of TU Delft are subdivided: Students & Education; Research & Innovation; People & Community; and Campus & Services. The SWOT analyses were prepared based on a broad series of interviews and discussion sessions with internal and external stakeholders. The threats reported in this SWOT analysis have been included in the schedule below. Measures for managing these threats have been included in the new strategic plan, as well as in the schedule below. The Strategic Framework for 2018-2024, including the complete SWOT analyses, is available at www.tudelft.nl/en/about-tu-delft/strategy.

Risk area	Risk	Management measure
Students & Education	Staff/student ratio is too low	TU Delft intends to better control student growth and at the same time acquire more financial resources to attract academic staff.
Students & Education	Unbalanced student growth, and limited legal possibilities to select students.	TU Delft strives for a valuable diversity of students and a good balance between Dutch and international students. The quality of our education is leading herein
Students & Education	Uncertainty about funding model (performance agreements, funds from student loans, etc.).	TU Delft aims to be better prepared for upcoming policy developments in the field of Higher Education by improving the information provision.
Research and innovation	Decrease of 1st money stream, and growing dependence on 2nd and 3rd money stream.	TU Delft strives to maintain a high standard of transparency, accountability and financial control in the coming years. To this end, we ensure strict financial guidelines for ratios, such as the solvency ratio, 'current ratio', interest cover ratio and leverage ratio.
Research and innovation	Strong, global competition	TU Delft aims to increase the number of internationally recognised and impactful areas of research strength.
Research and innovation	Declining appreciation for science in society	At TU Delft we strive to connect our research more systematically to societal challenges and to make this more visible to the outside world. Students and staff members are encouraged to engage with public and private partners and to co-create and deliver multi-faceted solutions to community concerns.

People & Community	Heavy workload and increasing pressure for both staff and students.	It is important to TU Delft for staff to have the time and resources to perform their work to the best of their ability; this is therefore one of our priorities. We give students the opportunity to realise their ambitions in a longer period, provided that they use their time in a valuable manner.
People & Community	Strong international competition for academic talent, with restrictive policy of the Dutch government on remuneration.	TU Delft will implement a focused strategy for academic recruitment, talent management and personal career development. We aim to both attract (potential) figureheads in (upcoming) scientific fields, as well as support our own excellent researchers in developing as such.
Campus & Services	High maintenance costs for the campus in the coming years.	TU Delft will develop a policy that aims to make effective and efficient use of space, energy, equipment and materials. We discard outdated and obsolete buildings.
Campus & Services	High reserves fir redevelopment campus present wrong image of financial position of TU Delft.	TU Delft strives for a reserve policy that is as stringent as possible. In addition, we are transparent about the real estate challenges and related financial policy, to correct a possible distorted picture.
Campus & Services	In the coming years it is necessary for TU Delft to make long-term campus investments. Uncertainties, e.g. student numbers, entail an investment risk.	TU Delft's starting point is to invest in buildings in such a way that they are adaptable to future developments in education and research, both in size and quality.

7.6 Report of the supervisory body (Part B3)

The report by the Supervisory Board can be found on page 10 of this report.



Appendices

1. Faculties and departments
2. Personal grants and subsidies
3. Full professor appointments
4. Overview of ancillary activities of members of the Executive Board and Supervisory Board
5. Letters of objection, appeals and complaints
6. Clarity notes
7. Definitions

Appendix 1

FACULTIES AND DEPARTMENTS
(overview on 31 december 2018)

Faculty of Architecture and the Built Environment (ABE)	
Department	**Chair**
Architecture	Prof.ir. D.E. (Dick) van Gameren
Architectural Engineering & Technology	Prof.dr.ing. U. (Ulrich) Knaack
Research for the Built Environment	Dr.ir. M.J. (Machiel) van Dorst
Management in the Built Environment	Prof.dr.ir. V.H. (Vincent) Gruis
Urbanism	Prof. V. (Vincent) Nadin
Faculty of Civil Engineering and Geosciences (CEG)	
Department	**Chair**
Engineering Structures	Prof.dr. A. (Andrei) Metrikine
Geoscience & Engineering	Prof.dr. M.A. (Michael) Hicks
Geoscience & Remote Sensing	Prof.dr.ir. H.W.J. (Herman) Russchenberg
Hydraulic Engineering	Prof.dr.ir. W.S.J. (Wim) Uijttewaal
Materials, Mechanics, Management & Design	Prof.dr.ir. S.P. (Serge) Hoogendoorn
Transport & Planning	Prof.dr.ir. L.C. (Luuk) Rietveld
Watermanagement	Prof. dr. ir. L.C. (Luuk) Rietveld
Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS)	
Department	**Chair**
Applied Mathematics	Prof.dr.ir. G. (Geurt) Jongbloed
Electrical Sustainable Energy	Prof.dr.ir. M. (Miro) Zeman
Intelligent Systems	Prof.dr. A.(Alan) Hanjalic
Microelectronics	Prof.dr. K.A.A. (Kofi) Makinwa
Quantum and Computer Engineering	Prof.dr.ir. H. (Henk) Sips (a.i.)
Software Technology	Prof.dr. A. (Arie) van Deursen
Faculty of Industrial Design Engineering (IDE)	
Department	**Chair**
Design Engineering	Prof. dr. P. (Peter) Vink
Industrial Design	Prof.dr.ir. R.H.M. (Richard) Goossens
Product Innovation Management	Prof. dr. ir. R. (Ruth) Mugge

Faculty of Aerospace Engineering (AE)	
Department	**Chair**
Aerodynamics, Wind Energy, Flight Performance and Propulsion	Prof. dr. F. (Fulvio) Scarano
Control and Operations	Prof. dr. ir. M. (Max) Mulder
Aerospace Structures & Materials	Prof. dr. ir. R. (Rinze) Benedictus
Space Engineering	Prof. dr. E.K.A. (Eberhard) Gill
Faculty of Technology, Policy & Management (TPM)	
Department	**Chair**
Engineering Systems and Services	Prof.dr.ir. P.M. (Paulien) Herder
Multi-Actor Systems	Prof.dr. B.A. (Bartel) Van de Walle
Values, Technology and Innovation	Prof.dr.ir I.R. (Ibo) van de Poel
Faculty of Applied Sciences (AS)	
Department	**Chair**
Bionanoscience	Prof. dr. M.(Marileen) Dogterom
Biotechnology	Prof.dr. U. (Ulf) Haneveld (a.i.)
Chemical Engineering	Prof.dr.ir. M.T. (Michiel) Kreutzer
Imaging Physics	Prof.dr. S. (Sjoerd) Stallinga
Quantum Nanoscience	Prof. dr. L. (Kobus) Kuipers
Radiation Science & Technology	Prof.dr.ir. J.L. (Jan Leen) Kloosterman
Faculty of Mechanical, Maritime and Materials Engineering (3mE)	
Department	**Chair**
Biomechanical Engineering	Prof.dr. H.E.J. (DirkJan) Veeger
Cognitive Robotics	Prof.dr.ir. J. (Hans) Hellendoorn
Delft Center for Systems and Control	Prof.dr.ir. B. (Bart) De Schutter
Maritime and Transport Technology	Prof.ir. J.J. (Hans) Hopman
Materials Science and Engineering	Prof.dr.ir. J. (Jilt) Sietsma
Precision and Microsystems Engineering	Prof.dr.ir. J.L. (Just) Herder
Process and Energy	Prof.dr.ir. B.J. (Bendiks Jan) Boersma

Appendix 2

PERSONAL GRANTS AND SUBSIDIES

Overview of personal grants and subsdies from NWO and ERC.

ERC	
ERC ADVANCED GRANT	
Ibo van de Poel	Design for changing values: a theory of value change in sociotechnical systems
Nynke Dekker	Eukaryotic DNA replication: a single-molecule approach to the study of yeast replication on chromatin
ERC CONSOLIDATOR GRANT	
Pouyan Boukany	Flow and Deformation of Cancer Tumor near Yielding
Chirlmin Joo	Repurposing Small RNA From Ciliates For Genome Editing: Single-Molecule Study
ERC STARTING GRANT	
Attila Geresdi	Simulated Majorana states
Sergio Grammatico	Game theoretic Control for Complex Systems of Systems
Farbod Alijani	Exploring Nonlinear Dynamics In Graphene Nanomechanical Systems
Marios Kotsonis	Spatio-temporal measurement and plasma-based control of crossflow instabilities for drag reduction
Oded Cats	Concepts, theories and models for planning , operating and evaluating the dynamics of Mobility as a Service
Jens Kober	Teaching Robots Interactively
Sonia Conesa Boj	Living on the Edge: Tunable Electronics from Edge Structures in 1D Layered Materials
Geeske Langejans	Ancient Adhesives - A window on prehistoric technological complexity
NWO	
VICI - SUBSIDY	
Dr.ir. M. (Marnix) Wagemaker	Spying on batteries at work to achieve superior energy storage
VIDI - SUBSIDY	
Dr. A. R. (Anton) Akhmerov	Artificial intelligence for nanodevice design
Dr. ir. G.N.J.C. (Joris) Bierkens	Zig-Zagging through Computational Barriers
Dr. A.D. (Andrea) Caviglia	A tunable platform to study quantum materials
Dr.ir. F.P. (Frans) van der Meer	What does it take to break a composite laminate?
Prof. dr. A.A. (Amir) Zadpoor	Clay-like orthopaedic implants
VENI - SUBSIDY	
Dr. J. (Jeremy) M C Brown	ACMI: A new tool to investigate the complexities of the human body
Dr. G.A. (Georgy) Filonenko	New sensors to study soft materials
Dr. R.J. (Robbert) Krebbers	Verified programming language interaction
Dr. C.C.S. (Cynthia) Liem MMus	Recommendations for perspective broadening
Dr. M. (Mladena) Luković	Interfaces in innovative hybrid concrete systems for future structures
Dr. Z. (Zoltán) Perkó	Algorithm development for next generation radiotherapy: error mitigation in proton and X-ray treatment of cancer
Dr. C.S. (Carlas) Smith	Super-Resolution Microscopy in Live-Tissue

VENI - SUBSIDIE	
Dr.ir. A. Sciacchitano (LR)	Deploying Uncertainty Quantification in Particle Image Velocimetry
Dr.ir. A.M.H. Pluymakers (CiTG)	Are rocks made out of sugar: how does a realistic pore fluid chemistry influence rock mechanics?
Dr.ir. M.M.M. Bisschops Msc. (TNW)	Aging yeast to understand dementia
Dr.ir. J. Alonso-Mora (3mE)	Robots among humans: safe and socially intuitive navigation
Dr.ir. F. Luzia de Nóbrega Msc. (TNW)	Understanding inter-species gene exchange and compatibility
RUBICON	
Dr. P. (Pengling) Wang	Energy-efficient autonomous driving trains
Dr. Eline van der Kruk	Predicting movement problems with the elderly
Dr. Ö. (Önder) Gul	Layer by layer topological matter
Dr J.M. (Jorine) Eeftens	Phase separation in DNA organisation
Dr R. (Rocco) Gaudenzi	Concepts from mesoscopic physics in particle physics. Unveiling a success story in contemporary science
Dr. L. (Luuk) Loeff	Mechanistic studies into bacterial immune systems
Dr. G. (Giordano) Mattoni	Electric current is the new material
AWARDS FOR PHASE 1 TAKE-OFF FEASIBILITY STUDY	
Dr. ir. ing. T. Horeman	Force compensated laparoscopic instrument; Soft touch balanced instruments for safe laparoscopic surgery
Dr.ir. A. Bossche	Groundwater mapping using Unmanned Aerial Vehicles
Dr.ir. J.F.M.Molenbroek	Mesh Lingerie Technologies: Project Muse
Dr. ir. W.P. Breugem	Development of Riblet Microstructures for Optimal Resistance reduction
Dr. ing. R. Schmehl	VTOL Rigid Wing for Airborne Wing Energy
Prof. dr. ir. J.L. Herder	YUMEN ARM VOOR DUCHENNE
Dr. ir. C. Verhoeven	Autonomous swarms of robots for mobile sensor network applications
Dr. ing. A.J. Jansen	Avaguard
Prof. dr. ing. L. C. M. de Vreede	“DIsRuPt”, DIgital Rf Power
Prof. dr. E. Brück	Magneto
Prof. dr. C. Dekker	Development of a nanopore-based single-molecule protein sequencer
AWARDS FOR PHASE 2 TAKE-OFF FEASIBILITY STUDY	
Mr. Y.D. van Engelshoven BSc, Polytential BV	Virtual Chemist
R.R. Jones, Manomatric B.V.	Manometric: Automated workflow from 3D scan to customized 3D printed orthotics
IJ.P. de Lange, STIL B.V.	STIL: wearable tremor suppression
R. J. Crone - Drones for Work B.V.	Adaptive INDI for Drones
K. van Hecke - Mu-G Knowledge Management BV	Autonome microdrones voor gerichte insectenbestrijding
C. Silvestri - BIOND Solutions B.V.	BI/OND: The Versatile Organ-On-Chip platform
D. Borota - MainBlades Inspections	Drones for Aircraft Inspections
	Virtual Chemist

Appendix 3

FULL PROFESSOR APPOINTMENTS

NAME	M/F	CHAIR / WORK AREA	FACULTY	DATE OF DECISION	FTE	DURATION
Prof.dr.ir. T. Klein	m	Building Product Innovation	ABE	16 January	1.0	5 years
Prof.dr. M. van Vulpen	m	Radiation Medicine	AS	16 January	0.0	5 years
Prof.dr.ir. R. Mugge	f	Design for Sustainable Consumer Behaviour	IDE	16 January	0,9	indefinite period
Prof.dr. P.A.S. Daran – Lapujade	f	Experimental Systems Biology	AS	16 January	1	indefinite period
Prof.dr.ir. M. van Koningsveld	m	Ports and Waterways	CEG	23 January	0.4	5 years
Prof.dr. N. Llombart Juan	f	Quasi-optical Systems	EEMCS	30 January	1.0	indefinite period
Prof.dr.ir. A.C. den Heijer	f	Public Real Estate	ABE	13 February	1.0	indefinite period
Prof.dr. L.C.M. Itard	f	Building Energy Epidemiology	ABE	13 February	0.8	indefinite period
Prof.dr.ir. D.A. Abbink	m	Haptic Human-Robot Interaction	3mE	13 February	0.8	indefinite period
Prof.dr. E.L.V. Goetheer	m	Electrochemical Transformation of CO2	3mE	20 March	0.2	5 years
Prof.dr. C. Verdaas	m	Gebiedsontwikkeling	ABE	20 March	0.4	5 years
Prof.dr. P.A.N. Bosman	m	Evolutionary Algorithms	EEMCS	27 March	0.2	5 years
Prof.dr. B.F. van Eekelen	f	Design , Culture and Society	IDE	17 April	1.0	indefinite period
Prof.dr.ir. M.C. Veraar	m	Harmonic Analysis and Partial Differential Equations	EEMCS	17 April	1.0	indefinite period
Prof.dr.ir. Kapelan	m	Urban Water Infrastructure	CEG	15 May	1.0	indefinite period
Prof.ir. E.A.J. Luiten	m	Landscape Architecture	ABE	29 May	0.2	3 years
Prof.dr. A.F. Otte	m	Antoni van Leeuwenhoek Professor	AS	29 May	1.0	indefinite period
Prof.dr. C. Kassapoglou	m	Design of Composites Structures	AE	5 June	0.2	5 years
Prof.dr. M.M. Specht	m	Digital Education	EEMCS	12 June	1.0	indefinite period
Prof.dr.ing. U. Pottgiesser	m	Heritage & Technology	ABE	12 June	0.6	5 years
Prof.dr. A. Pereira Roders	f	Heritage & Values	ABE	26 June	0.6	5 years
Prof.dr. A. Webb	m	Magnetic Resonance Imaging	EEMCS	26 June	0.2	5 years
Prof.dr. S.R.M. Miller	m	Collective Responsibilty and Counter Terrorism	TPM	26 June	0.5	until January 1, 2021
Prof.dr. G.A. Steele	m	Antoni van Leeuwenhoek Professor	AS	26 June	1.0	indefinite period
Prof.dr. L. DiCarlo	m	Antoni van Leeuwenhoek Professor	AS	26 June	1.0	indefinite period

NAAM	M/V	LEERSTOEL	FACULTEIT	DATUM BESLUIT	FTE	DUUR
Prof.dr. M.J. Franca	m	River Basin Development	CEG	26 June	0.0	5 years
Prof.dr. P.W. Chan	m	Design and Construction Management	ABE	10 July	1.0	5 years
Prof.dr. S.W.A. Dekker	m	Aviation Safety	AE	11 September	0.2	5 years
Prof.ir. P.E.L.J.C. Vermeulen	m	Architectural Design- Urban Architecture	ABE	11 September	0.4	5 years
Prof.ir. N. de Vries	f	Architectural Design - Public Building	ABE	11 September	0.4	5 years
Prof.dr.ir. J.T. Padding	m	Complex Fluid Processing	3mE	23 October	1.0	indefinite period
Prof.dr.ir. M. Wagemaker	m	Electrochemical Energy Storage	AS	23 October	1.0	indefinite period
Prof.dr. S. Stallinga	m	Computational Imaging	AS	23 October	1.0	indefinite period
Prof. J. O'Callaghan	m	Architectural Glass	ABE	20 November	0.3	5 years
Prof.dr. P.A. Lloyd	m	Integrated Design Methodology	IDE	20 November	1.0	indefinite period
Prof.dr. A. Urakawa	m	Catalysis Engineering	AS	11 December	1.0	indefinite period

Appendix 4

OVERVIEW OF ANCILLARY ACTIVITIES OF MEMBERS OF THE EXECUTIVE BOARD AND SUPERVISORY BOARD

(overview as at 31 December 2018)

Ancillary activities of members of the Executive Board

Tim van der Hagen
Rector Magnificus / President of the Executive Board

Ancillary positions connected to main position
- Member of the central board of the Royal Dutch Society of Engineers (KIVI)
- Member of the Board of GROW (Growth through Research, Development and Demonstration in Offshore Wind)
- Member of the Board of the Netherlands Energy Research Alliance (NERA)
- Member of the Board of 4TU.Federation Foundation
- Member of the board of Medical Delta Foundation
- President of the board of the Stichting Justus en Louise van Effen Fund
- Member of the board of the University Fund Delft
- Member of the Steering Committee of the Leiden-Delft-Erasmus alliance (LDE)
- Member of Programme Council of ADEM: Advanced Dutch Energy Materials (ECN+3TU)

Ancillary activities
- Member of the Advisory Council for Science, Technology and Innovation (AWTI)
- Member of the Supervisory Board of the Central Organisation for Radioactive Waste (COVRA)
- Chairman Task Force Innovation, Dutch Climate Agreement

Nicoly Vermeulen
Vice President Operations
- Lid Raad van Toezicht Zorgcirkel
- Lid Raad van Toezicht Spaarne Gasthuis
- Voorzitter Raad van Toezicht Certe (tot 1 juli 2018)
- Lid Raad van Commissarissen Dokterszorg Friesland

Rob Mudde
Vice Rector Magnificus / Vice President
- No ancillary activities

The ancillary positions of the members of the Executive Board are with the permission of the Supervisory Board. This permission is not automatically granted. Further information on the TU Delft policy concerning ancillary positions can be found on the TU Delft website.

Ancillary activities of members of the Supervisory Board

Jeroen van der Veer
- President of the Supervisory Board of the Delft University of Technology
- Chairman of the Supervisory Board of Royal Philips NV
- Chairman of the Supervisory Board of Royal Westminster Boskalis NV
- Member of the Supervisory Board of Equinor ASA
- Chairman of the Science and Technology Platform (Stichting Platform Bèta Techniek)

- President of Het Concertgebouw Fund (HCF)
- Chairman of the Community of Chairmen (WEF)

Luc Soete
- Member of the Supervisory Board of Delft University of Technology, also vice-president
- Member of Royal Netherlands Academy of Arts and Sciences' 'Impact Mapped' committee and President of the Royal Netherlands Academy of Arts and Sciences 'Relation to Public Private Research Funding' committee
- Member of the committee 'Doelmatigheid Hoger Onderwijs' (Expendiency Higher Education)
- Commissioner of Media Group Limburg Netherlands and independent governor of De Zeven Eycken Foundation.
- Chairman of the 'Economic and Social Impact of Research' expert group of the European Commission
- President of the 'compass group' of the Limburg Regional Economic Cooperation (LIRES) in Belgian Limburg
- Member of Brainport Network as leader of the EU domain
- Member of the Advisory Board of the School of Business, Management and Economics and President of the Science Policy Research Unit Advisory Group at the University of Sussex
- President of the Advisory Board of UNU-CRIS in Bruges, Belgium

Carolien Gehrels
- Member of the Supervisory Board of Delft University of Technology
- Member of the Supervisory Board of Bouwinvest REIM
- Member of the Board of World Waternet
- Member of the Dutch Creative Council, Ministry of Economic Affairs
- Member of the Board of the Urban Renewal Platform
- Chairperson of the Foundation for More Music in the Classroom *[Stichting Meer muziek in de klas]* and the Platform for Music Education Ambassadors
- Member of the Supervisory Board of the Royal Concertgebouw Orchestra Amsterdam
- Chairwoman of the Board of Women Inc.
- Member of the Board of Friends of the Amsterdam Police
- Member of the Supervisory Board of The Blue Fund
- Member of the Board of Johan Cruyff Foundation
- Member of the Advisory Council of ASN Bank

Laetitia Smits van Oyen
- Member of the Supervisory Board of Delft University of Technology
- President of the Supervisory Board of Public Employment Service Werkse! BV
- Member of the board of the 'Zorg en Bijstand' Foundation in The Hague
- Supervisor of the Curaçao Dolphin Academy NV
- Secretary of the Friends of the Mauritshuis Foundation
- Member of the Supervisory Board of Novamedia Holding BV
- Member of the Supervisory Board of DKG Holding

Gijsbert de Zoeten
- Member of the Supervisory Board of Delft University of Technology
- Member of the governing board of the Registered Controller programme at VU University Amsterdam
- President of the HDM Youth Academy Foundation

Appendix 5

LETTERS OF OBJECTION, APPEALS AND COMPLAINTS

For good governance, letters of objection, appeals and complaints must be carefully handled. They also reflect how the organisation is functioning and can lead to improvement in the implementation or content of regulations. Any student or employee of TU Delft may file a complaint or an appeal against the university's decisions. The Executive Board makes a decision on objections after receiving advice from the Objections Committee for employees and other matters, or from the Student Affairs Committee. Students may submit letters of objection regarding rejections on the basis of the Graduation Support Scheme (RAS), as well as objections regarding enrolment, unenrolment or tuition fees. The letters of objection from employees concern legal status. Appeals from students and external students concerning the binding recommendation on the continuation of studies, exams, fraud, etc., are handled by the Examination Appeals Board in accordance with Article 7.60 of the Higher Education and Research Act. Based on the Doctoral Regulations 2014, doctoral candidates are able to field objections to decisions by or on behalf of the Board for Doctorates.

In the table below, the number of settled objections and appeals (86 and 148 respectively) in 2018 are shown according to category and decision type.

Category	Founded	Unfounded	Inadmissable	Withdrawn	**Total**
EAB (student)	7	30	6	95	148
Doctoral candidates	0	1	0	0	1
Student	5	17	18	32	72
Dismissal (employee)	0	0	0	3	3
Job evaluation (employee)	0	5	0	0	5
Remaining (employee)	0	1	0	4	5
Remaining, FOI	0	0	0	0	0
Total	12	54	34	134	234

The number of cases submitted to the Examination Appeals Board has increased steadily: 148 in 2018 compared to 145 in 2017, 115 in 2016, 97 in 2015 and 83 in 2014. One important reason is the continuing increase in foreign students lodging appeals against rejected applications for admission to the Master's degree programme. The large number of Examination Appeals Board cases that are withdrawn can be partly explained by the fact that many foreign students enrol in a programme at more than one university; in some cases it was no longer necessary to proceed with an appeal. The stricter procedure for amicable settlement is also a factor in the large number of appeals that are withdrawn. The number of student cases remains more or less stable. The number of employee cases (13) has decreased in comparison with 2017 (17 cases).

Complaints

Complaints in the case of inappropriate conduct

The Complaints Committee for Inappropriate Conduct (Kog) handled three complaints in 2018. Two complaints were considered well-founded and one complaint was withdrawn.

Complaints about scientific and academic integrity

In 2018, four complaints were dealt with and three complaints were submitted. Two complaints were finally settled. A complaint from 2015 was deferred in connection with its investigation at another university; at the end of 2017, a request was made to deal with this case at TU Delft; this complaint was declared partly inadmissible and partly unfounded. A complaint from 2018 was declared partly inadmissible and partly unfounded. The Executive Board has given its provisional opinion on two complaints, both from 2017; in both complaints, LOWI was asked to investigate the complain. Two complaints from the end of 2018 have yet to be settled.

Other complaints

Three complaints were dealt with in 2018. Two complaints were considered unfounded and one inadmissible.

Appendix 6

CLARITY NOTES

These notes provide further clarification of several accountability items in the annual report, including the outsourcing of teaching duties, the investment of public funds in private activities, exchange agreements with foreign institutions and the development of customised tracks.

TU Delft personnel and initial degree programmes
Data on the enrolment of personnel in initial degree programmes are not aggregated. If this occurs at all, it only involves a very small number.

Outsourcing to private organisations
The degree programmes registered in the CROHO are provided by the institution itself, where a number of programmes are entirely or partly provided in collaboration with partner universities. There is no outsourcing to private organisations. TU Delft does not use public funds for private educational activities.

Expenditure of public funds on private activities
TU Delft spends public funds on such private activities as providing facilities for students (housing or other facilities). The scope of these activities, permitted by the relevant laws and regulations, is extremely limited and makes a positive contribution to improving the quality of the education and/or research.

Tailored tracks
There are no paid tailored tracks for external organisations and/or companies within the existing degree programmes.

Modules
Students occasionally take programme modules without actually intending to obtain the degree certificate. These students belong to the HBO bridging student group and are enrolled in Bachelor's degree programmes in order to follow bridging programmes in accordance with an agreement with the ministry.

Emergency fund
An emergency fund exists for students with financial problems. The emergency fund is only used in exceptional cases, always involves a loan and in all cases involves costs other than tuition fees, such as hospital costs. Tuition fees are never reimbursed.

Following a different degree programme than the one in which the student is enrolled
This is not an issue at TU Delft.

Exchange agreements
TU Delft has exchange agreements with a broad range of foreign knowledge institutions. In the 2017-2018 academic year, 700 foreign students participated in exchange programmes at TU Delft, and there was a nearly equivalent number of outgoing exchange students. There were no applications for funding for any of these students. More than 3,000 Dutch students gained international experience following a degree programme this year. An overview of the knowledge institutions with which TU Delft has an exchange agreement can be found at www.tudelft.nl/en/education/programmes/exchange/.

Appendix 7

DEFINITIONS

Term	Definition / Description
Bachelor's degree	A Bachelor's degree is a degree certificate awarded as a result of the successful completion of the Bachelor's degree programme.
Binding recommendation on the continuation of studies (BSA)	If a student does not meet the BSA requirements of a minimum of 45 ECTS (European Credits) in the first year of enrolment, he/she may not re-enrol in this TU Delft programme for three years. The following recommendations are given in the course of the academic year (in March and August): Positive, Doubtful, Negative or Postponed (= special circumstances preventing the student from meeting the requirements). In addition, the number and percentage of students who discontinue their studies before 1 February of the current academic year is shown. The definitive binding recommendation (in September) does not contain the Doubtful category.
Foreign student	A student who does not possess Dutch citizenship.
First-year student at the institution	A person who is enrolled at TU Delft as a student for the first time in the academic year in question.
Re-enrolment students	Students who enrol for the second academic year of the same programme/ faculty/institution as the one in which they started.
Master's degree	A Master's (or doctoraal) degree is a degree certificate awarded as a result of the successful completion of the final examination of a Master's or doctoraal degree programme.
Degree programme	A degree programme is a Bachelor's or Master's degree programme accredited by the Ministry of Education, Culture and Science. All programmes are registered in the Central Register of Higher Education Degree Programmes (CROHO). This register also indicates whether the programme is funded by the government.
Reference date	The date on which the selection is made during a count. The reference date for intake and population is 1 December of the academic year in question. That means that only the students who are enrolled on 1 December will be included in the count. The reference date for degree certificates, drop-out and pass rates is 31 August of the academic year in question. All degree certificates awarded up to and including that date will be counted.
Profiling Fund	The purpose of the Profiling Fund is to provide financial assistance to students who have fallen behind in their studies due to exceptional circumstances, as specified in Art. 7.51, paragraph 2 of the WHW. The following are regarded as exceptional circumstances: situations beyond the student's control, recognised administrative or participation activities, or top-level participation in sports or culture.
Propedeuse	This consists of the stipulated 60 ECTS of the first year of the Bachelor's degree programme. The name 'propedeuse' was abolished as from the 2014-2015 academic year.
Pass rates	The percentage of students who have successfully completed the programme (or institution, faculty) (obtained a degree certificate). This can be broken down into different groups (such as foreign citizens, women and joiners from pre-university education).

Bridging class / Bridging programme	A bridging class student does not have sufficient qualifications to directly enter a Master's programme. The bridging programme yields approximately 30 ECTS (depending on the Master's programme and the prior education) and ensures that the student is admitted to the selected Master's programme. Bridging-programme students are often HBO students lacking a sufficient background in mathematics, but in the past few years they have also included several Bachelor's students. Note: these are not Bachelor's or Master's students (even though they were enrolled in the Bachelor's degree programme up to and including 2005 and in the Master's programme from 2006 to 2010). As of 2011, bridging-programme students are no longer allowed to enrol in a Master's programme.
Student (degree student)	A student is a person who is enrolled 'as a student' at TU Delft in accordance with the Higher Education and Research Act. The following students are included in the education statistics of TU Delft (on the reference date of 1 December): • those who are enrolled as full-time or external students • those who intend to complete a TU Delft programme and obtain a degree certificate • those who paid tuition or examination fees to TU Delft The condition 'Has paid the tuition fee to TU Delft' means that some of the students active in the so-called shared programmes that are organised with another university are not included in these indicators. Only the main study programme counts (a student can be enrolled in multiple study programmes, but will only be counted once). As of 2016, students who take part in a shared degree programme count as well. The counts do not include the following students, unless specified otherwise: • exchange students • freemover students • minor students • guest students • contract students These exceptions concern students who do study at TU Delft, but who do not intend to take a degree audit here.
Duration of study	The time that elapses (in years) between the first-time enrolment and the time at which the relevant diploma has been achieved. The first-time enrolment is taken to be 1 September of the academic year in question. The time of graduation occurs when the student has met the final requirement for obtaining the diploma in question.
Study switcher	A student who chooses to enrol in a programme that is different from the programme in which he/she was originally enrolled (at TU Delft).
Drop-out	Students who leave the programme, either to discontinue their studies or to study somewhere else. There are three different types of drop-out: at programme level, at faculty level and at institutional level (TU Delft-wide).


DAMEN
GBS
TUDelft
VI
SAUNDERS
ASUB