

# Annual Report 2016



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# Annual Report 2016

Delft

University of  
Technology

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# Key indicators

Indicator		Unit
<b>Education</b>		
<i>Intake of new students:</i>		
• Bachelor's degree programme	3.100	Number
• Master's degree programme	1.432	Number
• HBO bridging programme	183	Number
	Total 4.710	Number
<i>Student population:</i>		
• Bachelor's degree programme	11.395	Number
• Master's degree programme	9.933	Number
• HBO bridging programme	430	Number
	Total 21.758	Number
Positive Binding Recommendation on Continuation of Studies in 1 <sup>st</sup> year	72	%
<i>Degree certificates:</i>		
• Bachelor's degree programme	1.988	Number
• Master's degree programme	2.671	Number
• PDEng	26	Number
<b>Research</b>		
PhD candidates	2.710	Number
Doctorates	398	Number
PhD pass rate within five years	49	%
<i>Academic staff:</i>		
• Permanent academic staff+	890,9	Fte
• Postdocs	456,1	Fte
• Other academic staff (lectures and researchers)	797,6	Fte
	Total 2144,6	Fte
<b>Financial matters</b>		
Government funding	459,6	€ million
Indirect funding	45,5	€ million
Contract funding	139,2	€ million

# Foreword





In terms of figures, 2016 was a milestone year. Student numbers continued to increase, exceeding 21,000. At the same time, the number of participants in our online courses (MOOCs) passed the one-million mark. At the Kavli Institute of Nanoscience, researchers achieved a storage capacity of 80 terabits per square centimetre, more than 500 times the capacity of the best hard disk that is currently available on the market. The students in the Nuon Solar Team won the Sasol Solar Challenge in South Africa with their Nuna 8s, becoming world champion solar racers for a phenomenal eighth time. In the process, with a total of 4,717 kilometres, they also set a new world record for the number of kilometres driven in a solar race.

Although such figures are impressive, they are not a goal in themselves; it is all about the underlying performance. Our students will soon be entering society as highly educated engineers who are very much in demand. With our MOOCs we are reaching participants all over the world who would otherwise have no access to high-quality course material, and at the same time we are renewing and improving our teaching. The results of the Kavli Institute's research, mentioned above, bring us a great step closer to data storage at the

atomic level, something which would make the data centres of the future much smaller and more energy-efficient. Furthermore, through RoboValley, the results of our robotics research can be used to make business more sustainable.

The development of ground-breaking technology requires substantial investment, both in time and money, and it is therefore a long-term process. Nowhere is this as apparent as in the quantum research at Delft. Back in the 1980s, Professor Hans Mooij was already conducting research into all the phenomena that quantum mechanics has predicted. Building on this, from the end of the 20th century, Professor Leo Kouwenhoven and his team worked on the building blocks for a quantum computer. The partners working together on the development of this ground-breaking technology at the QuTech institute now include TU Delft, the Netherlands Organisation for Applied Scientific Research (TNO), the Ministry of Economic Affairs and industrial partners such as Intel. The technology was awarded National Icon status in 2014. In 2016, Microsoft announced that it wanted to engage in a more long-term collaboration and double its investment in QuTech.



Quantum research also involves enormous numbers: not only the hundreds of millions of euros involved in the development, but also the numbers that a quantum computer can compute extremely fast. This computational power should enable us to model pharmaceutical molecules in order to develop better medicines, or to model materials for producing high-efficiency batteries. We do not yet know precisely what this technology will enable us to do, but when Professor Leo Kouwenhoven conducted his first quantum experiments a long time ago, he had no idea that they would ever result in something useful. One thing is certain, however: QuTech has put the Netherlands in the lead in the race to develop the first quantum computer. This further underlines the importance of collaboration within the 'triple helix' of (fundamental) research and the public and private sectors.

The project also emphasises the importance of funding instruments for ground-breaking research, such as the ERC grants, a large number of which have been awarded to TU Delft in the past decade. The ERC currently supports more than 50 Delft scientists through grants. The number of researchers funded in this way is a multiple of this. In 2016 too, we again were successful with ERC awards, and not only in the field of experimental physics. The ERC awarded a Consolidator Grant to Professor Caspar Chorus. This will enable the 'professor of choice models' to extend his highly acclaimed regret model to moral choice behaviour in the broadest sense of the word.

Linking the humanities and social sciences with the natural sciences and technology is an important success factor in terms of resolving societal issues. Technical innovation should, after all, go hand in hand with social innovation, which is a matter of organisational embedment, societal acceptance and revenue models – subjects that traditionally you would not expect from a university

of technology, but that happen to be among TU Delft's strengths. In 2016, in order to develop this field further, we appointed a Professor of Policy Analysis, specialising in the role of data and information during disaster relief operations. Professor Bartel van de Walle's research in this new specialisation focuses on how the abundance of data available in today's world helps – or perhaps even hinders – disaster relief operations. In this context too, technological innovation alone is not enough.

Our graduates are, and will remain, one of our most valuable contributions to society. In recent years, partly in the context of the performance agreements, we have worked hard to consolidate the studiability and study success of our degree programmes. When we published the 2015 Annual Report, we already knew that we would realise our ambitions for the performance agreements. The final assessment took place in 2016, and the Review Committee praised the way in which TU Delft has complied with the agreements. The measures we introduced are now anchored in our education policy. Obviously, we are continuing to invest in our teaching in all sorts of ways: in more and better workspaces, in additional lecturers and educational support staff, and in educational innovation. We do this partly through pre-investment in anticipation of the money that should be freed up through the introduction of the student loan system. A larger part of this investment is an integral part of our regular expenditure, to ensure that in the years to come we will be able to combine impressive student and graduate numbers with high-quality research and continue to make a contribution to society with technological knowledge, sustainable innovations and highly qualified employees.

The Executive Board of Delft University of Technology

# Report of the Supervisory Board

In 2016, 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 2017, first term)
- *Prof. D.D. Breimer*, vice-president, former Rector Magnificus/President of the Leiden University Executive Board (appointed until 1 May 2017, third term)
- *Drs. J.C.M. Schönfeld*, former vice-president and CFO of Stork NV (appointed until 1 May 2016, second term)
- *Ms Ir. L.C.Q.M. Smits van Oyen MBA*, director and major shareholder of companies in the healthcare, ICT and tourism sectors (appointed until 1 January 2021, second term)
- *Ms Drs. C.G. Gehrels*, European Director of Big Urban Clients at Arcadis (appointed until 1 June 2019, first term)
- *Drs. G. de Zoeten RC*, Senior Vice President of Finance at LeasePlan Corporation N.V. (appointed from 1 May 2016 until 1 May 2020, first term).

## Vision and strategy

The university's strategic course in 2016 was determined by the strategic plan, the 'TU Delft Roadmap 2020', which was approved in 2012. The Supervisory Board performs its tasks on the basis of this Roadmap. In 2016, TU Delft began drawing up a new strategic plan, the 'Strategic Framework', for the period 2018-2024. The process leading to a new strategic plan and the underlying principles have been discussed in strategy meetings with the Supervisory Board.

The Supervisory Board is actively involved in the further development of the strategic partnerships of TU Delft, both nationally and internationally. Regionally, the partnership with Leiden University and Erasmus University Rotterdam, known as the LDE partnership, is of great importance to TU Delft. To this end, the Board frequently communicates with the Supervisory Boards of both universities. At national level, TU Delft has a partnership with Eindhoven University of Technology, the University of Twente and Wageningen University, the universities of the former 3TU.Federation, which became the 4TU.Federation in 2016.

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.

At international level there have been discussions

about a country-team approach, in which the collaboration between TU Delft and other scientific institutes and organisations will be concentrated in strategic partnerships along the lines of countries/ international regions.

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 closely monitored. Accreditation and re-accreditation processes for the degree programmes are also regularly discussed with the Board. 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.

The real estate issues of TU Delft are discussed in the meeting of the Supervisory Board each quarter, and further decisions are made if necessary.

In 2016, decisions were made regarding the conversion of the building at Van Mourik Broekmanweg 6 into an academic work setting that nearby faculties can use as office space as the need arises.

Throughout 2016, the Supervisory Board gave close attention to the preparations for updating the real-estate strategy and its financing.

## Administration and Management

In 2016, 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. At the beginning of 2016, the Supervisory Board set up a new committee. In addition to the Audit Committee and the Remuneration and Appointments Committee, the Board now has a Committee for Quality Assurance in Education and Research (Commissie Kwaliteitszorg Onderwijs en Onderzoek, CKOO). The appointment of this additional committee aligns with a broader national policy development. One of the reasons for setting up the new committee was that in 2013, following the evaluation of the Enhanced Governance Powers (Educational Institutions) Act (*Wet versterking bestuurskracht onderwijsinstellingen*), the duties assigned to Supervisory Boards included the statutory task of regulating the design of the quality assurance system, and Boards of



Examiners were given a heavier responsibility in terms of monitoring the standards attained by students/graduates. This also includes topics such as Institutional Accreditation. The appointment of a CKOO by the Supervisory Board is in line with developments such as involving Supervisory Board members in policy processes at an earlier stage. The committee met twice in 2016.

The Supervisory Boards must also monitor compliance with legislation and regulations by the board. To enable the Supervisory Board to properly perform this supervisory task, subjects such as (anticipated) amendments to the law, activities in the field of academic integrity, the Code of Ethics, and safety and 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 once again visited a number of faculties and service departments in 2016.

This included a working visit to the Holland Particle Therapy Centre (HollandPTC), the first centre for proton therapy in the Netherlands. HollandPTC will provide education and scope for scientific research at TU Delft. The centre is expected to receive its first patients at the end of 2017.

A comprehensive introductory programme focusing on real-estate and campus development was offered to the new members of the Supervisory Board.

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.

### Personnel and internal affairs

At the end of 2015, the Supervisory Board initiated a procedure to recruit a new president of the Executive Board. The Remuneration and Appointments Committee met regularly to discuss this in the first six months of 2016, and held intensive consultations with participation bodies and other TU Delft departments. This led to the appointment of Prof. Tim H.J.J. van der Hagen as the new President of the Executive Board from 1 May 2016. Until Prof. Van der Hagen took office, Prof. Breimer provided support to the Executive Board.

On 5 October 2016, following a positive recommendation by the participation bodies, the Supervisory Board took a final decision to reappoint *Drs. Anka Mulder* as VPEO of TU Delft for a second period, from 1 April 2017 to 1 April 2021.

In the lead-up to the appointment of the new President of the Executive Board, the Supervisory Board and the combined Confidential Committee of the Works Council and Student Council agreed that the Supervisory Board will deliberate further in the coming period on possible changes to the current TU Delft governance model. This will be developed in detail during 2017.

In 2016, the Remuneration and Appointments Committee again conducted annual appraisal interviews with the individual members of the Executive Board.

In April 2016, the Minister for Education, Culture and Science appointed *Drs. de Zoeten RC* as member of the TU Delft Supervisory Board with effect from 1 May 2016. Mr de Zoeten succeeds Mr Schönfeld, who stepped down from the Board on that date after two terms of appointment. The Supervisory Board actively involved the Works Council and the Student Council in the nomination of Mr de Zoeten. In addition, the Minister of Education, Culture and Science reappointed *Ir. Laetitia Smits van Oyen* as member of the Supervisory Board for a second four-year term, with effect from 1 January 2017. In this case too, the representative bodies were consulted regarding the nomination to the Minister.

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, the Supervisory Board discusses its own performance as well as that of the individual members, and the consequences that must be attached to this, at least once a year without the presence of the Executive Board. The self-evaluation was completed at the beginning of 2016 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.

## Finances and operational management

### *Audit Committee*

The Audit Committee met three times in 2016. Important items on the agenda were the situation regarding the performance agreements concluded by TU Delft with the Ministry of Education, Culture and Science, and the review of those agreements by the Higher Education & Research Review Committee. Another important agenda item was the status of major investment projects (mainly real-estate projects), including the financing of these investments. Further items discussed were the reports, the annual audit plan and the planning and results of Internal Audit activities, the financial results and cash flow. Also on the agenda were the discussion of the 2015 audit report, the 2016 management letter and the associated improvement initiatives, and the 2017 budget. The 2015 audit report and the 2016 management letter were discussed in the presence of the external auditor.

### *Supervisory Board*

In its meeting on 19 April 2016 the Supervisory Board approved the 2015 Annual Report and the Financial Statements; in its meeting on 12 December 2016 the Board approved the Budget for 2017. During its meetings in 2016, 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 special subjects in this regard were: the organisation of the risk management at TU Delft, the long-term financing of necessary investments (mainly relating to real estate), and improving the control of operational management in the broad sense. The Supervisory Board concludes that the financial position of TU Delft is healthy and that control processes are in order.

### *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 profiling of the Board members. The Supervisory Board and the representative bodies have made procedural agreements concerning these matters. To this end, one of the members of the Supervisory Board has conducted informal discussions with the Confidential Committee of the Works Council

and also with the Student Council on several occasions. In addition, several members of the Supervisory Board attended meetings of the Works Council and the Student Council.

## 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. Since the beginning of the 2012 calendar year, new contracts have been drawn up in accordance with the WNT, taking account of any transitional provisions that apply. Under the current employment contracts, the TU Delft administrators do not receive any performance-related bonus.

In the opinion of the Supervisory Board, in 2016 the Board performed its task in accordance with the governance code.

The Supervisory Board honoured the principle of independence in 2016.

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









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# TU Delft in brief

## 1.1 Institutional profile

### Vision

The increasing number of people on the planet and the struggle to achieve ever-higher levels of prosperity raises major issues for society. In order to address these issues, both technology and the underlying scientific knowledge generated and disseminated by universities are essential.

Today's university of technology is a source of new scientific insights and pioneering technologies. It also trains scientists and engineers, offering them a broad academic basis. As such, it is a catalyst of innovation and economic growth. With their advanced expertise and know-how, engineers are vital to our society and economy. They are the people who develop the science-based technological solutions that help improve the lives of millions of people.

As one of the world's leading training grounds for these engineers, TU Delft defines its role in society as supplying solutions that take us further along the road towards sustainability and a healthy economy. We position ourselves as an open academic community which, through its academic staff and graduates, is represented throughout the world and is deeply rooted in our own regional and national, social and economic environment.

### Ambition

TU Delft aims to remain a university of technology with a leading global reputation. The University wishes to offer a full range of high-quality disciplines, degree programmes and unique facilities in the engineering sciences. By doing so, TU Delft wishes to retain its prominent global reputation as a university of technology that is regarded as a world leader by its peers. TU Delft wants to be an incubator for cutting-edge scientific and technological developments in order to meet the great societal challenges of our age.

It is also TU Delft's ambition to be viewed by the business community as a source of outstanding professional scientists and engineers, as a producer of excellent practical knowledge and as an innovative partner – in other words, as a university that fosters new activities and whose research and education have a significant impact on a competitive economic environment.

TU Delft wants to be a place where academics and students have an interdisciplinary and multidisciplinary approach, and where science, design and engineering are the primary driving

forces behind teaching and research. In addition, there is an increasing focus on responsible innovation. We aim to be an inspiring, progressive and gender-aware institution, attracting the world's best scientists and most talented students who are confident they will be able to fulfil their potential here.

### Mission

TU Delft's mission is to make a significant contribution towards a sustainable society for the twenty-first century by conducting ground-breaking scientific and technological research that is acknowledged as world-class, by training scientists and engineers with a genuine commitment to society and by translating fundamental knowledge into innovations and activity with both economic and social value.

Nearly 100% of the engineers trained in Delft find employment within a year of completing their degree. TU Delft aims to maintain this position.

## 1.2 Outline

With a solid financial position, as well as a culture of freedom, calling each other to account, consultation and supervision, TU Delft can realise its strategic ambitions. These features constitute an excellent basis for realising the strategic objectives for education, research, knowledge valorisation and the necessary renovation of the campus and facilities. The balance sheet for 2016 clearly shows that TU Delft has realised its strategic priorities from the Roadmap 2020 and has achieved its performance and profiling agreements.



## Final assessment of the performance and profiling agreements

At the end of 2011, the State Secretary of the Ministry of Culture, Education and Science concluded an Outline Agreement with the Dutch universities concerning the implementation of the strategic agenda Quality in Diversity. Each university then concluded bilateral agreements with the State Secretary with regard to the details of the Outline Agreement. TU Delft also concluded performance and profiling agreements in 2012, involving long-term agreements for the period 2013-2015 on ambitions for education quality and success rates, and on educational and research profiles and valorisation. In 2012, on the basis of its strategic plan (the TU Delft Roadmap 2020), TU Delft proposed a set of ambitions and discussed them with the Higher Education & Research Review Committee (HERRC), which rated the proposed performance agreement as 'very good', and the State Secretary for Education, Culture and Science accepted this evaluation.

The final evaluation of the performance agreements that were concluded took place in the autumn of 2016. To this end, the HERRC held discussions with the Executive Board of TU Delft on 7 September 2016. During the discussions, the Executive Board explained the results that were published in the 2015 Annual Report. The results show a convincing movement in the right direction, with the ambitions for the performance agreements being achieved.

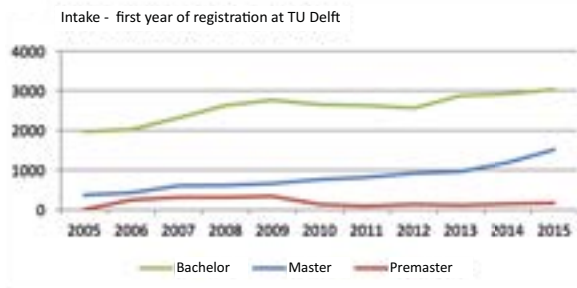
Indicator	Baseline measurement 2010	Target for 2015	Actual in 2015
Excellence	2,2%	8%	8%
Drop-out	19%	22%	16%
Switch	8%	8%	11%
Bachelor's pass rate after 4 years	27%	55%	55%
Lecturer quality (UTQ or equivalent)	7%	70%	72%
Teaching intensity (degree programmes with ≤ 12 contact hours)	0	0	0
Indirect costs	19,3%	19,3%	18,8%

In its advisory report for the Minister of Education, Culture and Science, the Review Committee gave a positive assessment of all aspects of the results achieved by TU Delft. The Minister of Education, Culture and Science (OCW) adopted these recommendations by the Review Committee.

### Education

In line with its ambition, TU Delft offers virtually the whole range of engineering disciplines in the Netherlands, supported by pioneering research. The range of programmes on offer is compact, consisting of 16 Bachelor's degree programmes and over 30 Master's degree programmes. Some of these programmes are unique in the Netherlands. In terms of focus on content and critical mass, all programmes stand on their own merits. Cooperation with other universities of technology in the Netherlands in the context of 4TU ensures proper coordination on the efficiency of the range of programmes on offer. The internationally recognised quality of our

engineering programmes is a decisive element in the quality culture within TU Delft. We set the bar high because, as Delft engineers, our students and graduates must be able to measure up to the best of the competition in the international labour market. By Dutch standards, our students follow a relatively difficult and intensive curriculum. As a result, TU Delft students tend to take too long to complete their studies. In the past few years, TU Delft has therefore implemented a number of measures that have proved effective, as shown by the evaluation of the performance agreements. In 2015, research showed that the vast majority of our graduates were able to find a job almost immediately. This is an important indication that our engineers are still in high demand in the labour



market. More than ever, this job security attracts the attention of prospective students in the current economic climate. TU Delft was therefore able to enjoy a high student intake again last year. It is important to ensure that all of those students are in the right place as soon as possible. We are therefore committed to stimulating study success in all phases of the study programme – from the programme choice and the link between VWO (pre-university education) and WO (university education) to student progress in the Bachelor's and Master's degree programmes.

## Research

The technical and scientific breadth at TU Delft forms the basis for its strong disciplinary specialisation profile. The research questions that TU Delft tackles are mainly inspired by important future challenges facing society. The technical and scientific knowledge acquired through our research activities feeds naturally into the education we provide.

In research, TU Delft profiles itself through innovative multidisciplinary work on selected societal themes, by strengthening its knowledge base in its chosen disciplines and by investing constantly in focus and mass. Successful

multidisciplinary and interdisciplinary collaborations on particular themes are based upon strong core disciplines and specific specialisations within them. In its choice of subject matter within themes, TU Delft aligns itself with the Dutch science and innovation agenda (National Research Agenda, Top Sectors) and European policy (Horizon 2020). Building on its academic research base, TU Delft is forging close alliances with other leading universities within the region (e.g. the LDE partnership with Leiden University and Erasmus University Rotterdam), within the sector (the 4TU. Federation with the other three universities of technology in the Netherlands), at European level (the Idea League with ETH Zürich, Chalmers University, Politecnico di Milano and RWTH Aachen) and worldwide with a large number of partners.

TU Delft is heavily dependent on a high-quality and expensive research infrastructure in order to attract scientific talent, conduct ground-breaking research and train new generations of engineers. No other Dutch university has the capacity to test technical and scientific models on such a large scale. This is a defining factor of TU Delft's profile in the international research landscape.

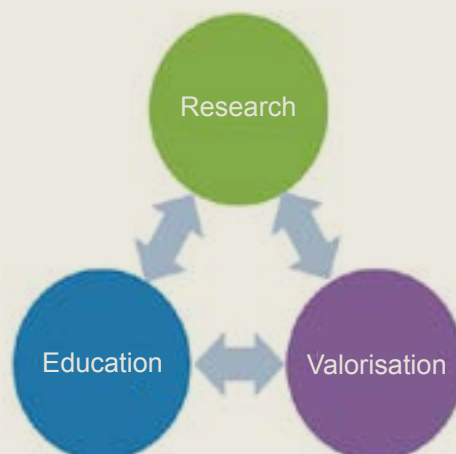
## Knowledge valorisation

Knowledge valorisation is TU Delft's third core task. TU Delft regards knowledge valorisation as the process of creating value from knowledge by making knowledge suitable or available for economic or social purposes. Moreover, it reflects our public remit to contribute towards a sustainable and competitive economy.

Multinationals, high-tech companies, SMEs and government agencies are all essential stakeholders

## Knowledge triangle

At TU Delft, research, education and valorisation cannot be considered in isolation. On the contrary; these 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.



## Pre-investment for student loan system

TU Delft invests in the quality of its education continuously. For 2016, this investment included targeted measures to provide extra student facilities, such as the Collaborative Learning Environment and the construction of Pulse, the new education building.

Since 2015, in anticipation of investment opportunities that will be created by the introduction of the student loan system, TU Delft has also been investing an additional six million euros per year in education quality. These investments relate to faculty initiatives for additional capacity for education and educational support, staff training and development, more and higher quality study workplaces, and sustainable innovations in education. With effect from 2017, the Executive Board increased the additional investment budget by a further two million euros to eight million euros per year, on condition that the university's financial position remains healthy. This investment policy has the support of the representative bodies.

Relative distribution of additional investments, 2015-2017	2015	2016	2017
<b>Teaching capacity</b>	<b>45%</b>	<b>82%</b>	<b>86%</b>
Extra lecturers:			
Facilitates smaller-scale education, student supervision and graduation options.			
Reduces the workload of lecturers.			
Teaching areas:			
Extra lecture rooms, tutorial rooms and examination rooms.			
<b>Training and development of lecturers</b>	<b>17%</b>	<b>3%</b>	<b>3%</b>
Lecturer professionalisation in terms of teaching skills and the application of new teaching formats.			
<b>Educational support tasks</b>		<b>8%</b>	<b>6%</b>
Student support and guidance:			
Extra capacity for the supervision of studying, internships and exchanges, and students' extracurricular activities.			
Lecturer support			
Extra organisational and logistical capacity to reduce the burden on lecturers.			
<b>Study workspaces</b>	<b>8%</b>	<b>2%</b>	<b>1%</b>
Quality:			
Workspaces adapted for teaching formats and student requirements.			
Volume:			
More study workspaces, partly to support students whose accommodation does not provide a good learning environment.			
<b>Educational innovation</b>	<b>30%</b>	<b>5%</b>	<b>4%</b>
Redesign of courses and curricula in line with the latest didactic advances.			

for TU Delft. It is vital that we align ourselves more closely with the agendas of our strategic partners. TU Delft has a long tradition of intense interaction between the results of research and valorisation. The TU Delft Valorisation Programme was initiated a decade ago to enable us to undertake knowledge valorisation activities in a more systematic way. This programme laid the foundation for the TU Delft valorisation profile, and is set out in the TU Delft Valorisation Agenda. This profile will be developed further in the coming years. At the European, national and regional levels, TU

Delft positions itself as a constructive knowledge partner in innovation clusters of businesses, governments and other universities. We regard this form of collaboration – what we call the 'triple helix' – as a crucial means of extending the process of knowledge valorisation in a systematic manner. It is also essential to improve our chances of success in obtaining funding from European programmes. We wish to further enhance our position in these innovation clusters.

## 1.3 Strategic priorities

TU Delft is strengthening its institutional profile and its ambition level along the lines of the profiling themes listed below, which are laid down in the institutional plan, the TU Delft Roadmap 2020. In 2016, a review of the current profile was initiated. This will result in a new institutional plan for the period 2018-2024. The basis for the current profiling themes and the proposed actions will be outlined in the individual chapters.

### Students & Education

- Differentiation and breadth in Bachelor's degree programmes
- Profiling of Master's degree programmes
- Professional Doctorate in Engineering
- Graduate School – Doctoral Education
- Postgraduate courses
- Quality of student intake
- Study success
- Development of excellence programmes
- Modern teaching methods, including digital forms
- Teaching abilities of academic staff
- Institutional accreditation, quality assurance and student satisfaction
- 4TU and Leiden-Delft-Erasmus partnerships

### Scientific profile

- Science – engineering – design, with an increasing focus on responsible innovation
- Interfaculty alliances (TU Delft Institutes)
- Grand Challenges for Society – four priority areas
- Strategic research cooperation
- International peer reviews and rankings
- Individual and group quality
- Top sectors and Horizon 2020
- Fundraising
- State-of-the-art research infrastructure

### Valorisation

- TU Delft valorisation profile
- TU Delft Valorisation Agenda 2020
- Structural cooperation with businesses and government
- Cooperation with SMEs
- Delft Technological Innovation Campus
- Support organisation for valorisation: TU Delft Valorisation Centre
- Entrepreneurship training and development of new commercial activity
- Intellectual property
- Debate on ethical aspects of public-private partnerships

## 1.4 Highlights

### Millionth MOOC registration

TU Delft has received its millionth enrolment for its free online courses (MOOCs, or Massive Open Online Courses). Anka Mulder, member of the Executive Board: 'I am proud that we are sharing our knowledge with so many people around the world, including colleagues, students and people who otherwise have no access to higher education.' TU Delft currently offers 36 MOOCs. All you need is an internet connection in order to register. And there are no requirements for prior education.



### RoboValley attracts investment fund worth 100 million euros to Delft

Chrysalix Venture Capital and RoboValley from Delft have set up the RoboValley Investment Fund. The purpose of this investment fund for robotics, which has a target size of 100 million euros, is to foster the development of robotics worldwide. TU Delft makes expertise available on the basis of its mission to valorise knowledge, for example by bringing it to the market.



More than 170 robotics researchers from a range of disciplines work in RoboValley on the development of next-generation robotics. They work alongside experts, entrepreneurs and decision-makers from both the public and private sectors. As a result, a unique network is evolving, with the TU Delft Robotics Institute as the nerve centre.

### New Applied Sciences faculty building now in use

The new Applied Sciences building is the state-of-the-art accommodation for part of the Faculty of Applied Sciences. A new building was needed to enable the faculty to continue performing at the top level internationally. The building was completed



in spring 2016. It is used daily by 600 staff and 800 students of TU Delft. The building has been constructed to minimise vibrations, reduce noise, and meet strict requirements for ventilation and temperature stability. These requirements were the basis for the building's spatial design, construction and systems. Underground geothermal storage provides sustainable heating and cooling for the whole building.

#### **TU Delft and municipality strengthen collaboration**

TU Delft and the Municipality of Delft have signed a covenant to strengthen the collaboration between them. The advisory report by the Deetman Committee 'Delft, parel in de Randstad' ('Delft, Jewel in the Randstad Conurbation') was the basis for the covenant, which focuses on four themes. The agreement relates to the fostering of the link between the city and the campus, cooperation to attract innovative enterprise, and the intention to work together to disseminate joint interests both within the region and far beyond.



#### **Impressive performances from student teams**

Several Delft student teams won prizes in international competitions. The WASUB student team won the European International Submarine Races with its human-powered submarine. The team's sub completed the course in a record time of just 78.3 seconds, beating the previous record by more than six seconds.

The Nuon Solar Team once again showed that they can build the most efficient solar car in the world. After an exciting race, the Nuna S8 won the Sasol Solar Challenge in South Africa. With a total of 4,717 kilometres on the clock, they broke the world record for the number of kilometres driven in a solar race.

During the International Genetically Engineered Machine (iGEM) competition in Boston, the Delft team won several prizes. They won a gold medal

with their project 'Opticoli', bacteria that develop biological lenses. They also won three other prizes: 'Best New Application', 'Best Model', and 'Most Innovative DNA Fragment'.



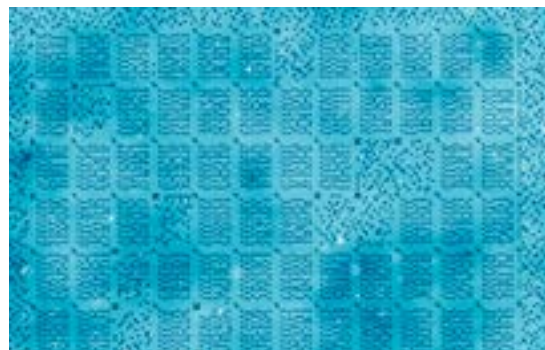
#### **Printing without ink: TU Delft spin-off Inkless ready for the next step forward**

Printing without ink. Inkless, a TU Delft spin-off company, has the technology to do this without sacrificing print quality. This can be done by carbonising the paper using a method developed in collaboration with the TU Delft Optics Research Group. Inkless has a good control over the carbonisation process, and as a result the printing does not go through the paper. The print is black enough, and also permanent. There are several patents on the technology..



#### **Smallest-ever hard disk writes data one atom at a time**

Every day, society generates billions of gigabytes of new data. In order to ensure that these data can be stored properly, it is becoming increasingly important to minimise the amount of space they





take up. A team of scientists from the Kavli Institute of Nanoscience at TU Delft has succeeded in reaching the ultimate limit: they built a memory of 1 kilobyte (8,000 bits), in which each bit is represented by the position of a single chlorine atom. The team managed to achieve a storage capacity of 80 terabits per square centimetre, more than 500 times better than the best hard disk that is currently available on the market. The researchers published an article about it in *Nature Nanotechnology* on Monday 18 July.

#### **Team Delft wins the Amazon Picking Challenge**

A team of engineers from TU Delft won the Amazon Picking Challenge during RoboCup 2016, a renowned international robot competition. There were two separate finals. In the stow task, the robot had to take products out of a container and place them on the shelves. In the pick task, the robots had to carry out the process in reverse. The Delft team won both finals, their robot having autonomously transported a wide range of products.

#### **Tom Dumoulin wins in Delft time-trial**



Cyclist Tom Dumoulin took part in the time trials of the Tour de France and the Olympic Games wearing a new skinsuit developed by Team Giant-Alpecin and TU Delft. TU Delft used an unusual method to research the aerodynamics of the time-trial suit: Dumoulin's body was scanned, and the scan was used to create a 3D printed model of Dumoulin. The air resistance of the model,



was then measured and optimised in the Delft wind tunnel.

#### **TU Delft scientists recreate Alcatraz escape on TV**

In March, Discovery Channel showed a



documentary featuring an adventure with a Delft twist. In *Alcatraz: Escaping the Rock*, three scientists (from Deltares and TU Delft) investigate whether history's most famous prison escape could actually have been successful, by recreating the original boat and entering the waters of San Francisco Bay.

The escape from Alcatraz in 1962 has always been surrounded by mystery. Did the three escapees reach land safely? The researchers built a computer model and tested it themselves.

## 1.5 Management and Organisation

TU Delft is an institution governed by public law; it is subject to the Higher Education and Scientific Research Act (WHW) and to administrative law with its fundamental principles. The responsibilities and authority of the Executive Board and the Supervisory Board are laid down in the WHW. The Code of Good Governance for Universities of the Association of Universities in the Netherlands (VSNU) is applied and observed by TU Delft. In 2014, the regulations for the Supervisory Board and the Executive and Management Regulations (BBR) were adjusted in view of the sector code and the government vision on good governance. Under the current employment contracts, the TU Delft administrators do not receive any performance-related bonus, since this is not permitted under the Senior Officials in the Public and Semi-Public Sector (Standards for Remuneration) Act (WNT).

### Executive Board

The Executive Board is the highest administrative body of TU Delft, and it is charged with the governance and management of the university. The Executive Board has three members, who are appointed by the Supervisory Board. When appointing members, the Supervisory Board confidentially consults with the Works Council and the Student Council (at the institutional level).

### Division of tasks and areas of interest

The basic principle is that the collegial policy model is applied to subjects that are of importance to all board members. Furthermore, the president has final responsibility for the administration of the university.

### Supervisory Board

The Executive Board is accountable to the Supervisory Board, which is appointed by the Minister of Education, Culture and Science. The Supervisory Board has a number of specific tasks as set out by law, including the approval of executive and management regulations, the strategic plan, decisions regarding the employee participation scheme, the budget and the annual report. Profiles of the Supervisory Board members can be found on the TU Delft website, [www.tudelft.nl](http://www.tudelft.nl).

In 2016, the Supervisory Board was made up of the following members:

*Drs. ir. J. van der Veer*  
*Ms ir. L.C.Q.M. Smits van Oyen, MBA*  
*Prof. D.D. Breimer*  
*Ms Drs. C.G. Gehrels*  
*Drs. J.C.M. Schönfeld, MBA (until 1 May 2016)*  
*Drs. G. de Zoeten RC (from 1 May 2016)*

### Operational Committee

In the Operational Committee, the Executive Board consults with the deans on matters of general

Faculty	Dean
Architecture and the Built Environment	Professor P.J. Russell
Civil Engineering and Geosciences	Professor B.M. Geerken
Electrical Engineering, Mathematics and Computer Science	Professor R.H.J. Fastenau
Industrial Design Engineering	Professor M.A. Voûte
Aerospace Engineering	Professor H. Bijl ( <i>until 1 November</i> ) Professor R. Benedictus ( <i>acting dean</i> )
Technology, Policy and Management	Professor M.J. van den Hoven ( <i>acting dean until 1 October</i> ) Professor T.S. Baller ( <i>acting dean</i> )
Applied Sciences	Professor T.H.J.J. van der Hagen ( <i>until 1 May 2016</i> ) Professor L.J. van Vliet ( <i>acting dean</i> )
Mechanical, Maritime and Materials Engineering	Professor T.S. Baller

## Division of Executive Board portfolios

### President of the Executive Board

(since 1 May 2016)

Prof. dr. ir. Tim van der Hagen



- Strategy and policy of the institution
- Promotion of the external network
- Public Affairs and Communications
- Real Estate
- Financial strategy
- Human Resources
- Legal Affairs

### Rector Magnificus

(also Vice-President)

Prof. ir. K.Ch. A.M. Luyben



- The academic direction of the university in education and research
- The appointment of full professors and key academic positions
- Research
- Valorisation
- Library

### Vice-President for Education and Operations

Drs. J.L. Mulder



- Education
- Administrator of University Services
- Student Affairs
- Operations
- ICT
- Facility Management

importance to the entire university. This is partly in relation to the specific interests of the faculties and is aimed at improving unity and the development of the university as an institution of scientific research and education.

### Board for Doctorates

The Board for Doctorates has the following tasks:

- the establishment of the Doctoral Regulations;
- the appointment of PhD supervisors and the forming of doctoral committees;
- the conferment of the doctorate;
- the conferment of the honorary doctorate;
- advising on the establishment of endowed chairs.

### Council of Professors

The Council of Professors is an advisory body of the Executive Board, consisting of a panel of experienced professors employed at TU Delft. The Council gives both solicited and unsolicited advice to the Executive Board about TU Delft as an 'academic company'.

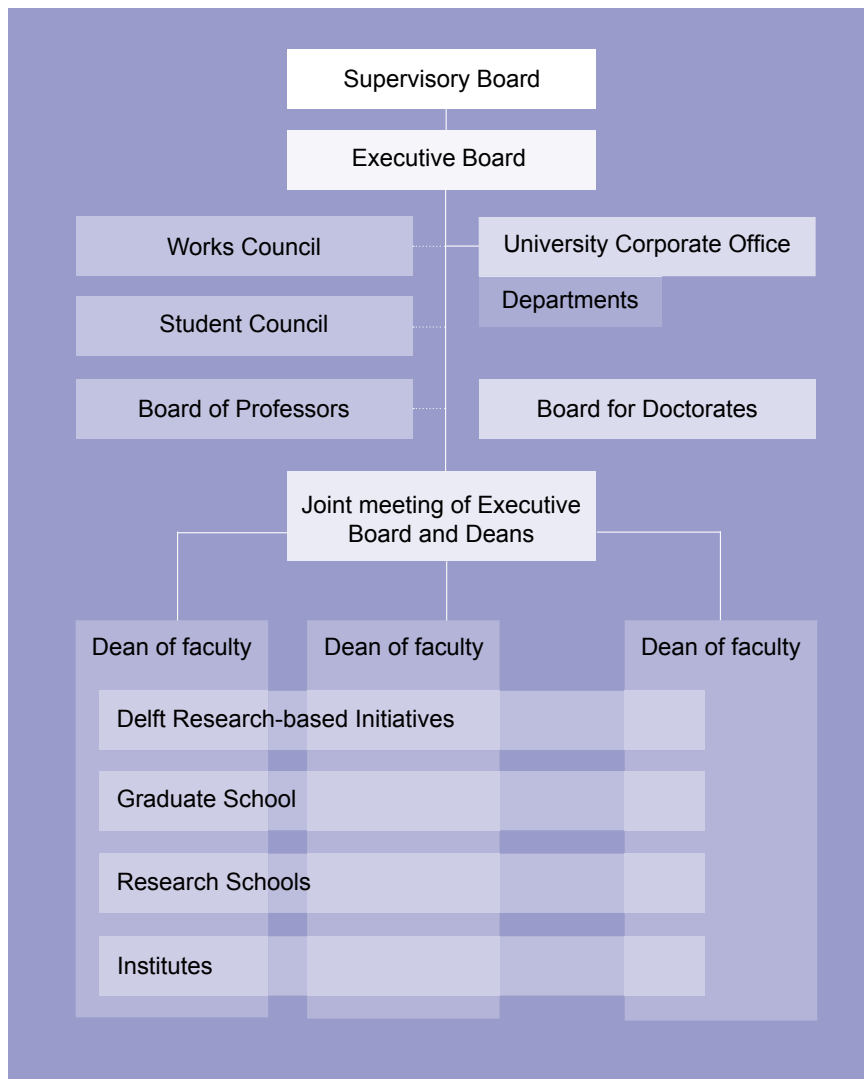
### University Services

University Services is responsible for the provision of services to students, staff and other stakeholders. University Services supports TU Delft as a whole and facilitates and coordinates administrative processes. The service has an important task with regard to initiating and implementing the administrative agenda of TU Delft. This is done in close cooperation with the decentralised University Services.

### Employee participation

#### Works Council

The Works Council is an employee representative body, elected for three years and composed of 23 members. It is subject to the Works Councils Act and has a number of powers, including advisory powers and right of approval. The Works Council consults with the Executive Board. In addition to the statutory powers, agreements were made in 1998 on a number of matters, such as advisory powers relating to the budget, and the procedure to be followed during restructuring.



#### Local Consultation Body

Pursuant to the Collective Labour Agreement for Dutch Universities (CAO-NU), TU Delft has a Local Consultation Body. This is a body for consultation at institution level between the Executive Board and the trade unions on matters relating to terms of employment. The trade-union members are appointed by the central trade-union organisations. Pursuant to the Works Councils Act, the Works Council also has a number of powers relating to some of the matters included in the Collective Labour Agreement. In 2002 the Executive Board, Works Council and trade unions in the Local Consultation Body concluded a covenant that sets out agreements regarding overlapping powers: in certain matters the trade unions in the Local Consultation Body advise the Works Council, and vice versa for other matters.

#### Student Council

The Student Council is a student representative body that promotes the interests of students. Its powers include the right of approval and advisory powers, as provided for in the Higher Education and Research Act (WHW) and the Student Council regulations. The Student Council consults with the Executive Board. The Student Council is elected for one year and has 10 members.

#### General Assembly of Councils

The Works Council and the Student Council together form the General Assembly of Councils. This is the representative body referred to in Section 9.30a of the WHW. The General Assembly of Councils has the right of approval with regard to the strategic plan, the quality assurance system, the Executive and Management Regulations and, with effect from the 2016 budget year, the key elements of the budget. The other powers of the

General Assembly members include the right to nominate one Supervisory Board member in whom they have particular confidence. The General Assembly consults with the Executive Board.

#### *Personnel Committees*

Pursuant to Article 15.3 of the Works Councils Act, the Works Council has set up personnel committees for the faculties and University Services. These personnel committees represent staff members at decentralised level. They consult with and advise the individual in charge of the relevant unit, namely the deans and the heads of University Services. Elections for members of the personnel committees and members of the

Works Council are held at the same time. The term of office is three years. The number of members depends on the size of the faculty/service.

#### *Faculty Student Councils*

The Faculty Student Councils represent student interests relating to all manner of aspects at the faculties, particularly education and student policy. The councils have the right of approval regarding certain elements of the Teaching and Examination regulations, and advisory powers with regard to other elements. The councils have between 5 and 15 members (depending on the size of the faculty), who are elected annually.

2

Education

In the Annual Report for 2015 there was a great deal of emphasis on the presentation and evaluation of the performance agreements. As reported in Chapter 1, the performance agreements were realised and the Review Committee praised TU Delft in its report. A start has now been made on the evaluation of the education improvement programmes that were introduced four years ago. The focus in this process is on study success. As part of this, all Bachelor's curricula were restructured four years ago. The effects of the reviews are being identified and evaluated.

In 2016, preparations also began for the Institutional Quality Assurance Audit. The visit of the Assessment Committee will take place in May 2017, and most of the preparations for this were made in 2016.

In 2016, TU Delft began work on updating its vision on education.

## 2.1 Bachelor's degree programmes

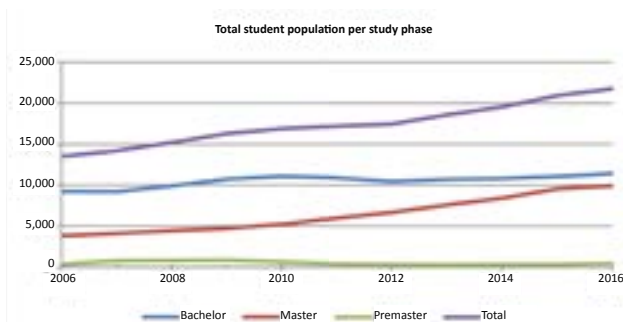
### Overview of degree programmes

All 16 Bachelor's degree programmes are included in the TU Delft Register of Degree Programmes, which can be found on the website: [www.tudelft.nl](http://www.tudelft.nl).

### Population and intake of students

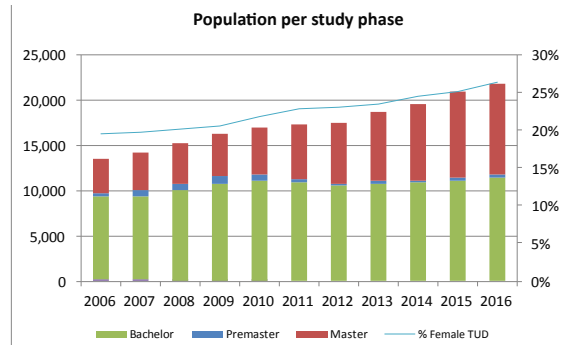
The growth in student numbers seen in previous years is continuing. Intake increased from 3,031 in 2015 to 3,100 in 2016 (+2%).

As at 1 December 2016 there were 11,395 students; an increase of 3% on the previous year's total (11,075).



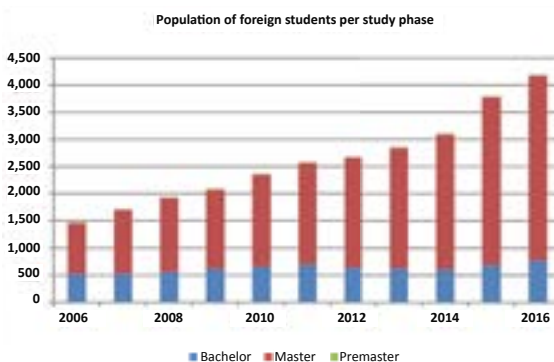
### Proportion of female students

The number and proportion of female Bachelor's students increased, from 2,635 in 2015 to 2,922 in 2016, an increase from 25% to 26% in this student population.



### Proportion of foreign students

The proportion of foreign students following the Bachelor's degree programmes also increased. The population increased from more than 689 in 2015 (6% of all students) to more than 778 in 2016 (7%). The vast majority of foreign Bachelor's students are studying at the Faculty of Aerospace Engineering (58% of the intake of foreign Bachelor's students), the first English-taught Bachelor's degree programme at TU Delft.



### Degree certificates

A total of 1,988 Bachelor's degree certificates were awarded in the 2015/2016 academic year. This is a decrease of 9% compared to the previous year. This is possibly due to the fact that many students graduated early, in August 2015, in order to remain eligible for grants under the old system when they transferred to Master's programmes.



## Bachelor's degree programme admissions policy

Admission to the BSc degree programmes is laid down by law. See also section 2.9 concerning limited enrolment programmes.

## 2.2 Master's degree programmes

All 35 Master's degree programmes are included in the TU Delft Register of Degree Programmes, which can be found on the website: [www.tudelft.nl](http://www.tudelft.nl).

### Relocation of EPA

During the two-year Master's degree programme in Engineering and Policy Analysis (EPA), students learn to work at the interface between technology and policy. The Master's degree programme has been relocated to The Hague. The proximity of ministries, international organisations and multinationals will facilitate closer collaboration between teaching, research and professional practice. The degree programme focuses on case studies from practice. EPA will still be a Delft programme, leading to a Master of Science degree from TU Delft.

### Population and intake of students

The Master's student population continues to grow. In 2015 the number of Master's students as at 1 December was 9,541. In 2016 this figure increased by 4% to 9,933. The external intake of Master's students (i.e. students registering at TU Delft for the first time) fell from 1,513 to 1,432, or -5%.

### Proportion of female students

The number and proportion of female Master's students increased, from 2,577 in 2015 to 2,734 in 2016, an increase from 25% to 26% in this student population.

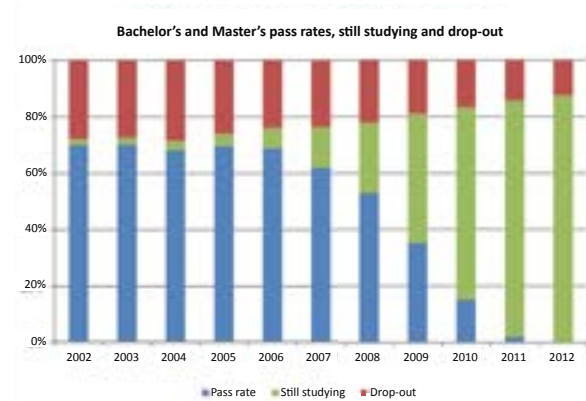
### Proportion of foreign students

The number and proportion of foreign students in the Master's degree programmes increased from 3,087 in 2015 (32% of all Master's students) to 3,387 (34%) in 2016, an increase of 10%.

## Degree certificates

A total of 2,671 Master's degree certificates were awarded in the 2015/2016 academic year, an increase of 9%.

The figure below shows the pass rate of cohorts, with the percentage of students still studying and the percentage of students who dropped out.



## 2.3 PhD candidates

The number of PhD candidates increased from 2,607 in 2015 to 2,710 in 2016. The proportion of PhD candidates of foreign nationality continues to grow, and increased to 68% in 2016. The top five countries of origin of foreign PhD candidates was the same as in 2015: China, Iran, India, Italy, Germany.

After a slight decrease in 2015, the number of doctorates conferred increased again in 2016, from 359 in 2015 to 398 in 2016. Further information about PhD candidates and doctorates conferred can be found in section 3.5 of this report.

## 2.4 Other degree programmes

### Professional Doctorate in Engineering

At the 4TU.School for Technological Design, the Stan Ackermans Institute, the four universities of technology train engineers to qualify as technical designers: the Professional Doctorates in Engineering (PDEng). The programmes for designers were established in response to the demand from the business community for broadly oriented knowledge workers with a strong science and technology background.

TU Delft has established four designer programmes at the Stan Ackermans Institute:



- Process and Equipment Design
- Bioprocess Engineering
- Bioproduct Engineering
- Chemical Product Engineering

These two-year post-Master's programmes are offered in close collaboration with SMEs and larger enterprises.

Participants spend one year taking courses to broaden their knowledge, for example in design methods. They then spend a year at a company where they work on a specific design assignment. Scientists of universities of technology, along with company experts, assess whether the design assignment is worthy of the PDEng degree.

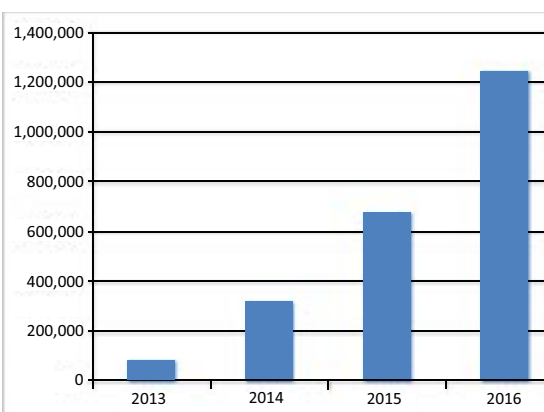
## 2.5 Digital Teaching Methods

The establishment of the Delft Extension School in 2014 created new possibilities for offering flexible online education to working professionals. It has been decided to extend the innovation programme by four years (2017-2020).



### Massive Open Online Courses (MOOCs)

At the end of 2016 there were 46 MOOCs available and a further 10 in production. The milestone of 1 million enrolments was reached and celebrated in the summer of 2016, making TU Delft one of the five institutions worldwide with more than a million enrolments on the edX platform.

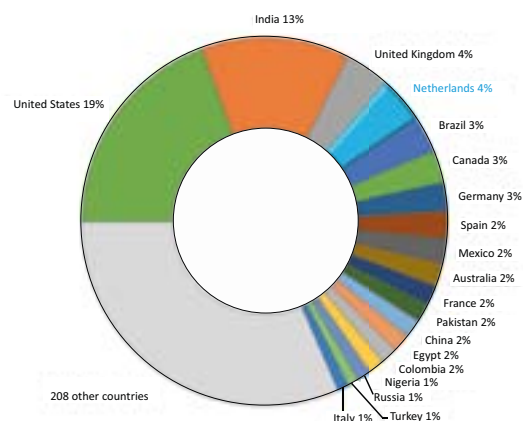


Number of MOOC participants

### Credits for MOOCs

Students who follow a MOOC do so in order to acquire new knowledge, but many of them also wish to see their efforts recognised with credits. TU Delft and a number of other edX universities have taken the initiative to enable their students to obtain credits for passing a MOOC. With effect from February 2017, it will be possible for Delft students to include a MOOC in their elective modules, Honours programme or Graduate School programme. Additional examination requirements for obtaining credits have been drawn up for the individual MOOCs.

The other institutions taking part in this pilot are Rice University (US), the University of British Columbia (Canada), the University of Queensland (Australia), Australia National University, Hong Kong University of Science & Technology, and EPFL (Switzerland). This has resulted in a wide and international range of courses that enriches the degree programmes.



Countries of origin of MOOC participants

### Open Education

OpenCourseWare (OCW) is high-quality, university-level study material that is published online and freely accessible. The material is usually in the form of courses with additional resources for effective planning and progress assessment, and additional thematic overviews. OpenCourseWare courses are freely available under an open licence.

Last year the OpenCourseWare website was completely updated, optimising the presentation of the 200 courses on offer. We receive a great deal of feedback showing that other universities also use our materials. This shows that we are successfully responding to a growing need which also contributes to our mission: *Educate the World*.

## Professional Education

The range of courses for professionals was expanded further in 2016. The range now consists of 17 courses, and a further 20 are being developed. Courses are developed in close collaboration with industry, to ensure that they meet the needs of the relevant professional fields.

## Awards

In 2016, TU Delft won several awards for its open education, including the Best Practice Initiative Award for a paper on its pedagogical model for online learning, and an Open MOOC Award for the Pre-University Calculus MOOC..

## 2.6 Collaboration

### Leiden – Delft – Erasmus Strategic Alliance (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. The three universities wish to provide outstanding, varied and innovative teaching for their students that will enable them to find answers to the issues of the future. By working together, the universities can broaden their curricula and make it easier for students from other universities to access them. In order to achieve this, they offer joint degree programmes. The range of LDE programmes was extended in 2016:

- 90 students enrolled for the new minor in Safety, Security and Justice.
- Development of the LDE Honours Classes continues.
- In September 2016, Leiden and Rotterdam launched the Master's specialisation 'Governance of Migration and Diversity'. TU Delft is contributing to the content of the curriculum.
- In November 2016, the LDE MOOC 'Heritage under Threat' was launched.
- In 2016, the post-initial Master's programme in Cyber Security in Leiden was launched.
- The Centre for Safety and Security took the initiative to introduce a Cyber Security Honours Class.

More detailed information about LDE can be found in section 5.9 of this report.

## 4TU.Federation

The 4TU.Federation is the partnership of the four universities of technology in the Netherlands. They jointly offer five Master's degree programmes, and provide Professional Doctorate in Engineering study programmes through the Stan Ackermans Institute.

The 4TU. Centre for Engineering Education (CEE) plays a supporting role in education.

In 2016, TU Delft made the following contributions:

- The assessment in teaching practice of the engineer profiles developed in 2015 by the Delft think tank 'Free Spirit'.
- The publication of a new vision on engineering education that meets the needs of our rapidly changing society and technological world.
- Research into the added value in teaching practice of emerging technologies such as virtual simulations and virtual reality systems.
- Comparison of the impact of study success in the Bachelor's degree programme in Architecture and the Built Environment and in Electrical Engineering on students' intrinsic motivation and science mindset.

More detailed information about the 4TU. Federation can be found in section 5.9 of this report.

## 2.7 Internationalisation

### Growing international population

#### Students

The number of international incoming Bachelor's, Master's and exchange students once again increased in 2016. There were 6,000 preliminary registrations, which led to 2,100 new student registrations.

#### Staff

The year 2016 also saw an increase in the number of appointments of paid international staff, internship students, student assistants and unpaid visiting staff.

All international staff and guests are welcomed with a personal interview, in which ample attention is given to terms and conditions of employment, the possibilities with regard to tax arrangements, residence and work permits, and assistance for family members who are either arriving with the staff member or guest or joining them at a later date

	2012	2013	2014	2015	2016
New hires	956	999	1221	1355	1421
Development (compared to 2012)	100%	104%	128%	142%	149%

*Paid international staff*

### More exchange students

The number of exchange students who wish to come to TU Delft is increasing steadily, and balances the number of exchange places that our partners offer our students abroad. The number increased from more than 500 in 2015, to exceed 600 in 2016. Attempts are being made to create more opportunities through fairs and communication with students. .

## 2.8 Quality

### Educational development and innovation

TU Delft believes that innovation is very important for maintaining and further developing the quality of education. To this end, important steps were taken in 2016, including the appointment of four lecturers as 'Education Fellows'. These lecturers have been given additional scope to experiment with new applications. They conduct research into the effects of those applications and share the findings with those around them, both within and outside TU Delft. This is the beginning of a programme in which, from 2017 onwards, eight lecturers per year will take on the role of Education Fellow.

The fact that TU Delft is a driver of innovation, not only in online learning but also in on-campus education, is evident from the external recognition of developments at our university. In 2016, for example, one of the first SURF Education Awards was presented to Anka Mulder, member of the Executive Board. She received this award for her role as a change maker in higher education who raises the level of education through the use of ICT. A further example is the edX award for 'Exceptional Contributions in Online Teaching and Learning', presented to Professor Arno Smets.

### Accreditation

In 2016, a number of departments were visited by panels of peers to carry out an evaluation for the purpose of accreditation renewal. The following

degree programmes were given a final rating of 'Good' by their panel: the BSc in Electrical Engineering, the MSc in Electrical Engineering and the MSc in Computer Engineering. The following degree programmes are still awaiting their rating: the BSc in Systems Engineering, Policy Analysis & Management, the MSc in Systems Engineering and Policy Analysis, the MSc in Engineering and Policy Analysis, and the MSc in Management of Technology..

### Quality assurance for degree programmes

In 2016, a large number of departments conducted a midterm review of their degree programmes or began preparing for a midterm review in the first half of 2017.

In order to assure the quality of degree programmes, it is important that Boards of Studies function effectively. In order to provide support to the Boards, a guide has been written and training meetings have been held. In 2016, 42 members of Boards of Studies (lecturer and student members) took part in six training meetings.

### Excellence

The TU Delft policy of excellence aims to provide students of above-average talent with additional challenges. TU Delft offers the best-performing students various options both within and outside the degree programmes, such as Cum Laude regulations, double degree programmes, MSc scholarships and Honours Programmes. There are also students who participate in study-related extracurricular activities, which include administrative activities or projects of the Dream Teams, such as the NUON Solar Team (NUNA) and the Delft University of Technology Racing Formula Student Team. University of Technology Racing Formula Student Team.

### Delft Honours Programme

In 2016, 189 students were admitted to the Bachelor's programme of the Delft Honours Programme. Within the programme, students follow faculty modules and projects worth 15 EC, and 5 ECTS within the interdisciplinary programme. In addition, honours students participate in the many activities organised by the Honours-programme management, such as a networking day, a visit to CERN and various lunchtime and evening lectures..

## Extracurricular projects: D:DREAM

In total, more than 400 students participate in the 13 D:DREAM teams. The students achieve top-level performance, learn to work in interdisciplinary teams, manage projects, learn to collaborate with businesses, build and test their own designs – and win!

TU Delft embraces these extracurricular student projects and facilitates them by providing the teams with a well-equipped workplace, known as the D:DREAM Hall. D:DREAM stands for Delft Dream Realisation of Extremely Advanced Machines.

In 2016, teams worked on projects including maglev trains that travel at the speed of sound through vacuum tubes, exoskeletons that enable paraplegics to walk again, human-powered submarines, hydrogen racing cars, vehicles that can circle the world on just 10 litres of fuel, and bicycles that travel faster than many urban cars.



2015-2016 project	Size of team	Top achievements in 2016
Delft Aerospace Rocket Engineering (DARE)	130, of which 5 full-time	Several successful test launches
Forze Delft	60, of which 9 full-time	Forze VII unveiling at Gamma Racing Days
Formula Student Team Delft	71, of which 11 full-time	1st place in Formula Student Competition, Spain
Delft Hyperloop	30	1st place in Hyperloop Pod Competition, Texas
Eco-Runner Team Delft	28, of which 6 full-time	3rd place in Shell Eco Marathon, London
MARCH project	27	Demo at Cybathlon Zurich
WASUB	24	Fastest track record and European record, European International Submarine Racing, London
TU Delft Solar Boat Team	23	2nd prize, Monaco Solar Boat Challenge
Human Power Team	16	3rd place in World Human Powered Speed Challenge
Nova Electric Racing	14	Participation in 'M to E'
Rowing Innovation and Sports Engineering	13	Building and testing innovative rowing shell
iGEM	10	Won several prizes in subcategories at the iGEM competition
Nuon Solar Team	8	Winners, SASOL Solar Challenge in South Africa

*Achievements of student teams in 2016*

## Top-level sports

In 2016, TU Delft continued with the implementation of its top-level sports policy. Forty-four students had an official TU Delft top-level athlete status. Although there are traditionally many rowers among TU Delft's students, other sports such as sailing, car racing and field hockey are also well represented.

TU Delft's top-level athlete status enables students to continue practising their sport during their degree programme. With the Rio Olympics taking place in 2016, sport was the top priority for a number of these students. They achieved impressive results. TU Delft student Annette Duetz and her sailing partner finished seventh in the 49er FX Class in Rio de Janeiro. The Delft alumnus and rower Chantal Achterberg (silver medallist in the quadruple sculls), and Olivier Siegelaar and cox Peter Wiersum (both bronze medallists in the men's eight) were also among the prizewinners. This was Achterberg's second Olympic medal in her rowing career.

Apart from these exceptional performances, other athletes have achieved excellent results in national, European or world championships

## Studying with a disability

An estimated 11 to 14% of students at TU Delft have a disability. These students are at high risk of incurring study delay or dropping out.

In recent years, the University has increased the range of facilities it provides, both centrally and at faculty level. Short-term individual or group support is available to all students with a disability. In 2016, a workshop focusing on job applications for students with a disability was introduced. Students may also be assigned a Study Buddy. A large group of students with a reading impairment make use of the read-aloud software, which is provided as standard. TU Delft is the only education institution in the Netherlands to offer this facility, along with a scanning service for digitising printed study material. These facilities were introduced for English in 2016.

## 2.9 Study success

### Bachelor's information

A record number of school students visited the open days in the spring and autumn of 2016. In the autumn, 6,000 school students visited TU Delft, an

increase of around 10% compared to the autumn of 2015.

School students are quick to embrace new ways of communicating. In 2016, TU Delft appointed a vlogger. This was one of the suggestions made by the school panel. The vlogger films aspects of student life from his own perspective, so that prospective students have an idea of what it is like to study at TU Delft.

A student Webcare team has been set up to place content on social media and answer prospective students' questions.

### Numerus Clausus

Three Bachelor's degree programmes employed a numerus clausus (cap on student intake). The growth of the Clinical Technology programme needs to be controlled in its initial years, and students are admitted through decentralised selection only. This year, Industrial Design Engineering and Aerospace Engineering opted to admit a limited number of students through decentralised selection; the remaining students were selected by the decentralised lottery process. A numerus clausus of 100 has been requested for the Nanobiology degree programme in academic year 2017-2018. Interest in the programme is growing, and from 2017 it will be open to international students as well.

### The link with pre-university education (VWO)

In the context of establishing links between pre-university education and TU Delft, the focus is on teachers as well as school students. In 2016 there was increased focus on involving secondary-school teachers through the Bètasteunpunt Zuid-Holland.

The pre-university talent programme Junior TU Delft was set up for Year 5 students in VWO and now includes a new mathematics programme, the Maths & Science Class. Online trial studying is available for eight Bachelor's degree programmes. The Programme Choice Check (SKC) was performed for 12 Bachelor's degree programmes this year, and the SKC was more effectively integrated in the registration process as a whole. The response rate increased to 70%.

### Master's information

Peers are important sources of information for prospective Master's students. For this reason,



in addition to the usual Master's information, TU Delft has now appointed student ambassadors to communicate with prospective students. This year, we appointed 25 student ambassadors from all over the world. These TU students answer questions via email and Facebook, and organise informational activities at the university in their home country. In addition, they work together to expand the TU network in their home countries, primarily through contacts with Delft alumni, and also with universities that are of interest to TU Delft.

In 2016, informational activities were held in Indonesia, Taiwan, Singapore, Mexico, Peru, Ecuador and Colombia. Next year we will work with our alumni and with universities, embassies and local scholarship organisations to further expand the informational activities.

### Additional guidance and support for students

In addition to the support provided in the faculties by academic counsellors, mentors, internship coordinators and international coordinators, all students have access to the support and guidance provided by Career & Counselling Services. Students may seek individual support or, if they prefer, choose from the wide range of workshops and training courses focussing on effective studying, personal support, choice of programme and careers.

Examples include: smarter ways to prepare for exams, studying with dyslexia, and thinking constructively when dealing with fear of failure

### Choosing and switching degree programmes within TU Delft

The key to study success is to choose the right degree programme. Career & Counselling Services offers an in-depth workshop on choosing a degree programme. In 2016, this workshop was also offered in English for the first time.

During their studies, students may have doubts or need to make choices (e.g. relating to a BSA). Workshops on making choices and switching degree programme are offered by way of support. Workshops on choosing a Master's programme are also offered. Experience shows that students who switch degree programmes have a low probability of success in the new programme. In order to address this issue, a pilot with academic counsellors was launched in 2016.

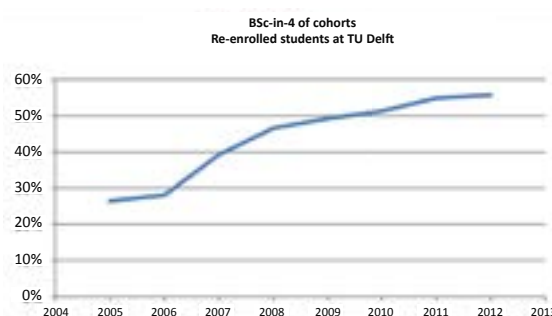
### Binding Recommendation on the Continuation of Studies (BSA)

For first-year students, the minimum requirement for a positive BSA is 45 ECTS. As in the previous year, 72% of the 2015-2016 cohort received a positive BSA. The percentage of students who discontinued their studies before 1 February increased slightly compared to previous years, from 16% to 18%.

The number of students who discontinue their studies and re-register for a Bachelor's degree programme at TU Delft in the following academic year is growing. This group (known as 'switchers') increased slightly to 392. Of the 370 students who switched degree programmes in September 2015, 42% received a positive BSA for their new programme.

### Bachelor's Review

In 2013-2014, totally updated programmes were introduced for all Bachelor's degrees. In the summer of 2016, these programmes completed their first 3-year cycle. Work then began on an evaluation of the Study Success Project and the updated Bachelor's degree programmes. The final report of the evaluation committee is expected at the beginning of 2017.



## 2.10 After graduation

### PhD candidates

TU Delft helps students and PhD candidates with their questions on choosing a degree programme or switching to a different programme, and on choosing a Master's programme or career. In the 2015/2016 academic year, more than 7,000 students and PhD candidates took part in the 125 group activities or received individual support. The activities and support are organised in collaboration with the Alumni Office, the business

community, and the Municipalities of Delft and Rotterdam.

It is important for PhD graduates to establish contacts with the business community. To facilitate this at national level, an expert session was organised with the Netherlands Centre of Expertise for Doctoral Education.

At international level, TU Delft worked with 7 universities and 2 companies to develop the Fit for Industry workshop for an international group of PhD candidates, in order to provide better preparation for a career in industry.

### Showcase for Delft talent

In 2016, for the first time, a meeting was held with 150 recruiters from key employers of our graduates, as a showcase for Delft talent. The Municipality of Delft is keen to see our graduates remain in the region, and will therefore be involved in these events over the next three years.

### Alumni

TU Delft maintains close ties with its alumni, many of whom are willing to share their knowledge, time and networks with new generations of engineers. Twenty-five alumni gatherings were organised all over the world in 2016. These meetings enable Dutch alumni to meet their fellow alumni from outside the Netherlands in the relevant city or region.

Ronald Prins of Fox-IT was named 2016 Alumnus of the Year. The Alumni Walk of Fame in the Mekelpark was also opened; this is the place where TU Delft honours its Alumni of the Year. With 24,000 members, the TU Delft alumni form an active community on LinkedIn. In addition, almost 90,000 alumni are linked with TU Delft LinkedIn University.



3

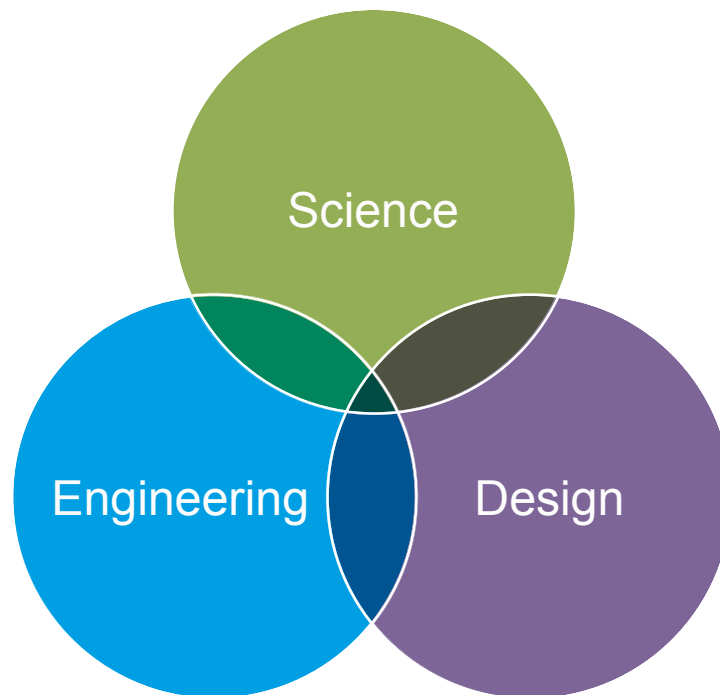
Research



### 3.1 Academic profile

Excellent scientists who are free to pursue their work form the foundation of world-class science and therefore of TU Delft's academic profile. This profile is firmly rooted within the faculties' departments and in the teaching and research remits of its professors. As such, they and other academic staff are the front-line representatives of our scientific position: the driving force behind the groundbreaking research for which we are responsible. TU Delft is therefore strongly committed to offering researchers/scientists the freedom to excel. The research conducted in the eight TU Delft faculties covers virtually the entire spectrum of engineering sciences.

The range of disciplinary specialisations is spread across 38 departments. The great strength of the research comes from the combination of those specialisations and the strategic cooperation with other research organisations in the Netherlands and abroad. World-class research also demands an excellent infrastructure. On its campus, TU Delft has a wide range of high-quality research facilities. A number of these facilities are unique in the Netherlands, including wind tunnels, a nano lab, fermentation facilities, robotics labs, the research reactor, and labs for serious gaming and product evaluation.



#### Science, Engineering & Design

Research can be approached from multiple angles. Research at TU Delft is characterised by a balance between three angles of approach: Science, Engineering and Design. Roughly speaking, these angles of approach are connected to a more deterministic approach for Science, a constructive

dimension for Engineering, and an integrating approach for Design. These three approaches do not in any way exclude one another. As the figure below indicates, research programmes may involve more than one approach. In fact, the successful integration of different approaches

within individual research projects can be regarded as one of the distinguishing characteristics of research at TU Delft.

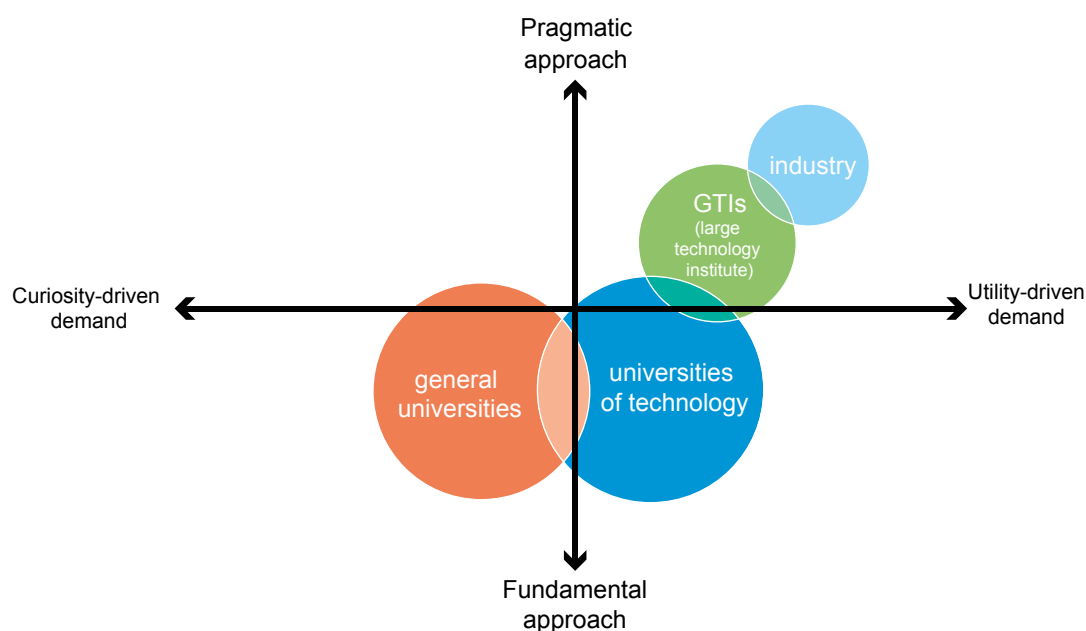
Faculties	Scientific Centres	
<b>Architecture and the Build Environment</b>	Architecture	Urbanism
	Real Estate & Housing	OTB
	Architectural Engineering + Technology	
<b>Civil Engineering and Geo Sciences</b>	Structural Engineering	Geoscience & Remote Sensing
	Transport & Planning	Hydraulic Engineering
	Geoscience & Engineering	Water management
<b>Electrical Engineering, Mathematics &amp; Computer Science</b>	Software and Computer Technology	Intelligent Systems
	Microelectronics	Applied mathematics
	Electrical Sustainable Energy	
<b>Industrial Design Engineering</b>	Design Engineering	Product Innovation Management
	Industrial Design	
<b>Aerospace Engineering</b>	Aerodynamics, Wind Energy, Flight Performance and Propulsion	Aerospace Structures & Materials
	Control and Operations	Space Engineering
<b>Technology, Policy &amp; Management</b>	Multi Actor Systems	Values, Technology and Innovation
	Engineering Systems and Services	
<b>Applied Sciences</b>	Bionanoscience	Imaging Physics
	Biotechnology	Quantum Nanoscience
	Chemical Engineering	Radiation Science & Technology
<b>Mechanical, Maritime and Materials Engineering</b>	Process and Energy (P&E)	Materials Science and Engineering
	Biomechanical Engineering	Precision and Microsystems Engineering
	Maritime and Transport Technology	Systems and Control

## Fundamental and utility-driven research

The strategic position of the research at TU Delft is determined by the source of the research question and the way in which that question is approached. In the figure below, the spectrum of possible research questions is shown on the horizontal axis, ranging from purely curiosity-driven (extreme left) to purely utility-driven (extreme right). TU Delft

is overwhelmingly involved in the domain of utility-driven questions. The vertical dimension in the figure indicates the manner in which the research question is processed, which can range from purely pragmatic (top) to very fundamental (bottom). The character of a university is determined by its fundamental approach to research questions; where else could

this approach be found? This leads to utility-driven research questions that are processed in a fundamental way for a long period of time (>8 years).



## 3.2 Research facilities

Research facilities are extremely important for a university of technology such as TU Delft, not only in order to carry out excellent research, but also to train the next generation of engineers and scientists. Moreover, state-of-the-art laboratories and equipment also make the campus – and the region – attractive to talented researchers from the Netherlands and abroad.

### National Landscape Analysis

- The NWO has appointed the Permanent Committee for Large-Scale Scientific Infrastructure in order to maximise and optimise the long-term use of investment opportunities in scientific infrastructure at national level.

On 24 June 2016, the Committee presented an analysis of existing large-scale research facilities in the Netherlands that promote a policy of open access for research with a minimum infrastructure size of 10 million euros in terms of capital investment and operating costs over five years. On 24 June 2016, the Committee presented an analysis of existing large-scale research facilities in the Netherlands that promote a policy of open access for research with a minimum infrastructure size of 10 million euros in terms of capital investment and operating costs over five years. The aim of the analysis is to map and give access to facilities. To that end, the information has been made available online at [www.onderzoeksfaciliteiten.nl](http://www.onderzoeksfaciliteiten.nl). The following TU Delft facilities are included:

- Else Kooi Laboratory (EEMCS)
- Multi-sensor observation system (EEMCS)
- Process and Energy Technology Laboratory (3mE)
- Ship Hydronic Laboratory (3mE)
- Laboratory Aircraft Citation II (AE)
- SIMONA research simulator (AE)
- Aerodynamics and Propulsion Laboratory (AE)
- Delft Aerospace Structures and Materials Laboratory (AE)
- Stevin Laboratory (CEG)
- CESAR Observatory (CEG)
- Fermentation/cultivation facilities (Applied Sciences)
- Reactor Institute Delft (Applied Sciences)
- WetFridges Low T Nanotech Research Facility (Applied Sciences)

### National Roadmap for Large-Scale Research Infrastructure

The analysis referred to above is the basis for the update of the National Roadmap for Large-Scale Research Infrastructure. The Roadmap identifies research infrastructure of national importance with an investment need in the coming five to ten years. The following TU Delft facilities have already been included:

- Dutch participation in the European Spallation Source (ESS), the world's most powerful neutron source, which is currently being built in Lund, Sweden. The Netherlands is participating through the Delft Reactor Institute (Professor Bert Wolterbeek).
- CESAR Observatory for atmosphere research (CEG in collaboration with the Royal Netherlands Meteorological Institute).
- UNLOCK, a cluster of facilities for research into microbial diversity. At TU Delft this involves a high-throughput facility for rapid selection and characterisation of new phenotypes and for rapid genetic modification of new microbial genotypes (Applied Sciences).
- EPOS-NL, a cluster of facilities for geological research. At TU Delft this involves a geothermal doublet (CEG).
- NanoLab NL, a cluster of nanofacilities, including the KAVLI Nanolab (Applied Sciences) and the Else Kooi Laboratory (EEMCS) of TU Delft.
- Solar cells, a cluster of solar-cell facilities in which TU Delft is a collaborative partner through the Electrical Sustainable Power Lab (EEMCS).

Only those facilities included in the Roadmap are eligible to be considered for future NWO funding. TU Delft will submit specific investment proposals to NWO in the spring of 2017.

### Future fund credit for research facilities

Through the Future Fund Credit scheme for Research Facilities, the Ministry of Economic Affairs is investing in the construction and utilisation of high-quality research facilities that are important for the development of innovative products and services.

In 2016, TU Delft was awarded future fund credit for the following projects: Flex200 (upgrading of facilities at the Else Kooi Laboratory), Geothermie Delft (construction of a geothermal doublet as a research facility) and NanoLab NL (upgrading of nano-lab facilities). TU Delft and the Ministry of Economic Affairs are engaged in consultations regarding the conditions of acceptance for the loans.

### Reactor Institute Delft – OYSTER

With the OYSTER (Optimized Yield – for Science, Technology & Education – of Radiation) programme, the research reactor of the Reactor Institute Delft (RID) is becoming significantly more precise and more broadly applicable. The core of the programme is the cold 'neutron source' in the reactor, which is being connected to a system that will cool the neutrons it produces to -250 °C. At this extremely low temperature, it is easier for our scientists to 'guide' the particles and so obtain better research results. Both the cold source and the new instruments and facilities make the RID better equipped for medical and energy research for society and industry.

In 2016, the final price agreements were concluded with all the parties involved. As soon as the licence is granted, construction of the non-nuclear cooling building will begin in 2017. Thereafter, construction of the cold source will follow. The RID is conducting the OYSTER project in collaboration with the South Korean consortium KHC. A number of Dutch subcontractors are also involved in parts of the project.

# QuTech

QuTech is a specialist TU Delft research unit for quantum technology. QuTech was founded as a collaboration between TU Delft and TNO (Netherlands Organisation for Applied Scientific Research) and, together with industrial partners, focuses on issues in science and engineering.



## *Microsoft intensifies cooperation with QuTech*

At the end of 2016, Microsoft announced that it is doubling its investment in quantum research. It is already an important partner of QuTech and will be extending its cooperation with the Delft quantum institute. In addition to this, Microsoft is to set up its own lab on the campus at TU Delft. In this latest move,

Microsoft is increasing its investment in the development of topological qubits, one of the five QuTech roadmaps.

## *Quantum Campus*

In order to further expand TU Delft's leading position in quantum research, the university has asked René Penning de Vries to head up the development of a Quantum Campus on behalf of TU Delft. Penning de Vries declared, "TU Delft and the Dutch government feel that the establishment of an ecosystem of this kind, where science and business work together intensively, is essential to the ambition of the Netherlands to play a leading role in the development of the quantum computer." René Penning de Vries is the former CEO of NXP and has been appointed captain of the top-sector ICT team on behalf of the Ministry of Economic Affairs.

## *Flagship on Quantum Technologies*

The European Commission has proposed making the sum of one billion euros available to establish



a Quantum Flagship, a large-scale European research programme for quantum technology. With QuTech, TU Delft wishes to take on a role in this Flagship whereby scientists from various disciplines continue the development of quantum mechanics and bring new applications to the market. The Quantum Flagship is part of the 'Technology Package', a wide-ranging package of measures to strengthen Europe's digital economy.



### 3.3 Thematic cooperation

For its research TU Delft takes inspiration from major challenges in society. The resulting research subjects are often so complex that the only way of responding to them is to adopt a thematic approach in which various disciplines cooperate in multidisciplinary and interdisciplinary alliances. Such cooperation takes place at all levels: thematic, regional, national and international. In its choice of subject matter within themes, TU Delft aligns itself with the Dutch agenda concerning science and innovation policy. The Netherlands Organisation for Scientific Research and the Top Sectors Policy are important drivers in this respect. The routes of the Dutch National Research Agenda also play a leading role in the way in which our thematic research is organised. In the European Union, TU Delft aligns itself with the themes of Horizon 2020 and with the Knowledge & Innovation Communities (KICs).





#### TU Delft Research-based Initiatives

The purpose of the TU Delft Research-based Initiatives (DRIs), established in 2009, is to contribute to resolving societal issues within four themes: Health, Energy, Global Development, and Deltas, Infrastructures & Mobility. They engage with the government and the business community, identify opportunities and actively spotlight innovative science. In addition to stimulating multidisciplinary research that is in line with Dutch and international research funding agendas, the initiatives also have a strong inspirational effect on students and education.

##### *Delft Energy Initiative*

The Delft Energy Initiative (DEI) is the portal to energy research, education, and innovation at TU Delft. This initiative serves as a catalyst for collaboration and debate between scientists and students and between TU Delft and businesses, government agencies and politicians.

## Delft Research-Based Initiatives

	Energy	Deltas, Infrastructures & Mobility	Health	Global
				
Research fields	<ul style="list-style-type: none"> <li>• Wind Energy</li> <li>• Solar Energy</li> <li>• Energy Networks</li> <li>• (Chemical) Storage</li> <li>• Energy Efficiency in Design</li> <li>• Energy Efficiency in Industry</li> <li>• Energy in the Built Environment</li> <li>• Geo-energy</li> <li>• Biomass</li> <li>• Nuclear Energy</li> </ul>	<p><b>Overall programme:</b></p> <ul style="list-style-type: none"> <li>• Vital Infrastructures for Water Safety and Smart Mobility</li> </ul> <p><b>Specific subjects:</b></p> <ul style="list-style-type: none"> <li>• Sustainable, Efficient Transport</li> <li>• Logistics &amp; Mainports</li> <li>• Safe, Sustainable Deltas and Metropolises</li> </ul> <p><b>Connective theme:</b></p> <p>Resilient, Durable Infrastructures</p>	<ul style="list-style-type: none"> <li>• Medical Imaging &amp; Image Guided Medicine</li> <li>• Interventions &amp; Care</li> <li>• Targeted Molecular Technology</li> <li>• Vitality</li> </ul>	<ul style="list-style-type: none"> <li>• Science and Technology for Global Development</li> <li>• Sustainable Solutions in Close Cooperation with Partners in Developing Countries</li> </ul> <p><b>Themes:</b> Water, Urbanism, Healthcare, Energy, Disaster Resilience</p>
Start	2009	2009	2009	2015
	8 faculties	5 faculties	6 faculties	8 faculties

Overzicht TU Delft DRI's

### *Innovative energy research*

In the past year, DEI has fostered innovative energy research into cross-faculty themes such as heat, high-density energy carriers, PowerWeb, Ocean Energy and Social Innovation. In addition, work was carried out in the spring of 2016 on the realisation of Route 17 of the Dutch National Research Agenda: Energy Transition. This route sets out ten important and urgent challenges that need to be addressed in a long-term programme.

### *Advice and master classes*

In December, the Dutch Advisory Council for Science, Technology and Innovation (AWTI) presented its advisory report on energy innovation to Henk Kamp, Minister for Economic Affairs. The report calls for substantial investments in the field of energy innovation. In June, civil servants from the Ministry of Economic Affairs came to Delft for the annual Energy master class, focusing on the latest developments in various research themes at Delft. In the autumn, the civil servants returned to take a joint in-depth look at the feasibility of the sustainability objectives.

### *Guest lectures, MOOCs and student activities*

In 2016, DEI organised a series of guest lectures by worldwide pioneers in the transition to a sustainable energy system. The speakers included Henk Kamp (Minister for Economic Affairs), Nicholas Ashford (MIT) and Steven Chu, Nobel laureate and former U.S. Secretary for Energy. September saw the launch of a Massive Open Online Course focusing on the design of a 100% sustainable energy system. The range of courses is being extended, and work is also in progress on an Extension School for Energy.

### *Delft Deltas, Infrastructures & Mobility Initiative*

In 2016 too, the focus of the Delft Deltas, Infrastructures & Mobility Initiative (DIMI) was on

an integral approach to specific societal issues with the involvement of scientists and students from various faculties and disciplines. In 2016, a Delta Coordinator was appointed to map the Urban Deltas network within TU Delft. This has resulted in a proposal for a research agenda and strategy.

### *DIMI Special Projects and co-funding*

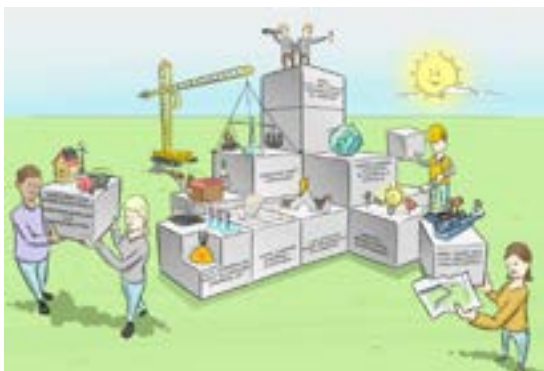
DIMI Special Projects are an instrument for fostering interfaculty collaboration and collaboration with other knowledge institutions, public-sector bodies and the business community. Six new Special Projects were approved in 2016: Innovation Airport, Subsurface Infrastructures, The New Delta (Phase 2) WeSense, Glass Masonry Bridge and Highway & City. In addition to the Special Projects, DIMI co-funds smaller projects ranging from book publications and research abroad to multidisciplinary student projects.

### *Conference and Minor*

In January 2016, to conclude the 'DIMI on Tour' series of debates, the 'Deltas & Ports of the Future' conference was held, with an attendance of more than 300. Several prominent figures spoke at the conference, and the supporting programme included an exhibition about the Zuiderzee Works. September saw the launch of the second edition of the minor in Integrated Infrastructure Design (IID), developed with support from DIMI. For their final design projects, students work with experts from the Municipality of Rotterdam.

### *Collaboration with the Ministry and professionals*

In the context of the partnership between TU Delft and the Ministry of Infrastructure and the Environment, annual Master Classes and a Summer School are held for ministry staff. In September, top civil servants from the Ministry paid a working visit to TU Delft to discuss visions and plans for the future. The DIMI Special Project 'Highway & City' was launched in February with an information meeting at the Ministry of Infrastructure and the Environment for professionals working in the field of space and mobility. On the basis of this project, seven selected multidisciplinary teams of professionals have carried out design research for case studies relating to the Amsterdam, Rotterdam and Utrecht ring roads. TU Delft students carried out complementary research. The results of this research have been presented to a wide audience and to policy officers at municipalities and Rijkswaterstaat. The results will be published in book form in February 2017.



### *Delft Health Initiative*

The Delft Health Initiative (DHI) brings together scientific knowledge of medical technology, the knowledge of medical professionals, and the medical and care needs of society. The DHI focuses on the themes of 'Medical Imaging', 'Cure and Care', 'Targeted Molecular Therapy' and 'Vitality'. The research teams involved in the multidisciplinary projects work closely with University Medical Centres, other universities, local and regional authorities and businesses.

#### *Bridge-builders and trial projects*

In 2016, seven Medical Delta Professors were appointed. Besides their main appointment in Leiden, Delft or Rotterdam, each professor will also be appointed in one of the two other cities. These appointments will create a bridge between the fields of medicine (Leiden, Rotterdam), pharmaceutical research (Leiden) and technology (Delft).

DHI fosters scientific research in the field of health. To that end, a call for pilot projects was issued this year for researchers who wish to take a first step with new research, or are looking for a proof of principle. Funding has been awarded for nine research projects.

#### *Innovative research in collaboration with social partners*

In the autumn of 2016, the Reinier de Graaf hospital and TU Delft signed a cooperation agreement. The university and hospital are working together in a 'living lab', whereby care professionals at the hospital are involved in innovation processes at an early stage. The collaboration enables TU Delft to measure the effect of innovations in medical technology in a hospital setting. As a non-teaching hospital, Reinier de Graaf is of interest to TU Delft because it provides certain treatments on a frequent basis, and these high volumes generate valuable research results.

#### *Holland PTC*

Significant progress was made this year with the construction of the Holland PTC proton therapy centre in Delft, an initiative of Erasmus MC, LUMC and TU Delft. In mid-2016, manufacturer Varian installed the cyclotron, which is the technical heart of the centre and will produce the proton bundles that will be used to treat cancer patients from the end of 2017 onwards. Philips and Siemens will supply the imaging equipment. The healthcare

insurers DSW and Zilveren Kruis signed a three-year contract with HollandPTC for the gradual introduction of proton therapy in the Netherlands. A new business director (Rob Florijn) and senior medical director (Marco van Vulpen) were appointed in 2016.

#### *Clinical technology training*

The Bachelor's degree programme in Clinical Technology was introduced almost three years ago, and is now a successful and unique collaborative degree programme of TU Delft, Erasmus MC and the LUMC, focusing on the interface between medicine and technology. In 2016, the three institutions worked on preparations for a Master's degree programme in Technical Medicine. TU Delft intends to introduce this new Master's programme on 1 September 2017. Consultation with the medical field takes place in order to further the profession of Clinical Technologist in the sector.

### *Delft Global Initiative*

The TU Delft Global Initiative is a platform for the application of science and technology in global development. With the help of Delft Global, scientists, students and entrepreneurs use their expertise to find concrete solutions to urgent problems faced by people in developing countries. They work closely with local partners in order to develop sustainable solutions that have a significant local impact. Delft Global concentrates on the fields of water, health, energy and urbanisation, with a focus on Africa and Southeast Asia. The priorities include global challenges, innovation, cooperation with local parties and developing concrete, workable solutions.

### *Fellows focus on concrete problems*

In 2016, Delft Global awarded 13 new fellowships (PhD funding) to scientists whose projects will make a concrete contribution to solving problems in the field of global development. These projects cover a wide range of issues: improving the diagnosis of tuberculosis and malaria in Nigeria, generating cheap electricity from biogas in rural Uganda, research into more efficient water management for the Zambezi in Mozambique, and developing attractive and affordable housing areas in rapidly expanding African cities (e.g. in Kenya, Tanzania and Ghana).

### *Lectures, training courses and building a global network*

In 2016, Delft Global held monthly Delft Global Lunches and Global Talks for staff involved in research and education relating to global development. In addition, training courses in capacity building and enterprise were held in countries including Tanzania, Ghana, Rwanda and Vietnam. This year, two liaisons for Sub-Saharan Africa were appointed by way of investment in the Delft Global network.

In the Netherlands, contacts with various ministries (Foreign Affairs, Economic Affairs, and Education, Culture & Science) were strengthened. In that context, Orange Corners were set up in Africa via the Ministry of Foreign Affairs, and a research programme focussing on Sustainable Development Goals (SDGs) was set up with NWO-WOTRO. Collaboration with the business community resulted in an investment by IBM in more than 300 weather stations throughout Africa. Delft Global is also involved in recruiting top students from Africa through Excellence Scholarships.





## TU Delft Institutes

TU Delft is clustering its internal research capacity in a number of university-wide institutes: the TU Delft institutes. These institutes are virtual partnerships of researchers focusing on specific research fields – many of them relatively new – and are the result of the wish of the researchers involved to adopt a structurally cross-disciplinary approach to the research themes. This clustering has proved to be successful: connections to consortia and participation in national and European programmes and projects in the various fields have been considerable extended.

There is a significant enthusiasm for this form of collaboration. In 2016, the foundations were laid for two new institutes: Computational Science and Engineering, and Bio-engineering. This means that TU Delft will begin 2017 with a total of ten institutes.

TU Delft Institutes			
Name	Focus	Start	Faculties
Bio-engineering	<ul style="list-style-type: none"> <li>The cell at work</li> <li>The interacting cell</li> <li>The cell for production</li> </ul>	2016	AS, CEG, EEMCS, 3mE
Climate	<ul style="list-style-type: none"> <li>Extreme weather and the city</li> <li>Aerosols, radiation and clouds</li> <li>Observation &amp; validation of sea level rise and mass transport</li> <li>Climate information and policy</li> </ul>	2012	CEG, EEMCS, TPM, AE, AS, 3mE, Arch
Computational Science & Engineering	<ul style="list-style-type: none"> <li>Dynamics</li> <li>Structures</li> <li>Solids</li> <li>Socioeconomics &amp; Life</li> </ul>	2016	EEMCS, CEG, AS, 3mE, AE, TPM
Process Technology	<ul style="list-style-type: none"> <li>Biochemical process engineering</li> <li>Process intensification</li> <li>Process technology for advanced materials</li> </ul>	2012	AS, 3mE
Robotics	<ul style="list-style-type: none"> <li>Swarm robotics</li> <li>Robots that work</li> <li>Interactive robots</li> </ul>	2012	TPM, AE, IDE, EEMCS, 3mE, Arch
Safety & Security	<ul style="list-style-type: none"> <li>Safety &amp; security at home</li> <li>Safety &amp; security in motion</li> <li>Safety &amp; security in society</li> </ul>	2013	EEMCS, CEG, AS, Arch, TPM, 3mE, AE
Space	<ul style="list-style-type: none"> <li>Sensing from space</li> <li>Space robotics</li> <li>Distributed space systems</li> </ul>	2015	AE, AS, EEMCS, CEG, 3mE
Sports Engineering	<ul style="list-style-type: none"> <li>Aero- and hydrodynamics</li> <li>Biomechanics, materials and human / material interaction</li> <li>Measurement, feedback and simulation</li> <li>Motivation</li> <li>Sports infrastructures and facilities</li> </ul>	2014	3mE, IDE, AE, EEMCS, Arch
Transport	<ul style="list-style-type: none"> <li>Coordinated and cooperative traffic management</li> <li>Transport policy</li> <li>Spatial planning &amp; mobility</li> <li>Logistics &amp; freight transport</li> <li>Railways</li> </ul>	2012	CEG, EEMCS, TPM, 3mE, Arch, IDE, AE
Wind Energy	<ul style="list-style-type: none"> <li>Unsteady aerodynamics</li> <li>Smart structure rotors</li> <li>Design methods</li> <li>Offshore components and design</li> <li>Dutch wind energy in Europe</li> </ul>	2012	AE, CEG, EEMCS, 3mE, TPM, AS



### *TU Delft Bio-Engineering Institute*

On 29 June 2016, the Executive Board formally approved the establishment of the Bio-Engineering Institute. Professor Isabel Arends was appointed as its director. The institute will set up major research programmes and consolidate the collaboration between TU Delft researchers who are developing technology based on building blocks from nature: DNA, cells, micro-organisms and biomass.

#### *Bundling existing research*

In recent decades, TU Delft has built a strong reputation in biotechnology. Research at TU Delft within large-scale public-private collaborative programmes (e.g. B(E)-Basic and the Kluyver Centre for Genomics) has led to the large-scale microbial production of ethanol, antibiotics and foodstuffs. Delft has established a worldwide reputation in the field of microbial water purification, using Nereda technology. The Delft Bio-Engineering Institute has been set up to continue the development of this wide-ranging knowledge on those topics at TU Delft.

#### *Objective*

The main objective of the institute is to bring together researchers and industrial partners in a number of fields, such as the production and implementation of biochemicals, the realisation of innovations for the health and pharmaceutical industry, and contributing to a circular economy through ecological technology and microbe-based environmental technology.

### *TU Delft Climate Institute*

The TU Delft Climate Institute brings together the research capacities of TU Delft in interfaculty climate research. The objective of the institute is to become an authority in the Netherlands in the field of data-based climate policy, in order to separate truth from myth in the debate on climate change. The Climate Institute focuses on the observation of climate-relevant geophysical parameters, on the modelling and simulation of climate-relevant geophysical processes, and on adaptation and mitigation models and methods for a knowledge-based climate policy. Following the five-yearly review, it was decided to continue the institute, given the fact that the relevance of climate issues for society has not diminished.

### *Development of infrastructure for climate research*

In 2016, through the CESAR and ACTRIS programmes and the Ruisdael Observatory, the institute made an important contribution to the development of the national and international infrastructure for climate research. CESAR (Cabauw Experimental Site for Atmospheric Research) is included in the NWO Roadmap for Large-Scale Research Infrastructure. It is a focal point of experimental atmosphere research in the Netherlands, giving researchers a unique picture of the interaction between the atmosphere and the Earth's surface. TU Delft also plays a prominent role in the European collaborative programme ACTRIS for measuring greenhouse gases, aerosols, clouds and radiation, for use in climate studies. ACTRIS is included in the ESFRI Roadmap. The planned Ruisdael Observatory is one of the 'dream projects' on the KNAW Agenda for Large-Scale Research Facilities

#### *Four broad research programmes*

As of 2016, the TU Delft Climate Institute is concentrating on four broad themes in climate research: Urban Climate, Ice and Sea-level Change, the Water Cycle, and Radiation Balance. In the years to come, the Radiation Balance programme will be extended into a broader programme: Engineering the Radiation Balance. In this context, Applied Sciences and 3ME will address key scientific challenges with regard to CO<sub>2</sub> conversion and the capture of CO<sub>2</sub> from the atmosphere

### *TU Delft Computational Science and Engineering Institute*

In July 2016, the Executive Board gave its approval for the establishment of the TU Delft Institute for Computational Science and Engineering (DCSE). Professor Kees Vuik was appointed as its Director. Computational Science & Engineering, a rapidly developing field, deals with computational models and simulation. Its areas of application cover the whole spectrum of TU Delft disciplines, ranging from calculating the aerodynamics for a new aircraft design to modelling the human immune system.

#### *Building on existing partnerships*

The field of Computational Science and Engineering is not new to TU Delft. The university has had a centre for this research since 2003. Now that the subject area is developing strongly, the decision was taken to scale up the research by the

establishment of a new institute. DCSE's aim is to develop into a multidisciplinary authority in its field. Thirty research groups within a total of six faculties are working with the business community, the public sector and other knowledge institutions in order to realise this aim.

#### *Initial activities*

The institute focuses on research, education, strategic partnerships and strategic communication. Work is in progress to consolidate an approach that integrates technology and multidisciplinary research. In addition, the institute will support young scientists in developing their research. With regard to education, the institute is developing courses in Scientific Programming and a multidisciplinary Minor programme. A Master's degree programme will follow in the longer term. The institute is also committed to the process of transition from scientific research to manufacturing.

#### *TU Delft Process Technology Institute*

The TU Delft Process Technology Institute (DPTI) focuses its efforts on making the chemical and biochemical industries, the energy industry and materials industry more sustainable.

#### *Large-scale lecture events*

In 2016 the Process Technology Institute held the Van 't Hoff Lecture. It was given by Ronald R. Chance, a prominent professor in the field of energy, who spoke about algae-based biofuel. Together with DRI Energy, the institute also organised a visit by Nobel laureate Professor Steven Chu.

#### *New research projects*

Research at DPTI has resulted in a funding award from the Dutch Technology Foundation STW (now TTW) for Professor Fokko Mulder's project 'The Battolyser'. This project involves the development of new techniques for large-scale energy storage and hydrogen production. This year, the Process & Energy department of the Faculty of 3mE entered into a unique collaboration agreement with Petrogas Gas Systems BV. An important element of this research is the modelling, design and testing of a new type of system for biomass gasification. Together with Petrogas Gas Systems B.V., the project team will explore whether this technology can be brought to market.

A start-up – Slimy Green Stuff BV – has emerged from the institute's research. The purpose of the company is to produce biopolymers from waste and develop broader applications for them.

#### *TU Delft Robotics Institute*

The TU Delft Robotics Institute brings together all the robotics research carried out at TU Delft. The main challenge for the Robotics Institute is to get robots and humans to work together effectively in unstructured environments. TU Delft has a unique combination of specialisations: the 'hard' robotics disciplines such as mechatronics, embedded systems, control and artificial intelligence, as well as the 'soft' robotics disciplines such as human-machine interaction, user interaction, architecture, ethics, safety/security and design. By bringing together the capacities of these disciplines and adopting a common approach to education, research and valorisation, the Robotics Institute is playing a pioneering role in the development of next-generation robots.

#### *Delft as a visible centre for robotics*

In 2016, the theme of the Dies Natalis at TU Delft was robotics, and included a seminar on communication and control principles in robots. Dies Natalis also saw the launch of the TU Delft Robotics Institute's 'Year of Robotics' in which workshops, lectures, conferences and RoboCafés were held. The institute also makes Delft robotics visible to a broad public through newspapers, radio and television, and organised 'Robot Camp', a summer camp where secondary-school students learned how to build robots.

#### *Prizewinners*

Delft robots regularly win prizes. Together with the Delft start-up Delft Robotics, TU Delft won the Amazon Picking Challenge with a robot that autonomously picked and stowed a wide range of objects. Staff and students from TU Delft also secured second place in the first-ever race for autonomous drones, which was held in South Korea. The year 2016 also saw the development of the DelftaCopter, a robot for providing medical assistance in remote, inaccessible locations.

#### *RoboValley*

More than 170 researchers in various disciplines work together in RoboValley, and collaborate with experts, entrepreneurs and public-sector organisations. The TU Delft Robotics Institute is the nerve centre of this network. RoboValley also helps to attract capital: in May 2016, in collaboration with Chrysalix Venture Capital, RoboValley set up a 100-million-euro investment fund for promising start-ups. In 2016 too, hard work was put into organising the first edition of

International Robotics Week, which will take place in the spring of 2017 in Delft and the Rotterdam/The Hague Metropolitan Area.

### *TU Delft Safety and Security Institute*

The Delft Safety and Security Institute (DSyS) develops technologies and models for safety and security in the private sphere, the public sphere and the movement between these two spheres. The institute is a knowledge and capacity-building partner, and functions as a platform for collaboration between the faculties, the business community and the public sector.

#### *TU Delft as a living 'safety and security' lab*

In 2016, the Safety and Security Institute identified several knowledge questions in six domains that require further research. Safety and security issues are best researched in a realistic test environment. The institute is therefore exploring the possibility of using the TU Delft campus as a Living Lab. In order to initiate this type of study, a Living Lab for evacuation exercises was set up in 2016. It is not only the faculties that make an important contribution to this project group, but also the support services Health, Safety and Environment, the in-house emergency response team, and Facility Management & Real Estate.

#### *Flood-risk index*

In 2016, in collaboration with DIMI, the Safety and Security Institute compiled a Smart Delta City Index of the cities in the world that are most susceptible to flooding. Flood risks and related consequences were quantified using information from ten open databases, taking account of many different scenarios for climate and economic growth. The ambition is to publish the index every year, possibly in collaboration with the World Bank, the United Nations or the Rockefeller Foundation.

#### *Contribution to new research projects*

In 2016, DSyS contributed to several EU research proposals, of which three Horizon 2020 proposals were approved: BRIGAID (Bridging the Gap for Innovations in Disaster resilience), NARSIS (New Approach to Reactor Safety ImprovementS) and SAFE10T (Safety of trAnsport inFrastructurE on the TEN-T network).

### *TU Delft Space Institute*

The TU Delft Space Institute (DSI) was established in order to foster collaboration and knowledge

exchange within the (Dutch) aerospace industry. The institute wishes to contribute to this industry with groundbreaking research. New techniques are usually demonstrated on space missions.

#### *Collaboration with ESA, MIT, TNO, Airbus and other universities*

In 2016, in collaboration with the European Space Agency (ESA) and the Massachusetts Institute of Technology (MIT), the Space Institute completed a five-year research programme with a successful experiment aboard the International Space Station (ISS), in which a one-eyed robot learned to judge distances. In another research project, researchers from Delft, Utrecht and Groningen worked together to develop sensors for a telescope that scans the Milky Way for traces of oxygen. The telescope was fixed to a giant NASA balloon and was launched at the end of 2016. Space Institute staff and TU Delft students also worked with TNO Space, ESA and Airbus Defence Systems Netherlands on the development of a space telescope. The institute was awarded funding under the Top Consortia for Knowledge and Innovation (TKI) scheme, thus enabling the further consolidation of the research.

#### *Symposium and various lectures*

In 2016, the institute held the 'Space for Society' symposium, which focused on the close link between space and society and how the institute can facilitate this. Staff of the institute also assisted the European Space Agency (ESA) in preparing for one of the European Conferences of Ministers.

### *TU Delft Sports Engineering Institute*

The TU Delft Sports Engineering Institute brings together education and research in the field of sport. The work of the institute focuses on areas including strengthening TU sports research and education, improving the performance of top athletes and preventing sports-related health problems.

#### *New international partnerships*

In 2016 the institute took part in NWO missions to Brazil and Japan, the aim of which was to establish contacts with researchers and businesses. This resulted in a collaboration agreement between the Sports Engineering Institute and Japanese universities.

In 2016, the Sports Engineering Institute held the scientific conference of the International Sports Engineering Association in Delft.

#### *Time trial with TU Delft skinsuit*

The institute attracted media attention with a skinsuit for cyclist Tom Dumoulin. An innovative method was used in its development: a number of suits were tested using a 3D print of Dumoulin's body, and the suit with the least drag was then optimised. Tom Dumoulin was wearing the suit when he won a 37.5-kilometre time trial in the Tour de France on 15 July.

#### *TU Delft Transport Institute*

The TU Delft Transport Institute combines expertise and research from several research disciplines in order to develop solutions that result in safer, cleaner and more efficient transport and improved accessibility. Researchers of the Transport Institute publish successfully on these subjects.

#### *Regional and national partnerships*

In 2016, the Transport Institute set up the Research lab Automated Driving Delft in collaboration with partners including the Municipality of Delft and the Rotterdam/The Hague Metropolitan Area. The lab is an education and research facility that focuses on automated vehicles. The institute continued its collaboration with other regional and national partners such as the Port of Rotterdam Authority, Rijkswaterstaat and the Netherlands Vehicle Authority (RDW).

#### *Prizes and research grants*

The European Research Council awarded Professor Caspar Chorus a Consolidator Grant for research into modelling moral choice behaviour in transport. Transport research received a further significant stimulus through the approval of proposals by, among others, NWO, STW and the Top Sector 'High Tech Systems & Materials'.

#### *Continuation of the institute*

In 2016, the Executive Board and the relevant deans decided to continue the institute's mission in the coming five years. Aims for the coming period include further expansion of the collaboration and knowledge exchange between lecturers and researchers, and a recognisable positioning for external organisations as a valuable partner in scientific research relating to transport.

#### *TU Delft Wind Energy Institute*

The TU Delft Wind Energy Institute (DUWIND) is the wind energy network of TU Delft, undertaking research into wind turbine technology across five faculties and thirteen research groups, and thereby embodying the multidisciplinary nature of research and education in the field of wind energy.

#### *Breakthrough in wind energy*

In 2016 there was a boom in offshore wind energy. The first two offshore wind farms under the Energy Agreement will generate kilowatt-hours at low prices. Currently, prices are only 20 to 30% above the prices for fossil-fuel energy. This cost reduction exceeds the expectations of the consortium set up in 2016 and the R&D programme FLOW, in which DUWIND has collaborated with Dutch industry and research partners. Sixteen PhD candidates at TU Delft conducted their research within FLOW.

#### *New consortium: GROW*

The parties participating in FLOW will continue their work, but within a larger organisation under the new name GROW, with new partners including Shell. As part of the consortium, DUWIND can expect to appoint at least as many PhD candidates as it did within FLOW. The aim of GROW is to facilitate the production of offshore wind energy without subsidies.

#### *Input in overarching research agenda*

In 2016, DUWIND made a major contribution to the drafting of the publication 'Long Term Research Challenges in Wind Energy – a Research Agenda by the European Academy of Wind Energy', which has played a role in the realisation of the Dutch National Research Agenda, and is the formal basis for drawing up new R&D programmes, including NWO and European Commission programmes.

#### *Director of research bids farewell*

The director of research, Professor Gijs van Kuik, retired at the end of 2016. After a career in wind energy spanning forty years, he gave his valedictory address at TU Delft on Wednesday, 7 December.

## Research schools

A research school combines research with the education of researchers in a given scientific area. The schools also contribute to the national coordination of research programmes within specific disciplines. The coordinating university of a research school is responsible for strengthening the profile of TU Delft. TU Delft was

	Arch	CEG	EEMCS	IDE	AE	TPM	AS	3mE
<b>Advanced School for Computing &amp; Imaging (ASCI)</b>			Coordinating university				X	
<b>Centre for Technical Geoscience (CTG)</b>		Coordinating university						
<b>Dutch Institute of Systems and Control (DISC)</b>			X					Coordinating university
<b>J.M. Burgerscentrum – Research School for Fluid Dynamics (JMBC)</b>		X	X	X		X		Coordinating university
<b>Transport Infrastructure and Logistis (TRAIL)</b>		Coordinating university	X	X	X		X	X

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

- Casimir Research School
- Research School for 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)
- Netherlands Research School in Process Technology (OSPT)
- Netherlands Research School for Information and Knowledge Systems (SIKS)
- Thomas Stieltjes Institute for Mathematics (SIMATH)
- Netherlands Graduate School for Science, Technology and Modern Culture (WTMC)

## 3.4 Regional, sectoral and international cooperation

### Leiden – Delft – Erasmus Strategic Alliance (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. The joint research activities are concentrated in the LDE Centres: multidisciplinary and inter-university thematic centres in which the various disciplines of the three universities are brought together:

- Centre for BOLD Cities
- Centre for Education and Learning
- Centre for Frugal Innovation in Africa
- Centre for Global Heritage and Development
- Centre for Metropolis and Mainport
- Centre for Safety and Security
- Centre for Sustainability
- European Research Centre for Economic and Financial Governance

More detailed information about LDE can be found in section 5.9 of this annual report.



## 4TU.Federation

Under the name 4TU, the four universities of technology in the Netherlands are jointly committed to strengthening and pooling technological knowledge. 4TU has pooled its research activities in 4TU Research Centres:

- High Tech Systems (HTS);
- Netherlands Institute of Research on ICT (NIRICT);
- Fluid and Solid Mechanics (FSM);
- Applied Mathematics Institute (AMI);
- Ethics & Technology (Ethics);
- Built Environment (BE);
- Design United (DU);
- High Tech Materials (HTM);
- Human-Technology Interaction (HTI)

More detailed information about the 4TU Federation can be found in section 5.9 of this report.

## International cooperation

### Joint Research Centres

Science and university education are part of an extensive international and increasingly competitive network in which cooperation with international higher education, research institutes, government bodies and the business community are becoming more and more important.

Delft academics have a long tradition of working with partners outside the Netherlands in the fields of research and education. The basic principles of this collaboration are the combination of specific expertise, opportunities for attracting talented researchers from outside the Netherlands, obtaining funding abroad, and access to research facilities that are not available in the Netherlands and Europe.

Recently, TU Delft continued the development of its international collaboration by establishing TU Delft Joint Research Centres (JRCs) in China, Brazil and Vietnam. The centres are located abroad, making it possible to establish an extensive network with local knowledge institutions, local government, funders and the business community. The research focuses on the themes of Solid State Lighting, Geospatial Information, Urban Systems and Environment, Rivers & Estuaries, Water and Environment and Biobased Economy. The specific activities vary from centre to centre. The JRCs offer TU Delft students the opportunity to carry out research projects in a foreign context and thus expand the horizons of Dutch students as they prepare for professional careers in a globalising world.

TU Delft carried out an evaluation of the Joint Research Centres in 2016. The results of the evaluation have been translated into policy geared to retaining current successful initiatives, embedding new promising opportunities in the international strategy and country policy of TU Delft, and improving access to talented scholars and partners in China.

### 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 today's modern universities. TU Delft is a founding 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 25 European countries. Rector Magnificus Karel Luyben is the president of CESAER for the period 2014-2017. In addition, TU Delft has a strategic partnership with ETH Zürich, the RWTH Aachen University, Chalmers University of Technology (Gothenburg) and Politecnico di Milano through the IDEA League, and is also a member of the European Universities Association. 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.

## 3.5 Quality and productivity

### Research scope

TU Delft uses external funding, research efforts of academic staff and PhD student numbers as indicators of the scope of the research.

### Funding

The total joint scope of the funding sources increased from 591.1 million euros in 2015 to 644.4 million euros in 2016. Government funding increased by 12% to 459.6 million euros. Indirect funding increased by less than 1% to 45.5 million euros. Contract funding increased by 4% to 139.2 million euros. Relatively speaking, the scope of government funding decreased in 2016 compared to 2015. In 2015, government funding accounted for 70% of the total scope of the three sources of funding, but in 2016 this was 71%.

### Research effort

The research effort for TU Delft is determined on the basis of effort percentages per function category. As is customary, the research data for a particular year do not become known until later in the following year. Therefore, the annual data for 2015 are included in the 2016 reporting year. The total research efforts of academic staff increased in 2015 (from 1,580 FTE in 2014 to 1,600 FTE in 2015). At 0.66, the proportion of indirect funding compared to government funding in 2015 was an increase on the figure for 2014 (0.61). This is a continuation of the upward trend of the past five years. In 2015, the proportion of commercial funding compared to government funding decreased to 1.63 from 1.73 in the previous year. The Rathenau Institute refers to the latter two indicators as the 'social and scientific ability to acquire funds'.

### Research productivity

The numbers of publications as shown in the figure are in accordance with the VSNU definitions drawn up in 2010, and are in line with the Standard Evaluation Protocol. The figures were generated by the new information system, Pure, which was introduced at TU Delft in 2016 to replace Metis. The data are still being entered in the new system and, moreover, this data-entry is retrospective. This means, among other things, that figures for the categories 'Other' and 'Popular publications' are not yet available at the time of writing. On the basis of the current figures, it also appears that the number of scientific publications – refereed and non-refereed journals, books, book volumes, etc. – decreased somewhat in 2016 compared to previous years. However, the expectation is that the number of scientific publications will increase to the level of 2014–2015 once all the data have been entered.

There is a different reason for the fall in the number of specialist publications, and was expected: TU Delft has focused less strongly on these publications recently

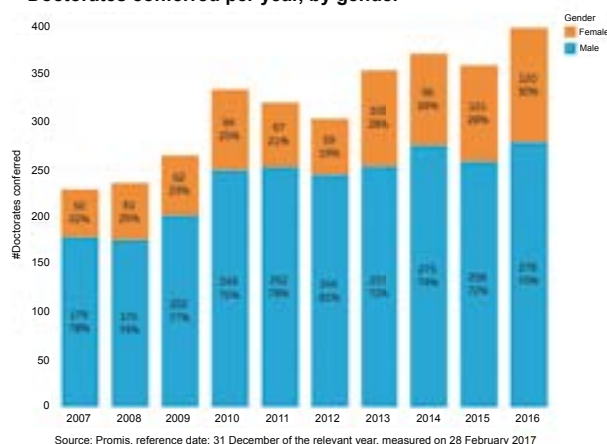
Number of publications, by category



### Number of doctorates

After a slight decrease in 2015, the number of doctorates conferred increased again in 2016, from 359 in 2015 to 398 in 2016. The proportion of foreign PhD graduates in 2016 also increased again (to 69%). In 2015, this figure had fallen to 65%, from 76% in 2014. The proportion of women increased again in 2016, this time by 2% (to 30%).

Doctorates conferred per year, by gender

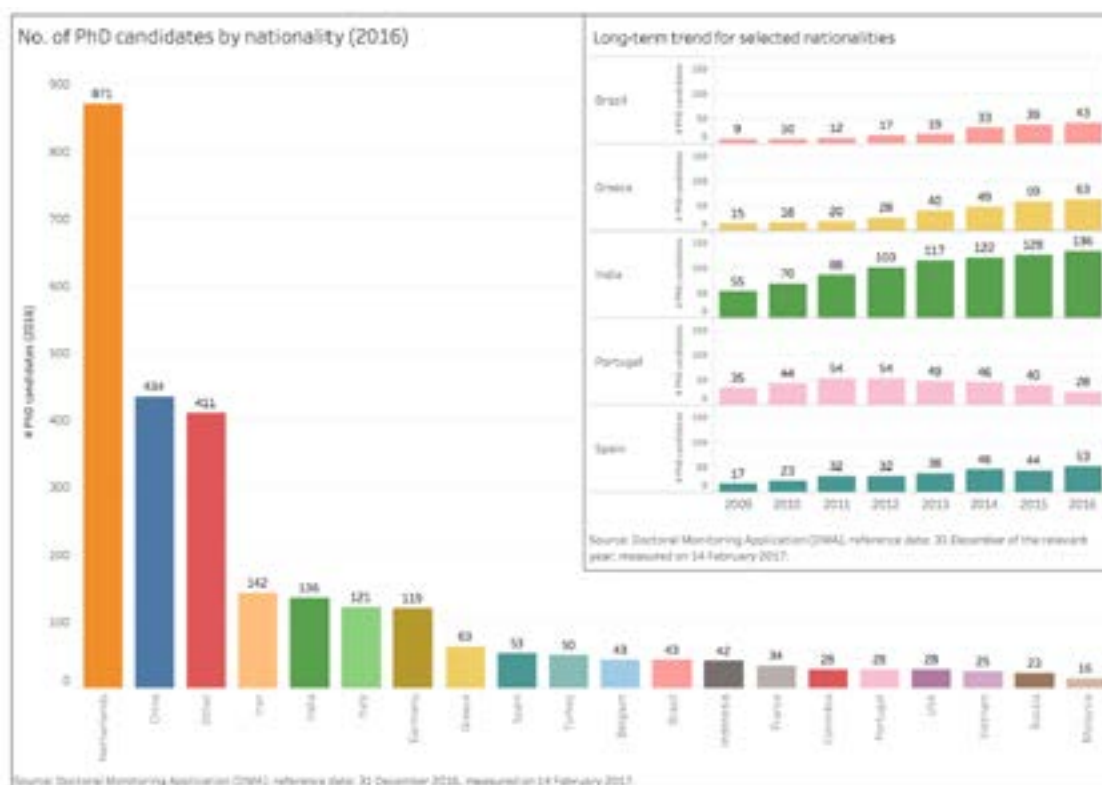


### Number of PhD candidates

In 2016, the number of PhD candidates increased to 2,710 (2,607 in 2015). This includes 1,408 standard PhD candidates. The remainder of the group consists of contract PhD students and external PhD students. The proportion of PhD candidates of foreign nationality continues to grow, and increased to 68% in 2016. The top five countries of origin of foreign PhD candidates was the same as in 2015: China, Iran, India, Italy, Germany. Relatively speaking, the number of PhD candidates from Greece, Spain and Brazil has increased substantially in the past eight years. The number of PhD candidates from Portugal has shown an increase in recent years, but is now showing a consistent decrease.

### PhD completion rate

TU Delft has adjusted the internal definition of the PhD completion rate indicator to be in line with the definition of the VSNU, for the purpose of optimal compatibility. All Dutch universities have agreed on this definition. The total completion rate of the new employee-PhD candidates (standard PhD candidates) remained unchanged at 76.9% (2006–2009 cohort intake totalised). The percentage of these new PhD candidates that obtains a doctorate within five years remained virtually unchanged at approximately 45% (2006–2009 cohort intake totalised).



## Research impact

### Quality assurance and organisation

All research programmes at TU Delft are assessed once every six years, in order to assess the quality of the research and identify possible areas for improvement. The assessment is carried out by an international independent committee of fellow academics in accordance with the Standard Evaluation Protocol 2015-2021 established by the KNAW, NWO and VSNU. The research is assessed on the basis of three criteria: a) research quality, b) relevance to society and c) viability. In addition, the committee reflects on other aspects including academic integrity, PhD education, and diversity. At TU Delft these assessments are conducted in a benchmark with comparable research of another Dutch or foreign university as much as possible. In accordance with the standards of the Standard Evaluation Protocol 2015-2021, TU Delft aims to achieve a score of 1 or 2, 'world leading/excellent' – 'very good'. The committee bases its findings on an internal evaluation written by the departments concerned and a subsequent visit by the committee. The committee's findings are published in a public report, which is available on the TU Delft website: [www.tudelft.nl/kwaliteitvanonderzoek](http://www.tudelft.nl/kwaliteitvanonderzoek). A position document, in which the Executive Board responds to the committee's findings, is also published on the website. The committee's findings are then

discussed by the Operational Committee and used to refine the faculty strategy and long-term planning.

### Research evaluations conducted

In 2016, research inspections were conducted for two disciplines at TU Delft: Architecture and the Built Environment, and Applied Physics. Both were stand-alone inspections involving only TU Delft research units. The site visits took place in the autumn of 2016, and the reports will be published in 2017.

The self-assessment report of the Technology, Policy and Management discipline was carried out in 2016. The site visit will take place in the spring of 2017, and the committee's report will be published later that year.

### Published reports

In 2016, reports on research assessments were published for four disciplines: Biotechnology, Geosciences, Computer Science Engineering and Applied Mathematics.

Research quality in the discipline of Biotechnology was rated as 'very good', with excellent societal relevance. The committee described the research as 'highly competitive', with many examples of collaboration with industry.

Geosciences research quality was rated as 'very good', and a number of research units were rated as 'excellent'. The committee also praised the

strong international reputation of the disciplines and was greatly impressed with the international benchmarking exercise.

The research assessments for Computer Science Engineering and Applied Mathematics took place in a national context. The committees rated the research quality as 'very good', and Applied Mathematics as 'excellent' in terms of societal relevance.

More information on these assessments can be found in the reports and position documents published on our website: [www.tudelft.nl/kwaliteitvanonderzoek](http://www.tudelft.nl/kwaliteitvanonderzoek).

#### *Plans of action*

In 2016, the plan of action was drawn up for the research assessment for the discipline of Electrical Engineering. The assessment will take place in conjunction with assessments of the discipline at other universities of technology. The site visit for this assessment is planned for the end of 2017.

#### *Rankings*

Several organisations use international rankings to provide insight into the relative quality of universities.

Based on the position in the various rankings, especially those in the field of Engineering and Technology, it can be concluded that TU Delft is among the top universities in the world.

Each of these rankings is compiled using a slightly different methodology, each with its own advantages and limitations. The rankings are primarily important to universities with regard to attracting international talent, because they are regularly consulted by students and researchers from all over the world. International students in particular seem to be interested in the relative position of TU Delft compared with other universities of technology.

#### **QS World University Ranking 2015/2016**

In 2016, TU Delft rose in the QS World University Ranking for the sixth consecutive year and currently occupies 62nd place (64th in 2015). Compared with other Dutch universities, TU Delft occupies 2nd place for the second time. TU Delft occupies a Top 20 position in five subject rankings:

- 4th place: Architecture / Built Environment
- 5th place: Engineering & Technology – Civil & Structural Engineering
- Joint 6th place: Engineering & Technology – Chemical Engineering
- 14th place: Natural Sciences – Environmental Sciences

- 16th place: Engineering & Technology – Mechanical

#### **Times Higher Education World University Ranking 2016-2017 (THE-Ranking)**

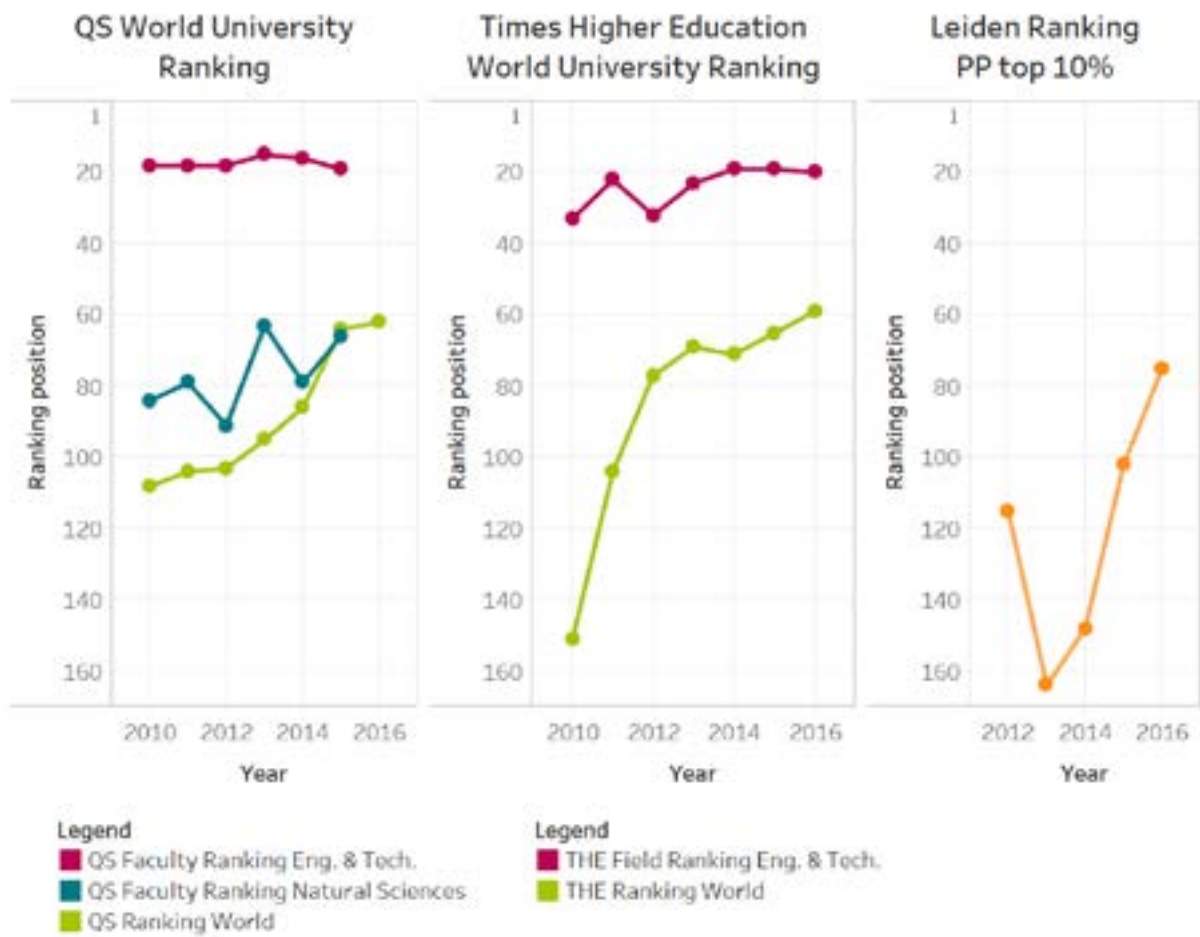
In 2016, TU Delft rose to 59th place in this world ranking by the Times Higher Education magazine. Last year, the university occupied shared 65th place. As in the previous three years, this makes TU Delft the highest-ranking university in the Netherlands. In the THE World Reputation Rankings, TU Delft occupies a position between 51st and 60th place, as it did in the previous year. In the more specialised THE Top 100 Engineering & Technology ranking, TU Delft occupies 20th place.

#### **Academic Ranking of World Universities 2016 (Shanghai-Ranking)**

In the 2016 Shanghai Ranking, TU Delft occupies a position in the 151-200 range (last year: 201-300). Universities are ranked methodologically, based on the number of Nobel Prizes and Fields Medals awarded to staff and alumni, the number of citations, and the number of articles published in the scientific journals Nature and Science. In the Field ranking for 'Engineering & Computer Science', TU Delft maintained its position in the 101-105 range.

#### **Leiden Ranking 2016**

The 2014 Leiden Ranking describes the performance of 750 (previously 500) important universities around the world. In terms of impact, TU Delft occupies 75th place, with 14.1% of TU Delft publications in the top 10% most frequently cited publications in a given field - the PP (top 10%) indicator.







4

# Valorisation

TU Delft sees it as its mission in society to create groundbreaking scientific and technological solutions that make a significant contribution to a sustainable society and a healthy economy. Valorisation is the creation of societal and economic value from academic knowledge. Valorisation is TU Delft's third core task alongside education and research. In 2014, the 2020 Valorisation Agenda was implemented. Its priorities are alliances with businesses, research funding, regional collaboration and strengthening entrepreneurship.

## 4.1 Research funding

In the years ahead, TU Delft aims to stabilise its income from indirect and contract funding at around 150 million euros a year. This concerns both European and Dutch grants as well as contract research and donations. This chapter includes several examples of research projects that were awarded funding from Dutch or European sources in 2016.

### Funding from sources in the Netherlands

For the 2016-2020 period, TU Delft aims to generate twenty percent of this income from indirect funding via NWO, and around ten percent from other Dutch government programmes. TU Delft is focusing on the Top Sectors, the Innovational Research Incentives Scheme and the Open Technology Programme of NWO STW. The Top Sector funding made available by the NWO and the Top Consortia for Knowledge and Innovation (TKI) contribution from the Ministry of Economic Affairs provide opportunities for conducting excellent scientific research in close collaboration with businesses. In addition, NWO's Take-Off funding is designed to encourage commercial activity and enterprise emerging from scientific research.

#### Top Sectors

In 2016 too, the top sectors Water, Chemicals, Energy, High Tech Systems & Materials, and Creative Industries were the sectors that aligned most closely with the research of TU Delft. The Top Sectors selected by the Dutch government are the sectors in which Dutch businesses and research centres are among the world's best. Professor Paul Hekkert (IDE), Professor Just Herder (TPM) and Rector Magnificus Karel Luyben are members of the top teams for the following Top Sectors,

respectively: Creative Industries, Energy and Water.

TU Delft projects have received Top Sector awards from NWO, STW, FOM and ZonMW Relevant awards include:

- Three STW awards of 1.8-3.4 million euros were awarded to TU Delft under the Perspectief programme.
- Prof. M. Kok (CEG) is the coordinator of the research programme that focuses on an effective approach for assessing and reducing flood risk. Within this programme, he collaborates with partners including the national Flood Protection Programme (HWBP), Rijkswaterstaat, the Foundation for Applied Water Research (STOWA) and Deltares.
- Dr P. Pawelczak (EEMCS) is working with the University of Twente, TU Eindhoven, and companies including NEDAP, NXP Semiconductors, Thales and Vodafone, on research into how to make Internet-Of-Things systems battery-free.
- Dr A. Adam (Applied Sciences) is collaborating with the University of Twente, Differ, TNO, ASML, Philips Lighting and Lumileds in the Perspectief programme for research into optical phenomena.
- Prof. E. Brück and Dr A. Dugulan (both from Applied Sciences) both received funding from the Innovation fund for Chemistry to develop chrome-free catalysts for producing hydrogen.
- Prof. J. Sietsma (3mE), Dr S. Garcia-Espallargas (AE), Prof. I. Richardson (3mE) and Dr R. Alderliesten (AE) received an award under the Top-Sector-related High Tech Materials call issued by STW.
- Prof. N. de Jong (Applied Sciences), together with the Dutch Heart Foundation, received 900,000 euros under the STW partnership programme 'Early Finding of diastolic heart Failure by EchoCardiographic Tissue Stiffness measurements' (EFFECTS).
- Dr M. Pertijs (EEMCS), working in collaboration with BronkHorst High Tech and KROHNE Altometer was awarded funding of up to 750,000 euros under the STW partnership programme 'Precision Ultrasonic Flow Meters using Matrix Transducers'.
- Dr. Z. Lukszo (TPM), Dr T. Keviczky (3mE) and Dr M. de Weerd (EEMCS) received a grant under NWO's URSES (Uncertainty Reduction in Smart Energy Systems) programme to test their solutions for future energy systems for cities and metropolises in the Amsterdam area.

This URSES grant is the result of cooperation between Amsterdam Metropolitan Solutions and Urban Energy (a TKI, Top Consortium for Knowledge and Innovation).

- Dr B.M. van Breukelen (CEG), Dr B. Hofland (CEG) and Dr J. Kwakkel (TPM) submitted applications in the Delta Technology/Water Technology category, and all were successful.
- Dr G. Elsinga, Dr W. Breugem, Prof. J. Hopman and Prof. C. van Rhee (all from 3mE) all submitted successful applications in the Maritime Technology category.

#### **TKI programme allowance**

The TKI Allowance is a financial resource relating to the Top Sectors, and is awarded on top of direct investment by businesses in public research activities. In 2016 there were successful attempts to generate additional TKI programme allowances. Through the active assessment of current European collaborative projects with industry over 2015, TU Delft succeeded in generating 4.5 million euros in TKI programme allowances in 2016. These resources relate mainly to the Top Sectors 'High Tech Systems and Materials', 'Chemicals' and 'Energy' and will be used in new research projects from 2017 onwards. In addition, in 2016 TU Delft received almost 5 million euros in TKI programme allowances (for the years 2013, 2014 and 2015) for QuTech under the covenant with the Ministry of Economic Affairs, TNO, STW, FOM and Microsoft.

#### **TU Delft Industry Partner Programme**

In 2016, the first contracts were realised in the context of the TU Delft Industry Partner Programme (TIPP). The aim of the programme is to stimulate cooperation within the Top Sectors between TU Delft and businesses. Through TIPP, TU Delft uses the TKI project allowance to fund a second PhD position if a business provides all the funding for the first PhD position. In 2016 this resulted in contracts with AstraZeneca and Vanderlande.

#### **Take-Off**

NWO's Take-Off programme provides funding that academic entrepreneurs can use to translate a scientific discovery into a product or service. Applications for Take-Off funding can be submitted for

- Phase 1 (feasibility study) – a grant of €40k
- Phase 2 (early-phase trajectory) – a risk-bearing loan of €250k for which the entrepreneur applies

In 2016, TU Delft researchers were awarded funding for 22 Take-Off feasibility studies. Eight entrepreneurs were granted early-phase trajectory funding on the basis of research conducted at TU Delft

#### **Innovational Research Incentives Scheme**

This NWO scheme is a competitive programme that offers personal grants to talented, creative researchers. It is geared to the top scientific researchers of the future. The funding enables researchers to pursue their own line of research. There are three types of grant: Veni, Vidi and Vici. In 2016, NWO awarded a personal grant to twenty TU Delft researchers. See Appendix 6 for a full overview.

#### **Rubicon**

NWO's Rubicon programme enables recent PhD graduates in science to gain experience at a top institute outside the Netherlands, an important step up in a science career. Four TU Delft scientists participated in the programme in 2016: Dr Riccardo Frisenda, Dr Maarten Goesten, Dr Hairen Tan and Dr Calin Plesa.

#### **Open Technology Programme**

The STW Open Technology Programme (OTP) is designed for projects within the full spectrum of scientific and technological research. The nine TU Delft projects that received funding under this programme in 2016 are listed below.



### Awards for Phase 1, Take-Off feasibility study

<b>Dr.ir. H. Polinder (EEMCS)</b>	E-Trailer
<b>Prof.dr.ir. M. Kok (CEG)</b>	FLAWS: a stylized map-based science-policy interface to support integrated water system development
<b>Ir. drs. C.P.M. de Vet (CEG)</b>	Delft Continuous Drilling System
<b>Dr. M. Spirito (EEMCS)</b>	High gamma vector network analysis (HF-VNA)
<b>Dr. J.F.M. Molenbroek (IDE)</b>	Mesh Lingerie
<b>Prof.dr.ir.H.E.J.G. Schlangen (CEG)</b>	Mineral Composites met baggerslib
<b>Dr. M. Mazo Espinosa (3mE)</b>	Next Generation Offshore Wind Installation: SeaState5 Grasshopper
<b>Dr.ir. O. Isabella (EEMCS)</b>	Feasibility study for exploitation of solar system design, output calculation and guarantee
<b>Dr.ir. M. Aguirre (3mE)</b>	The SensOtouch Grasper: Safe and sensible grasping in endoscopic surgery
<b>Dr.ir.R.A.J. van Ostayen (3mE)</b>	Contactless Handling System
<b>Ir. P. Naaijen (3mE)</b>	Next Ocean Maritime
<b>Dr. ir. E. Tempelman (IDE)</b>	ProGauntlet
<b>Dr. G.A. Steele (Applied Sciences)</b>	Cryogenic circuit technology for the quantum-industry and -physics labs
<b>Ir. R.J.H.G. Heur (IDE)</b>	Designing the next generation toothbrush
<b>Dr. ir. J.F.M. Molenbroek (IDE)</b>	CloudCuddle
<b>Dr. H. Vallery (3mE)</b>	Energy Restoring Knee
<b>Ir. J.S. Hoving (CEG)</b>	Active Pile Driving Tip
<b>Dr. ing. J.C. van Gemert (EEMCS)</b>	Virtual Chemist – Deep learning en high-tech sensoren voor economisch aantrekkelijk recyclen
<b>Dr.ir. M.C. Rozendaal (IDE)</b>	Somnox: An innovative non-medicinal solution to sleep deprivation.
<b>Prof.dr.ir. J. Westerweel (3mE)</b>	DRAG DRUM DELFT (D3)
<b>Dr.ir. S.F.J. Flipsen (Applied Sciences)</b>	Mayht DEUS (Double Excursion Units Speaker)
<b>Dr. A. Bacchelli (EEMCS)</b>	PReview Code

### Awards for Phase 2, Take-Off early-phase trajectory

<b>Dr. N.M.P. Bocken (Homie BV – currently being developed)</b>	HOMIE - pay per use domestic appliances
<b>Ir. J.F. Schorsch (IMSystems)</b>	Archimedes Drive: Revolutionizing Robotics
<b>Dr.ir. B. van Limpt (Delft IMP BV)</b>	Atomic Layer Deposition on pneumatically transported particles: Bringing Nanoscale benefits to Macroscale products
<b>Ir. S. Hulsman (ATMOS UAV BV)</b>	De eerste hybride drone voor de professionele mapping industrie
<b>Dr. M. Tohidian (Qualinx BV)</b>	Battery-Less Wireless Transceiver for Internet-of-Things (IoT)
<b>Dr.ir. T. Horeman (Surge-On Medical)</b>	A steerable punch for Meniscectomy
<b>F.B.Trip, BSc (E-Trailer B.V.)</b>	E-Trailer
<b>Ir.ing. W. Nerkens (MediShield BV)</b>	Safe and Sensible Grasping in Mini-Laparoscopy

### Awards under the NWO STW Open Technology Programme

<b>Dr. A.G. Denkova (Applied Sciences)</b>	Innovative irradiation facility for the production of <sup>166</sup> Ho microspheres to treat patients with liver cancer
<b>Prof. dr.ir. Winterwerp (CEG)</b>	BioManCO: bio-morphodynamic modeling of mangrove-mud coasts
<b>Prof.dr. M.A. Hicks (CEG)</b>	Energy Piles in the Netherlands
<b>Dr. R. Pecnik (3mE)</b>	ORC turbogenerators: a quantum step forward by a novel integral design approach
<b>Prof.dr.ir. G.J.T. Leus (EEMCS)</b>	tAsk-cognizant sParse sensing for InfeREnce – ASPIRE
<b>Dr. G.C.H.E. de Croon (AE)</b>	To be as nimble as a bee: A bio-inspired sensory-motor system for gust control of Micro Air Vehicles
<b>Prof.dr. F.M. Mulder (Applied Sciences)</b>	Integrated battery and electrolyser – combining electricity storage and Power2Gas for a renewable future
<b>Dr. E. van der Kolk (Applied Sciences)</b>	Tm2+ based Luminescent Solar Concentrators: Fundamental understanding and lab scale device (LumiCon)
<b>Dr. M. Snellen (AE)</b>	THAMES; Towards High-Reynolds Airfoil self-noise MEasurements



### Gravitation programme

In 2016, TU Delft was the coordinating university for the submission of two applications for the Gravitation programme, and a participant in a total of eleven submitted proposals. The aim of Gravitation is to form consortia of the best researchers in certain subject areas to conduct excellent research for a period of ten years. TU Delft is the coordinator of the following proposals:

- ‘Seamlessly Integrating Robots in Human Society’ (SIRIS), led by professor Frans van der Helm, in collaboration with the University of Twente, Eindhoven University of Technology, Radboud University and VU University Amsterdam.
- BaSyC – Building a Synthetic Cell, led by professor Marileen Dogterom, in collaboration with the University of Groningen, Radboud University, AMOLF, VU University Amsterdam, Wageningen University and the Rathenau Institute.

### FOM Valorisation Prize

The Foundation for Fundamental Research on Matter (FOM) awarded its 2016 Valorisation Prize of 250,000 euros to TU Delft Professor Ekkes Brück for his efforts in valorising the fundamental knowledge in the field of energy materials.

### Other national programmes

TU Delft also received awards under other national programmes. Examples include:

- An award to Dr Miren Vizcaino (CEG) under the ALW Open Programme for the project ‘Future-coupled evolution of Greenland ice sheet and climate change: short and long-term perspectives’.
- NWO Top Grants in Physical Sciences awarded to Dr Matthijs Spaan and Dr Claudia Hauff (both from EEMCS) for their research into, respectively, ‘Model learning for sequential decision-making’ and ‘Large-scale collaborative search & sensemaking’.
- STW Open Mind grants of 50,000 euros awarded to Dr Rienk Eelkema and Dr Antonia Denkova (both from Applied Sciences) for their proposal relating to Cerenkov chemotherapy for cancer patients, and to Dr Martin van Gijzen (EEMCS) for the development of a low-cost MRI system for detecting hydrocephalus. Open Mind funding challenges researchers to think outside the box and pursue original research with societal impact.

### European funding

TU Delft supervises, advises, trains and supports researchers and innovators from TU Delft in applying for all types of funding under the European Horizon 2020 programme. The Horizon 2020 Framework Programme is a cornerstone of the Innovation Union, and focuses on improving the international competitive position of Europe. When the Commission held the public consultations for the Horizon 2020 mid-term review, TU Delft took the opportunity at an early stage to influence the form that H2020 and its successors will take in the future. This is taking place within alliances such as CESAER and the IDEA League.

In 2016, TU Delft passed the 100-million-euro milestone for H2020 project funding since the start of the programme. More than 140 projects are still in progress, in fields including robotics, flood disaster resilience, and responsible research & innovation. Between 30 October 2015 and 30 September 2016, TU Delft attracted around 44 million euros in project resources.

The European Institute of Innovation & Technology (EIT) is at the heart of the Horizon 2020 programme. Within the EIT there are six ‘Knowledge and Innovation Communities’ (KICs), each geared to a particular societal challenge. TU Delft is involved in four of these KICs: Raw Materials, Health, Climate Change, and ICT.

## 4.2 Large-scale EU projects

TU Delft scores highly when it comes to attracting EU funding from sources such as Horizon 2020, the European Regional Development Fund (ERDF) and Interreg Europe. The implementation of these large-scale European projects requires a high degree of management and coordination. Researchers receive support in the area of administrative, legal and financial coordination, during both the submission of proposals and the implementation of projects. TU Delft coordinates the following H2020 projects, among others: BRIGAD, REPAIR and AWESCO.

### BRIGAD

BRIDges the GAp for Innovations in Disaster resilience involves the construction of eight European test facilities for innovations in the fields of drought, flooding and extreme weather. The aim is to make thirty of these innovations market-



*Professor Bas Jonkman standing on the BoxBarrier, a temporary flood defence that is being tested as part of the BRIGAD programme. (Photo: Alwin Wink)*

ready by May 2020. A budget of 7.7 million euros is available under Horizon 2020 for this purpose.

#### **REPAIR**

REPAIR stands for REsource management in Peri-urban Areas: Going Beyond Urban Metabolism. Within this project, eighteen organisations from six countries are working together to develop a tool that will enable local authorities to reduce waste flows. The tool will be tested in six 'living labs' in the areas around Naples, Ghent, Hamburg, Pécs, Łódź and Amsterdam. The Circular Economy project REPAIR is being financed with 5 million euros from the Horizon 2020 programme.

#### **AWESCO**

The aim of the Airborne Wind Energy System modelling, Control and Optimisation (AWESCO) project is to find innovative ways to generate wind energy using kite systems. TU Delft is coordinating this interdisciplinary research programme. The Marie Skłodowska-Curie European Training Network AWESCO has been awarded funding of 3 million euros under the Horizon 2020 programme.

### **4.3 Innovation programmes**

TU Delft initiates and implements projects and programmes that are geared to accelerating innovation and bringing knowledge to the market, for example through spin-offs, start-ups and living labs. Many programmes of this type are funded by the European Union (ERDF and Interreg Europe) or the Netherlands Enterprise Agency, which are increasingly making funding available for such programmes.

#### **Medical Delta**

The Delft-Leiden-Rotterdam region has a particularly high concentration of health centres, medical, technological and scientific expertise in Life Sciences, Health and Technology organisations. The surrounding areas provide a dynamic climate within which innovative spin-offs and national and international organisations can flourish through the development of new products and services. The Medical Delta organisation supports researchers, engineers, medical professionals and entrepreneurs in establishing connections and translating shared ambitions into concrete knowledge-driven projects for which funding is sought. Scientists, engineers, medical professionals, entrepreneurs and local authorities

working in the Medical Delta region are working together closely on solutions for sustainable healthcare. One example is the Holland Particle Therapy Centre (HollandPTC), the first centre for proton therapy in the Netherlands. HollandPTC is a collaborative partnership between TU Delft, Erasmus MC and the LUMC. The expectation is that, from mid-2017 onwards, HollandPTC will be treating 600 patients per year. Smart innovations and technology can help to improve healthcare and also to keep it affordable. At regional level, Medical Delta is also very active in the Dutch healthcare innovation through the Netherlands Federation of University Medical Centres (NFU), the Association of Universities in the Netherlands (VSNU), the Top Sectors LSH (Life Sciences & Health) and HTSM (High Tech Systems and Materials), and the open database Zorginnovatie.nl. Medical Delta has also established sound international connections through many Horizon 2020 projects, the exchange programme with Berkeley University in the field of eHealth and big data, and as the base for the Belgian-Dutch headquarters of EIT Health. Collaboration between highly diverse parties is essential to innovation in health care, and stakeholders need to step outside their usual areas of knowledge and work. That is why Medical Delta is establishing an active Life Sciences, Health & Technology community. The community is consolidated through meetings, events and the social media. The requirement is that all activities are based on the knowledge of the partners and

direct access to healthcare practice:

- Fostering cross-disciplinary research and education
- Identifying and creating growth opportunities in early-stage ideas
- Providing support for promising research projects and infrastructure
- Providing a platform for researchers, students, patients and entrepreneurs for communicating and testing new ideas.

### VPdelta

The areas in the world that are most vulnerable to flooding are the urban areas in river deltas. Water can flow into them from all directions: from the hinterland, the sea, the sky and the ground. It is predicted that, by 2050, approximately 6 billion people will be living in these vulnerable delta regions. The region of The Hague, Delft, Rotterdam and Drechtsteden is the most urbanised delta in Europe. Until recently, the many parties in this region made insufficient use of each other's facilities and expertise when developing initiatives in delta technology and water management. Collaboration is vital if the Netherlands is to remain a world leader in this field. Scientists, entrepreneurs and (local) authorities have joined forces and set up VPdelta. The aim of the programme is to accelerate and increase innovations and enterprise in the delta cluster, and to test and showcase the innovations



EU Commissioner Frans Timmermans learns about innovative solutions in the Flood Proof Holland living lab.



through field labs. One of the jewels in the VPdelta crown is Flood Proof Holland, a facility in Delft for testing and demonstrating innovative temporary water defences. The facility has been visited by six hundred delegations from more than forty countries. In 2016, visitors to the field lab in the polder included Frans Timmermans (EU Commissioner) and Melanie Schultz van Haegen (Minister of Infrastructure and the Environment), who were very enthusiastic about the innovations that were showcased there.

### Green Village

The Green Village on the TU Delft campus is an incubator for innovation. The aim is to shorten the time it takes to translate scientific research into applications for society. To this end, the Green Village focuses on technologies that have an impact on people's physical environment, such as sustainable energy, clean water, and using waste as a resource.

In 2016, TU Delft, the Dutch government, the Province of Zuid-Holland, the Delfland Water Authority, the Municipality of Delft and various market players signed the Green Deal. The signatories to the Green Deal are working together to develop system innovations for a sustainable future, and to test them and shorten their time-to-market.

Innovations such as these are often confronted with legislative and regulatory obstacles. By signing the Green Deal, the authorities involved have undertaken to remove or resolve these obstacles.

### AMS

The Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute) is an ambitious international research institute that focuses on urban innovation. It was established in 2014 by TU Delft, Wageningen University, Massachusetts Institute of Technology and the City of Amsterdam. With a focus on urban issues such as water, energy, waste, food, data and mobility, practical solutions are being sought for urban challenges through studies, experiments and living labs in the Amsterdam metropolitan region. In some 40 current projects, the AMS Institute is collaborating with knowledge institutions, businesses, the public sector and citizens to realise a united, circular and vital city. In the past two years, this has increased the size of the institute's current research and innovation programme to 42 million euros.



*The THAMO project at the Flood Proof Holland living lab is demonstrated to Melanie Schultz van Haegen, Minister for Infrastructure and the Environment.*

A number of new subsidiary programmes and living labs will be developed and launched in 2017:

- Roboat, a research programme focusing on autonomous boats
- Mobility as a Service (MaaS) for the Amsterdam Zuidas district, a programme for seamless A-to-B transport connections
- The Urban Energy Innovation Lab, a large-scale research programme focusing on energy innovations in the Amsterdam Zuid-Oost district and the Floriade horticultural expo
- The Feeding City programme focusing on food production and its relation to the circular economy on a metropolitan scale.

## 4.4 Intellectual property

Findings from scientific research at TU Delft frequently result in new technologies. It is important for society that innovations are utilised, and intellectual property rights play an important role in that context. Protecting the right of ownership to (some or all) findings with a patent. A patent can then make it an attractive proposition to bring a research result to the market. This can be done by granting a licence, selling the patent, concluding research contracts or setting up a start-up.

The returns on such transactions may come in several forms, from royalties and participation in start-ups to subsidies and partnerships. In this way, TU Delft can market the results of its research and developments in technology, and thus generate additional revenue. Partly on the basis of its patent portfolio, TU Delft is the most innovative university in the Netherlands. A selection of TU Delft patents can be found on [www.patent.tudelft.nl](http://www.patent.tudelft.nl).

In 2016, 87 inventions were reported internally, and 47 new patent applications were submitted. In addition, 23 contracts were concluded on the basis of one or more patents from the TU Delft patent portfolio and 31 patents were commercialised. A number of prominent examples of the use of intellectual property rights in 2016 are listed below.

### Licences

TU Delft concluded a licence agreement with Milton Medical Innovations BV. This company is implementing a number of TU Delft patents for medical instruments. TU Delft also concluded a licence agreement with the Municipality of Lund in Sweden for the application of a TU Delft patent in the construction of a new tram line.

### Transfers

TU Delft transferred a patentable joint finding in the field of public-transport planning to NEC Laboratories Europe.

### Spin-offs

Delft Advanced Biofuels B.V. (DAB) resulted from technology research into the process for the recovery of lipids or hydrocarbons. DAB was established in order to scale up this technology and the related patents and bring them to the market.

### Start-ups

Delft Enterprises BV participates in Mayht B.V. on behalf of TU Delft through the contribution of a TU Delft patent. Mayht produces high-end loudspeakers and was set up by former students.

### Ranking

In the Reuters Top 100: The World's Most Innovative Universities, TU Delft jumped to 44th place, from 73rd place in 2015. Patents were an important factor in this improved rating.

## 4.5 Alliances with businesses

TU Delft is committed to conducting more research in collaboration with the Dutch and international business community, with a focus in 2015-2016 on improving relationships with businesses in Germany. Most of the contract research concluded with TU Delft is conducted by Dutch companies or Dutch branches of foreign multinationals.

The realisation of more contract research requires the showcasing of research and the building of strategic contract relationships and consortia. In 2016, work was carried out to do this, for example through a small-scale Research Exhibition and two CTO dinners on location. In addition, top civil servants from the Ministry of Infrastructure and the Environment paid an intensive working visit to TU Delft, focusing on joint efforts in the most important themes.

As an important private partner of QuTech (a collaboration between TU Delft and TNO), Microsoft will be extending its cooperation. In addition to this, Microsoft is to set up its own lab on the campus at TU Delft. The lab will be led by Professor Leo Kouwenhoven, who has been hired by Microsoft to this end. He will remain a professor at TU Delft and continue to supervise PhD candidates and students. See page 39 for more information on QuTech.

The Dutch Optics Centre, a collaboration between TU Delft and TNO, was launched in mid-October 2016. Together with a large number of companies, DOC works to develop and produce high-tech optical and optomechanical products such as satellites, telescopes, microscopes and control instruments. DOC builds on the strong position of optics and optomechanics in the Netherlands, in industry as well as scientifically.

On 22 November, a partnership agreement was signed with the Reinier de Graaf hospital. The aim of the agreement is to formalise and deepen existing collaboration, and facilitate future collaboration.

The partnership is of interest to TU Delft, apart from Medical Delta's collaboration with the university hospitals (Erasmus MC and LUMC), because Reinier de Graaf provides certain treatments on a frequent basis. These high volumes generate valuable research results. The Reinier de Graaf hospital also serves as a form of 'living lab' where research and innovation go hand in hand, according to the principles of co-creation and participatory design.



## 4.6 Fostering entrepreneurship

In 2016, the Delft Centre for Entrepreneurship (DCE) became an autonomous centre within the Faculty of TPM in order to improve the implementation of enterprise programmes in collaboration with departments and faculties. In 2016, three specific Minors in entrepreneurship were introduced in Bachelor's degree programmes. In addition, a programme worth 15 ECTS was developed as a specialisation in various Master's degree programmes, enabling students to obtain the Entrepreneurship annotation in addition to their Master's degree certificate. DCE also took steps to forge links between education projects and start-ups and industry.

### YES!Delft

In 2016 the business incubator YES!Delft, which was established in 2005, played a key role in fostering entrepreneurship among staff and students at TU Delft. YES!Delft offers coaching, training, facilities and access to relevant networks for promising new companies. To date, more than 180 high-tech start-ups have been launched under the umbrella of the YES!Delft incubator. These companies have an impact on different technical sectors such as medical technology, cleantech, ICT, industrial applications and consumer products. In 2016, YES!Delft was expanded with YES!Delft Labs (2,500m<sup>2</sup> of office space and 900m<sup>2</sup> of laboratory facilities). This expansion was needed to accommodate the growth of start-up companies.

### Research Exhibition

DIG-it! is a project that aims to provide proactive support to TU Delft researchers in their valorisation activities, thereby linking their innovative ideas with society and the market as effectively as possible. The process consists of three successive phases. In 2016, innovative ideas were sought in each faculty by talking to researchers. This made it possible to map the innovation ecosystem at TU Delft. Various 2D and 3D visualisations were created from these ideas in order to make them tangible and transparent. The ideas developed in this way were 'exhibited' in various forms. In 2016, TU Delft held a small-scale research

exhibition comprising twenty projects, two speed lectures, and networking opportunities. The exhibition was attended by 380 visitors from 125 companies.

## 4.7 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. In 2016, this process resulted in a tested and validated set of indicators for making university efforts in the complex context of valorisation transparent.

The assignment for the development of valorisation indicators was addressed by the universities of technology at the 3TU level at the beginning of 2013. In 2015, the indicators developed were tested and the operationalisation of the indicators was further coordinated at the 3TU level. The first final set of valorisation indicators was chosen at the end of 2015. The results for these indicators are shown below. These indicators will be developed further and/or supplemented in the years to come.

Indicator		Realised in 2016
Scope of indirect and contract funding	Government funding	459.6 M€
	Indirect funding	45.5 M€
	Contract funding	139.2 M€
Internships and graduation projects for non-university institutions	Bachelor's	3
	Master's	872
	PDEng	26
Co-publications with companies	CWTS Leiden Ranking - University Industry Co-publications	CWTS data not available for 2016
	Proportion of publications with one or more companies as co-author	CWTS data not available for 2016
Intellectual property	Invention disclosure	87
	Patent applications	47
	Transfers	8
	Licences	19
Commercial activity	Spin-off with TU-IP	9
	TU Delft start-up started by current and former TU Delft students without TU-IP	16
	Starters who did not start-up through third parties with TU-IP	0
Ancillary activities	Number of professors with non-academic ancillary activities	164 van 322 (76%)
Entrepreneurship training	Entrepreneurship minors (30 ECTS per minor)	119 students / 3570 EC
	Supplementary Entrepreneur courses (5-8 ECTS each)	288 students / 1586 EC
	Total ECTS for entrepreneurship programme	407 students / 5156 EC
Alumni careers	Percentage of alumni working for non-academic organisations	83,3% (2015)



5

# Organisation and policy

## 5.1 Organisational developments

Students and scientists, education, research and valorisation are what TU Delft is all about. The university is the sum of its people, facilities and services. A well-organised, service-providing professional organisation is an important precondition for maintaining education and research at the highest level. TU Delft needs excellent facilities, service departments and staff in order to carry out its core tasks to the highest standards. University Services has a supporting role in this context, based on reliable service provision and a flexible organisation that is able to respond to the needs of an environment that is constantly changing, for example with regard to developments in real estate, growing numbers of national and international students, collaboration with other stakeholders, and developments in the region.

### Organising international affairs

In recent years, the number of international students, doctoral candidates, staff, international partnerships, and education and research activities have increased sharply. Apart from this, the external environment is undergoing rapid change as a result of globalisation, increased mobility in higher education, and technological advances. TU Delft is aiming to achieve a closer alignment between the services for its target groups with regard to international relations and the current requirements and ambitions of the university. On 5 April 2016, the Executive Board decided in favour of a restructuring in the International Relations domain. This should result in a streamlined service provision to international students and staff, visiting delegations and international companies.

### An eye on excellence, an eye for you: Employee Survey

Working for TU Delft means working for an ambitious and forward-looking organisation. In order to compete with the world's best, TU Delft recruits talented people – students, researchers and support staff – and creates an environment that fosters their abilities and encourages them to excel in their performance. In 2016, in consultation with the representative bodies and with the approval of the Works Council, TU Delft made the decision to draw up a strategy for assessing psychosocial work stress and introducing any necessary measures to deal with it. At the

beginning of 2017, there will be a university-wide employee survey in which all staff will be asked about their perceptions and experiences of the work environment. The survey is intended for all academic and administrative/support staff, and will measure psychosocial work stress and satisfaction with service provision.

### Open Science 2016

There were a number of positive developments regarding Open Science in the past year. An Open Science Guide was written for researchers (see [openscienceguide.tudelft.nl](https://openscienceguide.tudelft.nl)). A milestone was the launch on 1 May of the TU Delft policy regarding the depositing of articles in the Delft Repository, which can be found at [repository.tudelft.nl](https://repository.tudelft.nl). This policy is designed to ensure increased awareness and use of Open Science and Open Access among scientists in the years to come. The proportion of peer-reviewed open-access articles increased from 25% to 30% in 2016.

### ICT

Modern universities are e-based. Work processes in 21st-century universities are highly dependent on up-to-date ICT. Studying and working are becoming less and less dependent on place and time. Increasingly, collaboration is taking place through the use of digital support, which is facilitating new forms of knowledge transfer and scientific research. In order to respond more effectively to these requirements, the Executive Board decided to reorganise the ICT department. This reorganisation is necessary in order to realise the ambitions of the divisions and faculties with regard to the role of ICT in the primary processes.

## 5.2 Diversity & Inclusion

One of the five core objectives of the HR strategy is to develop a talent pool that is as diverse as possible. We believe it is very important to have an organisational culture in which a wide variety of talented individuals feel at home and are able to fulfil their potential. TU Delft is keen to reflect society, and is therefore actively committed to diversity in the broadest sense of the word. This means that our policy focuses on stimulating diversity in all its facets, ranging from age, ethnicity and gender, to the less obvious aspects, such as social background, sexual orientation and disability. In 2008, TU Delft was the first university to sign



the 'Talent to the Top' Charter, an initiative of the Dutch government and the Social and Economic Council of the Netherlands (SER). Today, in 2016, it is still necessary to remain alert to factors that obstruct and foster diversity within TU Delft as an organisation. A project group will be set up to examine how this can be put into practice.

### **Delft Technology Fellowship**

In the autumn of 2015 and the spring of 2016, the third Delft Technology Fellowship recruitment round was held. The aim of this programme is to increase the number of top female scientists. Interest in this programme is growing. There were some 130 applications in the first two rounds, and in this third round the number of female scientists submitting an application amounted to 350. Nine top female scientists were eventually hired: six assistant professors, two associate professors and one professor. The programme is currently being evaluated, prior to a new recruitment round in 2017.

### **Establishment of True U - LGBT network**

True U is TU Delft's lesbian, gay, bisexual and transgender (LGBT) network. Members of the network also include 'straight allies' – heterosexuals who support an open work culture. By giving a face to the LGBT community at TU Delft, the network contributes to a culture in which all members of staff are able to be themselves. The network gives LGBT people an opportunity to get to know each other and share knowledge and experience, serves as a sounding board for the EB and HR, and can provide solicited and unsolicited advice.

### **TU Delft membership of Workplace Pride**

TU Delft aims to ensure that everyone feels supported and part of TU Delft, regardless of their sexual orientation. To that end, in 2016 TU Delft joined Workplace Pride, an overarching foundation that aims to achieve greater acceptance of lesbian, homosexual, bisexual and transgender people in the workplace and in society.

## **5.3 Integrity**

### **Human Research Ethics Committee (HREC)**

The activities of the interfaculty HREC are increasing. As of 2016, the HREC has its own

regulations and an independent status. This means that it no longer operates under the auspices of the Scientific and Academic Integrity Committee. Current practice is set out in the regulations: the chairperson of HREC assesses minimum-risk studies, and the faculties assess student projects. In total some 120 applications were discussed in 2016, ranging from trials with self-driving cars to the testing of exoskeletons ('robot suits') and of learning analytics in education.

### **Integrity Coordination Group**

The TU Delft integrity policy is set out in the Code of Ethics, and can be found on [www.integriteit.tudelft.nl](http://www.integriteit.tudelft.nl). The Integrity Coordination Group (CI) ensures that everyone remains aware of this theme. The subject of ethics will continue to be part of the introduction programme. In cooperation with HR, ways to expand this introduction and create lasting awareness among existing staff were explored.

TU Delft believes that all its departments should give attention to ethics. In an increasingly technology-dependent society that has a major impact on our daily lives, it is of great importance for all future engineers to have knowledge of the ethical issues associated with technology. All Bachelor's students currently follow courses in Ethics. As of the 2018-2019 academic year, ethics will be an integral part of all Bachelor's and Master's degree programmes.

## **5.4 Legal matters**

### **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 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. Since the Doctoral

Regulations 2014 came into force, doctoral candidates have been 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 (77 and 115 respectively) in 2016 are shown according to category and decision type.

Category	Founded	Unfounded	Inadmissible	Withdrawn	Total
EAB (student)	4	22	1	88	115
PhD candidates	0	1	1	0	2
Student	4	20	9	25	58
Dismissal (employee)	0	0	0	0	0
Job evaluation (employee)	0	0	0	0	0
Miscellaneous (employee)	5	3	1	8	17
Total	13	46	12	121	192

The General Administrative Law Act (Awb) specifies an 18-week decision period within which objections must be dealt with. The decision period for student cases is 10 weeks. The average settlement period at TU Delft in 2016 was 10.6 weeks for objections by employees and 10.9 weeks for student cases.

The number of cases submitted to the Examination Appeals Board is increasing steadily (115 in 2016 compared to 97 and 83 cases dealt with in 2015 and 2014, respectively). An important reason for this is the increase in the number of foreign students who lodge an appeal against a rejected application for admission to the Master's degree programme (73 appeals in 2016 compared to 54 in 2015 and 33 in 2014). Many foreign students register at more than one university. In some cases it was no longer necessary to proceed with an appeal. This partly explains the large number of Examination Appeals Board cases that are withdrawn. 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 is decreasing. This is partly due to the fact that a number of restructurings have been completed recently.

## Complaints

### *Inappropriate conduct*

The Complaints Committee for Inappropriate Conduct (KOG) did not receive or handle any complaints in 2016. The last complaint, which the KOG dealt with in 2014, was made in 2013.

### *Academic integrity*

A complaint made in 2014 was submitted to the Netherlands Board on Research Integrity (LOWI), following the preliminary decision taken by the Executive Board at the time. The LOWI issued its opinion in 2016, endorsing the Executive Board's 'unfounded' ruling. The Executive Board then finalised its preliminary decision from 2014.

A complaint submitted in 2015 was deferred because the same complaint was made to the University of Twente, which would deal with it in the first instance. The Twente Executive Board's preliminary decision ('Unfounded') was submitted to the LOWI.

A complaint was lodged with the Scientific and Academic Integrity Committee at the end of 2016, and was still being dealt with in 2016.

### *Conflict of Interest Committee*

The Conflict of Interest Committee (CoBeCo) is a committee with external members that can issue recommendations on dilemmas reported by researchers when science and the market meet. No cases were reported in 2016.

### *Other complaints*

Legal Affairs received three complaints in 2016. One of the complaints was dealt with by the faculty concerned. The other complaints were deferred until further notice due to current cases.

## Regulations

### *Regulations*

The 2016 regulations regarding compensation and facilities for the TU Delft Works Council lay down the rules for compensation in time and money for the work of the members of the Works Council, as well as the council's other facilities. They replace the regulations from 2004.

### *TU Delft Regulations on Human Trials*

The number of human trials taking place at TU Delft has increased considerably in recent years, and this places a responsibility upon the institution and researchers to conduct trustworthy and principled research in which the risk to the

test subject is acceptable and in proportion to the significance of the research. These regulations are intended to protect the physical and psychological integrity of the test subjects in human trials and to evaluate the ethical acceptability of such research. The key points of the regulations include setting up an independent Human Research Ethics Committee and an independent screening process. These previously formed part of the Regulations on and the Committee for Scientific and Academic Integrity.

#### *TU Delft Selection and Placement Regulations*

Under the Higher Education and Research Act (WHW), the Executive Board has the power to impose a numerus clausus for certain Bachelor's degree programmes when teaching capacity requires this. Just like in the previous year, a numerus clausus was imposed for four Bachelor's degree programmes. As of 1 September 2017, selection for these programmes will no longer be by means of a central draw. Instead, the individual departments will select the students.

Regulations need to be drawn up for the selection, in which, among other things, the qualitative selection criteria and the selection procedure are included. The university-wide Selection and Placement Regulations set out the general principles for selection, as well as aspects concerning enrolment and admission which are part of the central task of a university. Actual selection takes place for each degree programme and the dean in question draws up regulations setting out the specific selection criteria and implementation of the selection procedure.

#### *Partnerships*

The Assessment Framework for Joint Education: International Master's Degree Programmes has been finalised. It relates to Master's degree programmes that are set up in cooperation with institutions outside the Netherlands, and serves as a guide for faculties that are considering developing such a programme. The framework also aims to streamline the process of assessment and decision-making in this regard. One of the instruments developed for this purpose is the Model Agreement for International Joint Master's Programmes.

## 5.5 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 instruments are the Safety Profile and the Progress Report, which are drawn up every year. The safety risk level at TU Delft is steadily decreasing. Developments are in line with national trends.

In the field of design safety relating to the campus, there is close cooperation with Facility Management & Real Estate (FMRE) to structure campus development and building layout at an early stage.

The main focus areas in 2016 were:

- Coordination of programmes such as the Integrated Safety and Security Programme and the IVHO (Integrated Safety and Security for Higher Education)
- recommendations on aspects such as fraud, screening, travel safety, incident room, business continuity, crisis training, safety in lecture halls, Welcoming Week (Owee), VIP
- crisis and incident management.

Some examples:

**Crisis training:** Crisis-management training courses are offered TU-wide. In addition, the first step was taken towards setting up a 24/7 first-response team, in line with the Central Crisis Organisation.

**Lab safety:** The Lab Servant tool was implemented, and training in lab safety has been rolled out TU-wide for relevant departments and degree programmes. An audit of the labs will be carried out annually.

**Travel-safety training for students:** In the past year, 21 travel-safety courses, 5 individual training courses and 2 'last-minute' group training courses were given. For a number of Minor projects, workplace and machine safety was looked at, in addition to travel and accommodation safety.

**Nuclear security:** In the context of the OYSTER and HollandPTC projects, the security of the Reactor Institute Delft (RID) is constantly monitored and optimised by RID and Safety & Security, in consultation with the government.

**Awareness:** In February, an awareness campaign entitled 'Everyone can help' was held, with the focus on aspects including a clean and liveable campus environment and digital security. The campaign also drew attention to fire-hazard situations and escape routes.

Contacts with students, sports organisations and leisure organisations were intensified to facilitate the provision of support in internal safety and security management. It emerged from the Quick

Scan carried out in November 2016 that there is a need for support and cooperation.

## 5.6 Real Estate

### Towards a Strategic Framework for campus development

TU Delft aims to raise and maintain the quality of its research and education facilities to a high international standard. The university also has the challenge of reducing its footprint and thus helping to keep its real estate affordable in the future. The Campus Vision, the reference framework for the development of the campus, was adopted in 2013. It is the starting point for the development of concrete plans, which together form the Strategic Framework for Campus Development (formerly Real Estate Strategy). Every year, this Strategic Framework for Campus Development is adjusted if necessary. The growth in student numbers, developments in research, and the financial possibilities and constraints have resulted in the need for major adjustments.

### Development at TU Delft South

On 1 September 2016, the Faculty of Applied Sciences officially took possession of its new building at TU South. It was completed at the beginning of 2016, and the departments of Chemical Engineering, Biotechnology and Bionanoscience moved into the building. In mid-2016, a multi-storey car park with 275 spaces was completed. The Kluyverpark was developed between Applied Sciences and the Faculty of Aerospace Engineering (AE). It is a new park on the TU Delft campus with extensive green landscaping and water; a place for studying, work and relaxation. The project is an example of the transformation of public spaces into a Living Campus. The Kluyverpark is also home to the education building The Fellowship, with its extensive catering facilities, including a Food Market with three fresh-food concepts.

### YES!Delft Labs

On 8 September 2016, YES!Delft Labs was officially opened. The building is located at TU Delft South next to YES!Delft, the TU Delft incubator for technology start-ups. YES!Delft Labs, which has high-standard lab and office space for promising start-ups, including biotechnology start-ups, meets

the increasing market demand for office space and laboratories. The building was handed over on 28 April 2016, and 63% of the offices and 72% of the laboratories have now been leased.

### Development of TU North area, Biotechnology building – RoboValley

At RoboValley, researchers, entrepreneurs and government bodies work together on research into robots and on their development and production. RoboValley wants to be the leader in creating the next generation of robots.

It is based in the Science Centre building on the north side of the campus. The location is not satisfactory, so the nearby Biotechnology premises, which recently became vacant, are now being used by robotics companies.

### EEMCS high-rise building

The Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) is located in Mekelpark. The complex dates from 1972 and is very outdated. The decision was made to relocate the groups that are based in the high-rise building on the complex. A strategy for the future of the building will be drawn up.

### Teaching rooms

Education & Student Affairs is responsible for managing the quality and quantity of teaching rooms and, on the basis of the annual forecasts of student numbers, draws up a long-term framework for investment in teaching space. This was documented at the beginning of 2016 in the Classrooms and Study Areas transformation plan. An approach for 2016 was formulated on the basis of the transformation plan.

### PULSE

On 3 October 2016, the construction of the new education building PULSE (Practise, Unite, Learn, Share and Explore) was officially launched. The development of the new building is the result of growing student numbers year on year, and the need for more flexible teaching space. The design of the building is the result of a collaboration with students and lecturers. It will be a centre for modern motivational teaching (e.g. interactive tutorials and video conferencing). The building has rooms of varying sizes and layouts, with facilities including write-on walls. Apart from teaching areas,

the building has space for catering facilities, with 200 seats for relaxing or self-study. Pulse will be the first energy-neutral building on the TU Delft campus. There will be 950 m<sup>2</sup> of solar panels on the roof, and underground geothermal storage.

### Catering Strategy

In the new catering vision, TU Delft is moving from a single caterer to various providers across the campus. The number of users at the south of the campus is increasing. The new catering concept for this part of the campus consists of a central Marketplace in The Fellowship, which, with three fresh-food concepts, will form the catering heart of the south part of the campus. All catering facilities are combined with multifunction study places and workspaces.

The food trucks were relaunched with wider and more tailored menus. The menus are now more international, and include more healthy, organic and vegetarian options.

### Underground infrastructure

The underground infrastructure at the campus (cables, pipes and sewers) is due for replacement. Parts of the sewer system were renewed in 2016 or are due to be renewed. This is not the case for cables and pipes. Test trenches have been excavated for approved projects to investigate the condition of cables and pipes. Estimates of the replacement costs can then be drawn up.

## 5.7 Sustainability

Key developments are mentioned below, and more detailed information can be found in the TU Delft annual report on sustainability, which will be published alongside this annual report for the first time.

### The TU Delft Green Office

With the establishment of the Green Office, TU Delft has taken an important step in terms of anchoring sustainability more firmly in campus development and operation. The Green Office was launched on 1 January 2016.

Its main tasks include providing support in making the campus more sustainable, and involving education and research activities in this. The Green Office focuses on linking the student

community with these developments, for example through events and projects. An overview of current initiatives and projects can be found at [www.sustainability.tudelft.nl](http://www.sustainability.tudelft.nl).

In 2016, TU Delft ranked 19th out of 516 universities – with a second place for sustainability education – in the UI Greenmetric World University Ranking.

### Developments on campus

TU Delft is committed to reducing energy consumption from the 2005 level by 2020:

- 40% saving on primary energy
- 50% reduction in CO<sub>2</sub> emissions
- 25% renewable energy generation

In the longer term (by 2035), the campus will cease to use natural gas for heating, and the campus energy supply must be fully sustainable by 2040.

The following were realised in 2016:

- Completion of the 1.1 MWp Photovoltaic system, which generates 1 million kWh of electricity per year (of total electricity consumption of 50 million kWh).
- A grant of 45 million euros was obtained for the coming 15 years for the operation of a geothermal source that can heat the university's buildings and can also be used for research.
- The combined heat and power plant has been modified to facilitate the transition to the heating network.
- A contract has been concluded with Eneco for the supply of wind energy from the Luchterduinen offshore wind farm with effect from 1 January 2017. This will reduce the campus's CO<sub>2</sub> emissions by more than 50%. This means that 35% of the on-campus energy demand will be met from sustainable sources.

### Waste disposal

The collection of separated waste promotes reuse/useful application. Separation is not only essential from an environmental and hygienic perspective; separated waste and paper generate money. Together with the external waste processing company, TU Delft will ensure that waste separation at the source continues to be correctly performed. The diagrams below show the separation of the waste streams for 2016 and 2015.

For waste disposal at TU Delft, a distinction is made between the waste flows consisting of residual waste, paper, hazardous waste, glass, wood, metal, construction and demolition, and



rubble. The amounts of waste in the 2010-2016 period are shown below. Separate collection of plastic/foil as well as the organic waste from the restaurant kitchens commenced in 2014. As of 2016, paper coffee cups are also collected and processed separately. In 2016, there was a slight decrease in the total volume of waste, although

there was still an increase in the volume of certain types of waste. For example, there was more hazardous waste due to the disposal of old stocks of chemicals during the relocation to Applied Sciences South.

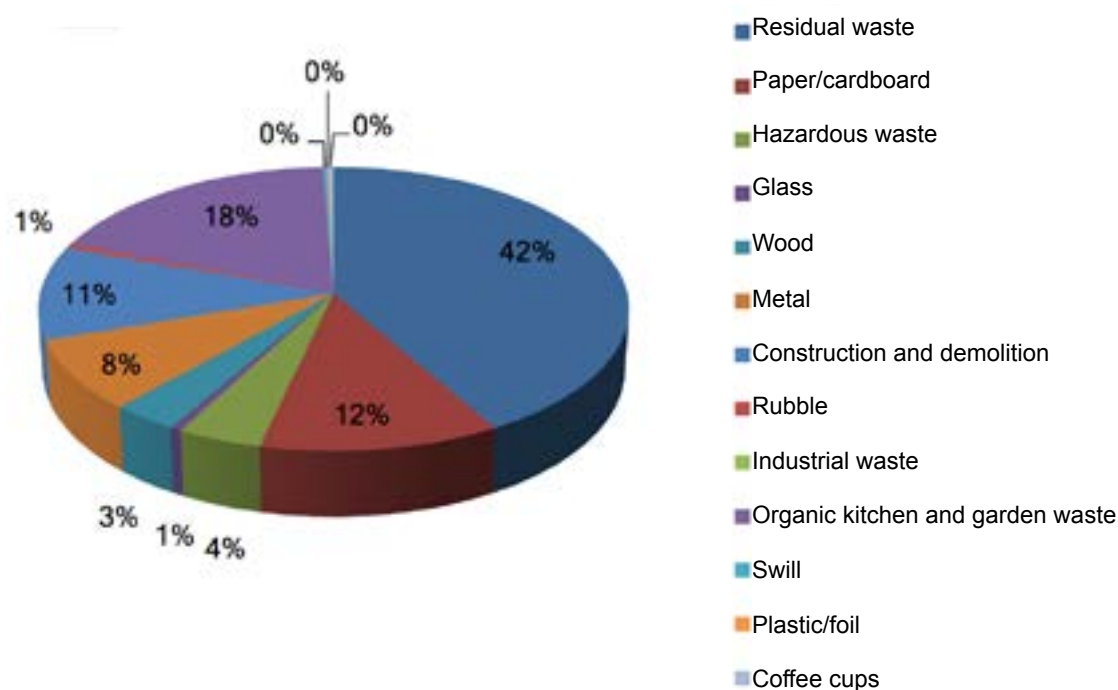
Waste streams at TU Delft (in tonnes)							
	2010	2011	2012	2013	2014	2015	2016
Residual waste	791.0	869.6	807.7	830.5	958.0	1092.0	1082.1
Paper/cardboard	401.0	404.3	413.6	345.4	429.8	441.5	308.0
Hazardous waste	87.0	107.7	82.9	96.7	64.2	97.3	107.8
Glass	12.5	11.0	11.6	13.9	14.3	17.1	15.6
Wood	76.6	60.6	73.9	73.0	63.8	103.7	85.0
Metal	152.8	147.8	167.9	113.8	165.8	242.8	210.1
Construction and demolition	157.5	160.9	139.9	167.2	171.4	331.1	276.8
Rubble	256.3	168.0	160.0	23.9	7.4	125.6	15.6
Industrial waste	73.4	68.0	66.8	73.9			
Organic kitchen and garden waste				55.8	70.0	202.2	474.3
Swill					7.0	12.4	7.5
Plastic/foil					0.5	2.2	2
Coffee cups							7.8
Total	2008	1998	1924	1738	1875	2668	2593

Industrial waste has been reported under 'residual waste' since 2014.

Swill and Plastic has been collected, processed and reported separately since 2014.

Coffee cups have been collected, processed and reported separately since 2016.

Organic kitchen and garden waste was partly reported until 2013, and has been fully reported since 2016.



## 5.8 Holding: TU Delft Services BV and TU Delft Enterprises

On 1 January 2016, TU Delft Holdings was divided into two separate holdings. One of the holdings, Delft Enterprises, is a venture-capital company with its own Supervisory Board, headed by Professor Rob Fastenau. Delft Enterprises manages TU Delft's shares in start-ups and spin-out companies. At the end of 2016, TU Delft had shares in some 50 companies. It is important that there is a clear exit strategy for each of the participations, which usually coincides with the first major external funding round. In 2016, Delft Enterprises participated in 11 new companies. The holding TU Delft Services BV includes the entities that relate to the primary objective of TU Delft, but are outside the main university organisation for fiscal reasons or for the sake of transparency. Examples include the HollandPTC proton clinic, the Bioprocess Pilot Facility (BPF), YES!Delft, and FlexDelft, TU Delft's internal payroll & secondment agency. These are entities for which there is no exit strategy.

In 2016, the WFOE (Wholly Foreign Owned Enterprise) was set up in Beijing, China. This facilitated the establishment of the Beijing Delft Institute of Intelligent Science & Technology Co.Ltd, a joint venture.

## 5.9 Collaboration

### TU Delft in the region

Within the Rotterdam/The Hague Metropolitan Region, government bodies, the business community and knowledge institutions are working to improve the economic business climate and to improve international, national and regional accessibility.

TU Delft is actively involved in a wide range of forums in the region. The Rector Magnificus of TU Delft is a member of the Executive Committee of the Economic Board of the region South Holland (EPZ), an organisation in which administrators from knowledge institutions and the public and private sectors work together to link their organisations in strategic initiatives. It is an administrative platform that helps to strengthen the economy.

TU Delft is a partner in The Hague Security Delta (HSD). Within this Dutch security cluster, more than three hundred businesses, government bodies and knowledge institutions work together on innovations and knowledge in the field of cyber

security, national and urban security, protection of critical infrastructure, and forensics. They share a common goal, namely more business activity, more jobs and a secure world. The Rector Magnificus of TU Delft is a member of the Executive Committee of HSD.

The 'Investing in Innovation' programme was launched on 6 July 2016. The aim of the programme is to renew the economy of the region and make it more sustainable, and it is geared to strengthening urgent economic structures. The programme was drawn up by the Rotterdam/The Hague Metropolitan Region, the EPZ and the Province of Zuid-Holland, and involves investments totalling 12 to 15 billion euros over the next ten years. These investments must be jointly generated by the business community, knowledge institutions and the public sector. Apart from the necessary economic renewal, the investments will ultimately create between 25,000 and 50,000 jobs. The 'Investing in Innovation' programme consists of 150 specific projects designed to strengthen the region's economic growth, employment, accessibility, sustainability and attractiveness.

InnovationQuarter (IQ) is the regional economic development agency for the Province of Zuid-Holland. It finances innovative and rapidly growing businesses, assists foreign companies in establishing offices in Zuid-Holland and organises partnerships between innovative entrepreneurs, knowledge institutions and the government. IQ is helping Zuid-Holland to develop into one of Europe's most innovative regions. TU Delft is one of the initiators of IQ.

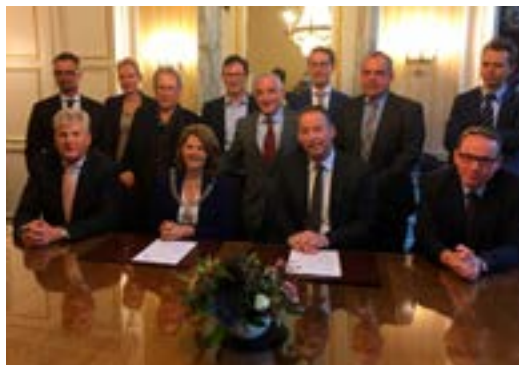
In 2016, UNIIQ, an investment fund for proof-of-concept phases, was set up. UNIIQ helps entrepreneurs in Zuid-Holland to shorten the time to market for their unique innovations. Entrepreneurs are actively supported in their strategic efforts through close cooperation with knowledge institutions and incubators. The fund was set up by a consortium comprising TU Delft, Erasmus MC, Leiden University and IQ. The shared ambition is to bring innovations to the market more quickly, thereby utilising the province's innovation potential.

### *Covenant between TU Delft and the Municipality of Delft*

On 1 November 2016, TU Delft and the Municipality of Delft signed a covenant to strengthen the collaboration between them. The closer collaboration focuses on 'the city as a

campus' and the ecosystem for knowledge and the economy. The themes are:

- business climate
- accessibility
- retaining talent in the region
- strong links between the university and city communities



One of the collaborations that have existed between TU Delft and the Municipality of Delft is Delft Technology Partners (DTP). DTP helps new knowledge-intensive companies to become established in Delft. It links and strengthens existing businesses and institutions in Delft through funding, community building and project development.

#### *Cooperation between TU Delft and Reinier de Graaf hospital*

The Reinier de Graaf hospital and TU Delft also signed a partnership agreement in November 2016. In order to deliver care of a higher standard that is more patient-centred, TU Delft and the hospital are working together in a 'living lab', in which care professionals at the Reinier de Graaf hospital are involved in the innovation process from an early stage. The main reason for signing the agreement was to set up an operating theatre for research at Reinier de Graaf.

#### **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. The aim of this alliance is to create added value for the institutions as well as the internationally operating economic region in which they are embedded. For more information, see [www.leiden-delft-erasmus.nl](http://www.leiden-delft-erasmus.nl).

#### *Education*

The range of LDE programmes was extended in 2016. Ninety students enrolled for the new minor

'Safety, Security and Justice', and the number of students enrolling for a minor at a partner university increased to 308. Development of the LDE Honours Classes continues. The programmes are designed for talented students with an enquiring mind who are looking for an additional challenge.

In September 2016, Leiden and Rotterdam launched the Master's specialisation 'Governance of Migration and Diversity'. TU Delft is contributing to the content of the curriculum.

In November 2016, the LDE MOOC 'Heritage under Threat' was launched, an education activity of the Centre for Global Heritage and Development.

In 2016, the post-initial Master's programme in Cyber Security in Leiden was launched.

The Centre for Safety and Security took the initiative to introduce a Cyber Security Honours Class.

The curriculum was designed by lecturers from three universities.

#### *Research*

The Centre for BOLD (Big, Open and Linked Data) Cities was launched in February 2016.

The centre uses data research to help develop solutions for urban issues.

The Centre for Frugal Innovation in Africa was awarded an NWO/MVI grant for a project that focuses on the development of frugal products, services and systems for East Africa ('frugal' means affordable and adapted to local cultures and circumstances).

In June 2016, seven new Medical Delta Professors were appointed. Eighteen professors now have a dual appointment, and the title Medical Delta Professor.

In addition, four universities of applied sciences from the Zuid-Holland region joined Medical Delta, and the E-health Initiative was launched. In addition, a number of Medical Delta projects were approved within the EIT Health consortium.

The Centre for Metropolis and Mainport works closely with SmartPort, the partnership focusing on knowledge development for the Rotterdam port area. On the basis of the roadmaps developed in the context of SmartPort, a number of project proposals worth a total of more than 12 million euros are being considered.

In 2016, the application for the Leading Fellows programme, a joint programme for a total of 90

postdocs of the LDE partners, Erasmus MC and LUMC, was granted under the European Marie Skłodowska-Curie Cofund programme.

Within the EIT Raw Materials partnership, various projects of the Centre for Sustainability were approved. The projects are worth a total of approximately 1 million euros. In 2016, the Centre for Economic and Financial Governance functioned as a think tank for the EU, advising on issues such as the consequences of BREXIT.

The Centre for Sustainability, together with the Province of Zuid-Holland and the Zuid-Holland Nature and Environmental Federation, organised the Challenge Circulair Zuid-Holland, in which student teams presented ideas for a circular economy in Zuid-Holland.

#### 4TU.Federation

In 2016, Wageningen University joined the partnership between the three universities of technology in the Netherlands, the 3TU.Federation. The federation is now known as the 4TU.Federation, and the cooperation on education and research will be extended further. With Wageningen University joining the federation, there are now opportunities for interesting cross-overs between High-Tech and Agriculture & Food in the field of water and the environment. Currently, possibilities for extending the portfolio of activities are being looked into.

##### Education

The 4TU.Centre for Engineering Education (CEE) plays a key supporting role in education. It is a joint initiative set up within the framework of the Technology Sector Plan. The Centre focuses on top-quality education through research and well-founded innovations. Its motto is 'Innovating engineering education for tomorrow's engineer'. In 2016, TU Delft contributed to the following activities that are carried out in parallel at all four universities:

- The design of effective interdisciplinary education in two different technological and scientific learning environments (Clinical Technology and Architecture).
- The preconditions for successful innovation in education (a bottom-up perspective).

Each institution also makes its own specific contribution. The contributions of TU Delft in 2016 concerned:

- The assessment in teaching practice of the engineer profiles developed in 2015 by the Delft think tank 'Free Spirit'.
- The publication of a new vision on engineering education that meets the needs of our rapidly changing society and technological world.
- Research into the added value in teaching practice of emerging technologies such as virtual simulations and virtual reality systems.
- Comparison of the impact of study success in the Bachelor's degree programme in Architecture and the Built Environment and in Electrical Engineering on students' intrinsic motivation and science mindset.

More information about the activities of 4TU.CEE can be found at [www.4tu.nl/cee](http://www.4tu.nl/cee).

##### Research

The addition of Wageningen University to the Federation enables an even stronger voice to be heard with regard to what is needed to achieve the Dutch ambitions in the areas of scientific and technological research and innovation.

The Federation's range of research focus areas are based in the following research centres:

- High Tech Systems (HTS);
- Netherlands Institute of Research on ICT (NIRICT);
- Fluid and Solid Mechanics (FSM);
- Applied Mathematics Institute (AMI);
- Ethics & Technology (Ethics);
- Built Environment (BE);
- Design United (DU);
- High Tech Materials (HTM);
- Human-Technology Interaction (HTI)

In addition, since 2008, the Federation has had a facility – the Data Centre – for carefully storing and permanently providing access to digital measurement data from applied and natural sciences.







6

# Financial report

## 6.1 Financial developments

The financial policy of TU Delft is aimed at achieving a structural balance between income and expenses. The university's equity capital must be maintained.

In 2016, TU Delft achieved a positive net result of 19.5 million euros, compared with a budgeted result of 0.0 million euros. In the longer term, increased operating expenses will be taken into account as a result of the necessary investments and the maintenance of the campus. The financial position expected in the longer term is discussed in more detail in the continuity section.

The financial results achieved by TU Delft in recent years were strongly influenced by exceptional events, such as the settlement following the fire at the faculty of Architecture and the Built Environment and the TU Delft Review. On the basis of these incidental effects, the institution will examine the operating results, excluding exceptional items, when assessing the activities. The positive result of 19.5 million euros includes a revised depreciation (2.6 million euros) of the Civil Engineering building. The expectation is that the building will remain in use until the end of 2026, 10 years longer than was initially planned. If this incidental effect is taken into account, the operating result is 16.9 million euros. The main reasons for this are the fact that a number of real-estate investments have been delayed, and the fact that the intake of teaching staff proceeded more slowly than expected.

### Pre-investment for the student loan system

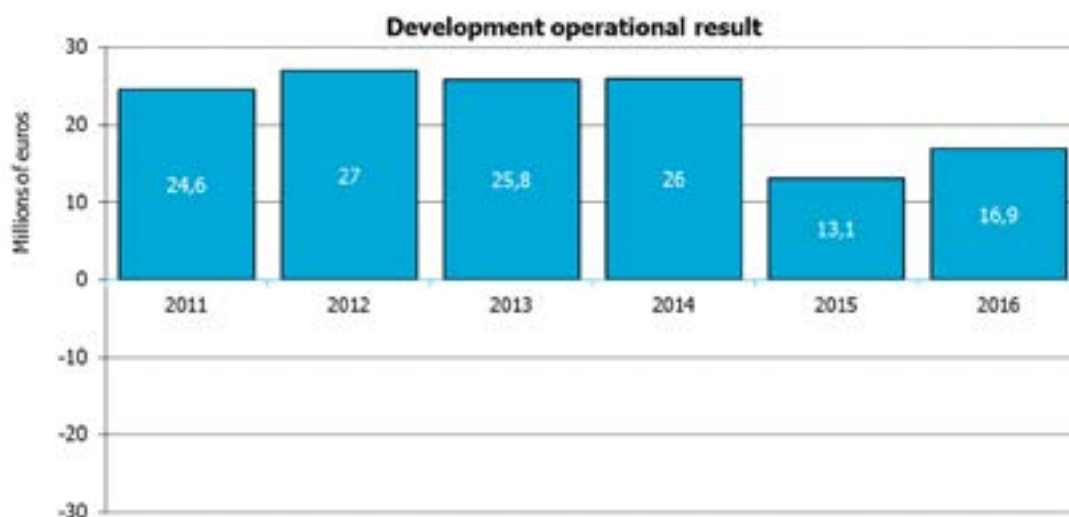
In 2016, a sum of 6.0 million euros was made available to the faculties for pre-investment of the student loan system. These means were used to improve the quality of education. Actual expenditure of the available means amounted to the sum of 5.2 million euros. The sum of 0.8 million euros that was not spent remains earmarked and available for the intended purposes.

### Gravitation programme

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 35.9 million euros was awarded to the entire consortium for the 2012-2016 period. Given the fact that the cash flow from the government contribution is not equal to the expenditure, 7.4 million euros (2015: 10.7 million euros) of the amount received was shown in the balance sheet at the end of 2016.

### 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 – risk relating to temporary surplus liquid assets, and maximising the interest earned on these. In the first half of 2016, the TU Delft treasury charter was aligned with the 2010 Investment and Loan Regulations for



Educational and Research Institutions drawn up by the Ministry of Education, Culture and Science. During 2016, 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 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.

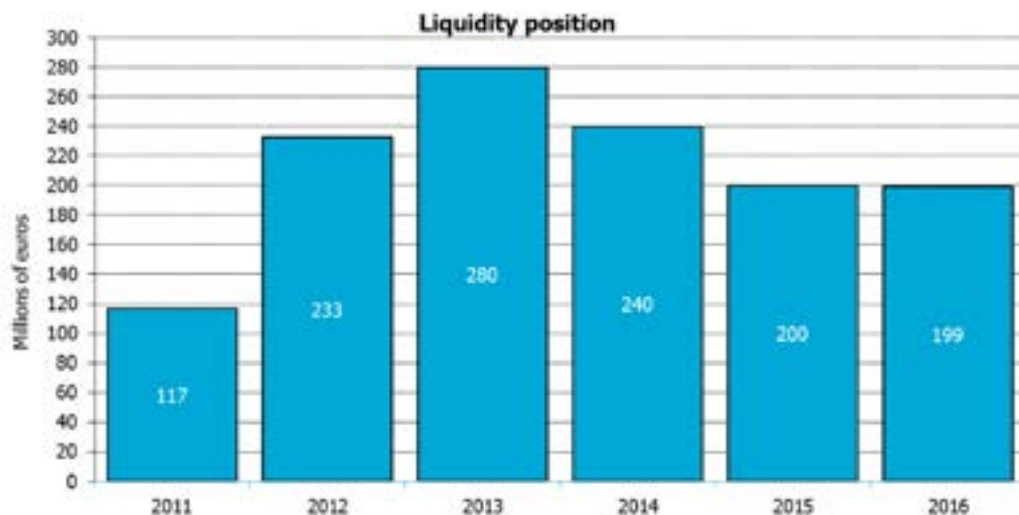
All temporary liquidity surplus that stems from the core activities of education, research and knowledge valorisation are public funds and are invested by TU Delft in savings products at various Dutch commercial banks with at least an A rating. The total balance of liquid assets is immediately available and is invested in the most risk-averse and flexible manner possible. Optimisation of interest income is pursued within this framework.

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). Forward exchange contracts are subject to a number of criteria. It is particularly important that there is considerable certainty regarding the receipt of the funding and the dates on which it will be received, and that these funds are spent in euros in their entirety.

Securities amounting to a total of 21.1 million euros are accounted for in the 2016 financial statements. 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 Lammingsfonds. 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 neutral risk profile.

## 6.2 Liquidity position

TU Delft's liquidity position at the end of 2016 amounted to 198.8 million euros, compared with 199.8 million euros at year-end 2015. In recent years, TU Delft has saved substantially in order to invest in new education and research facilities. In this context, there was a reduction in the liquidity position in 2014 and 2015. This stabilised in 2016. This is mainly due to the fact that careful preparation resulted in a delay in decision-making regarding the investment in new construction, which also meant that expenditure was delayed. The liquidity position at year-end 2016 includes the sum of 29.1 million euros (2015: 21.2 million euros)



relating to advances 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 following factors had a significant impact on the liquidity position in 2016:

- the expenditure resulting from the investments in tangible fixed assets (- 67.7 million euros);
- the result in the 2016 fiscal year (+ 19.5 million euros);
- the depreciation costs (+ 36.3 million euros), which did not lead to expenditure in 2016.

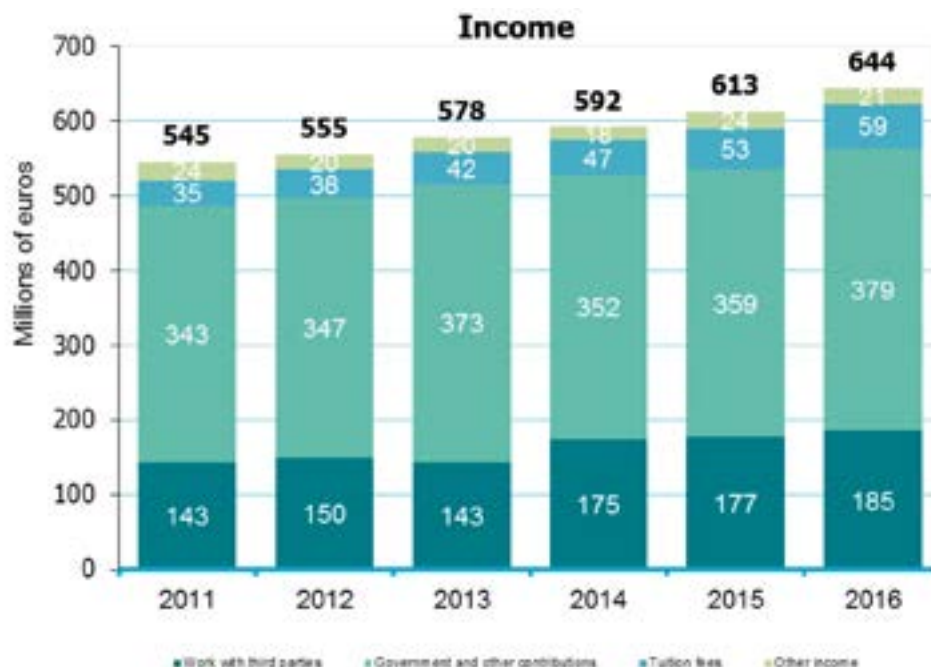
The surplus of liquid assets is temporary and necessary to fund the real-estate strategy, innovation in education and research, and the appointment of new staff as a result of increasing student numbers. The long-term financial estimate drawn up at year-end 2016 shows that the liquidity position will diminish in the coming years and that external funding will be required in the future as a result. TU Delft intends to obtain the necessary external funding by borrowing from the Ministry of Finance (treasury banking). The financial position in the longer term is discussed in more detail in the continuity section.

## 6.3 Income analysis

Total income (excluding financial income and the result from participating interests) in 2016 increased by 31.6 million euros to a level of 644.4 million euros. The chart below shows the development of income for the 2011-2016 period.

Government and other contributions increased by 19.9 million to 378.6 million euros in 2016. This increase is mainly attributable to increased funding that is the result of a growing student population (amendment of the reference framework of the Ministry of Education, Culture and Science) and the wage and price adjustment by the Ministry. Income from projects in collaboration with third parties increased by 7.7 million euros in 2016, continuing the upward trend of 2014 and 2015. QuTech, the public-private partnership in the field of quantum technology, generated an increase of 9 million euros. In 2016, income from projects in collaboration with third parties amounted to 184.8 million euros (2015: 177.1 million euros).

Tuition fees received in 2016 amounted to 59.4 million euros, compared to 52.7 million euros in 2015. The increase was mainly due to the growth of the student population.



## 6.4 Expenditure analysis

Total expenses, excluding financial income and expenses, increased by 18.4 million euros to 625.1 million euros in 2016. Personnel expenses increased by 21.6 million euros, while depreciation charges decreased by 3.6 million euros. Other expenses (including accommodation expenses) increased by 0.5 million to 170.5 million euros. see figure at the bottom of this page.

A breakdown of personnel expenses results in the following picture:

<b>Personnel expenses</b>		
<i>in millions of euros</i>	<b>2015</b>	<b>2016</b>
University personnel expenses	321,9	339,9
Third-party personnel	55,9	52,5
Change in provisions	5,9	8,4
Other personnel expenses	13,1	17,6
<b>Total</b>	<b>396,8</b>	<b>418,4</b>

### University personnel expenses

The number of FTEs at year-end 2016 was 4,939, representing an increase of 185 FTEs compared to year-end 2015. Of these 4,939 FTEs, 2,879 are academic staff and 2,017 are support and administrative staff. The number of student assistants decreased by 27 FTEs to 43 FTEs in comparison with 2015. This decrease is due to the fact that more student assistants were appointed for short periods, which means that they were not recorded as FTEs. The number of academic staff increased by 182 FTEs in 2016, while the number of support and administrative staff increased by 30 FTEs.

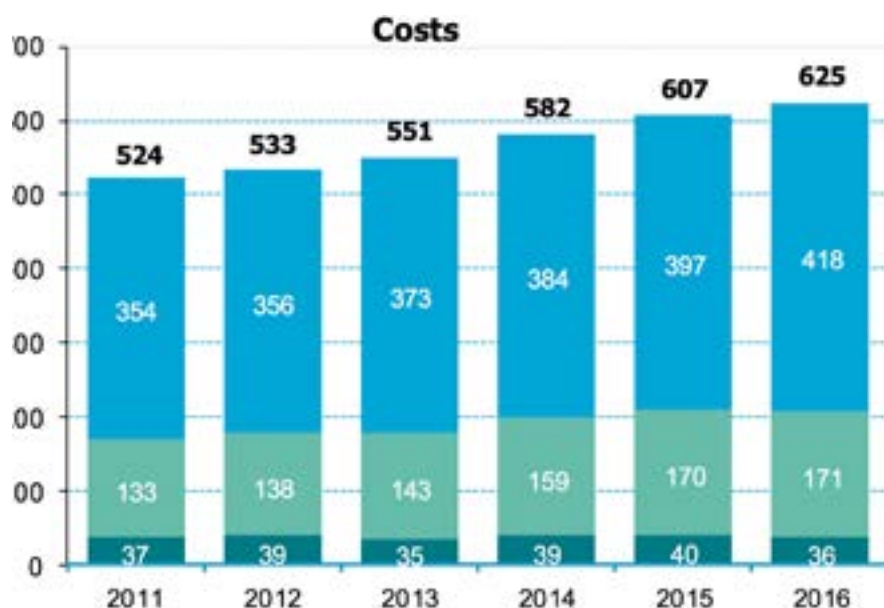
The increase in academic staff is partly due to pre-investments in anticipation of the student loan system, which were mainly made to permanently expand the number of teaching staff. In relation to the budget, however, this expansion is proceeding slower than expected. There was also a substantial increase (+ 148 FTEs) in the number of temporary academic staff (researchers and PhD candidates). The increase in these job groups also led to a visible increase in income from work for third parties, in particular at QuTech.

The number of administrative and support staff increased by 30 FTEs. The growth was due to a more robust real-estate organisation and the expansion of University Services.

The increase in total university personnel expenses from 321.9 million euros to 339.9 million euros is due to the increased number of FTEs and Collective Labour Agreement effects. University personnel expenses were 4.5 million euros lower than budgeted for 2016, mainly as a result of the fact that the intake of new staff proceeded more slowly than expected, particularly with regard to teaching staff.

### Third-party personnel expenses

There was a slight decrease in hiring of third-party personnel in 2016 compared to 2015. The decrease is particularly evident in indirect and contract funding. The increase in the cost of agency workers is mainly due to the hiring of student assistants for short periods, rather than





<b>Third-party personnel</b>		
<i>in millions of euros</i>	<b>2015</b>	<b>2016</b>
Education (hiring of full professors & guest lecturers)	4,0	3,9
Temporary agency workers	6,5	9,3
Payment for services rendered by third parties	25,6	22,8
Travel and accommodation expenses of third parties	2,8	2,6
<b>Government funding for personnel of third parties</b>	<b>38,9</b>	<b>38,6</b>
<b>Contract and indirect funding for personnel of third parties</b>	<b>17,0</b>	<b>13,9</b>
<b>Total</b>	<b>55,9</b>	<b>52,5</b>

deploying them as the university's own staff. In 2016, the pilot project with the External Hiring Unit was extended to all faculties. The unit will enable TU Delft to gain greater control over the hiring of external staff. In addition to realising cost savings, the unit provides greater insight into the expenditure and risk management relating to external hiring.

### Depreciations

Depreciations decreased by 3.6 million euros to 36.3 million euros. The decrease compared to 2015 is mainly due to the one-off accelerated depreciation in 2015 of equipment and inventory of the Faculty of Applied Sciences.

### Other expenses (including accommodation expenses)

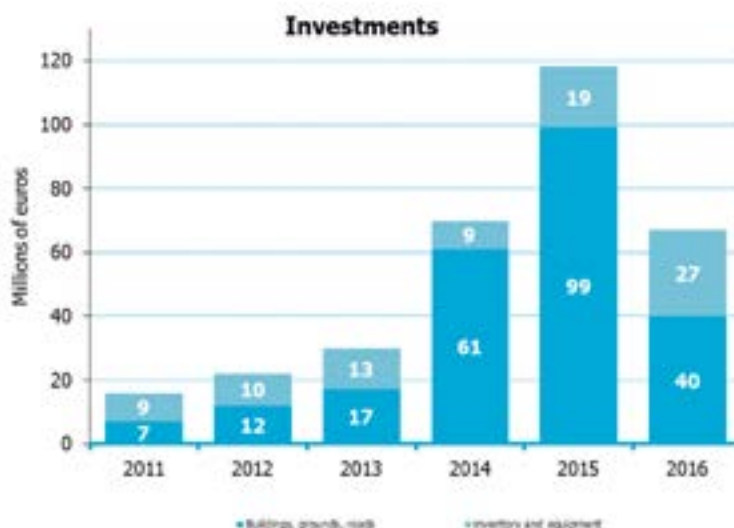
Other expenses (including accommodation expenses) in 2016 showed a slight increase in comparison with 2015. In 2016, the total sum of other expenses (including accommodation expenses) amounted to 170.5 million, compared to 170.0 million euros in 2015.

## 6.5 Investments

The total investments in buildings, grounds, roads, equipment and inventory decreased in 2016 compared to 2015. Investment in buildings, land and roads decreased from 98.4 million to 40.4 million euros. The most important investments in 2016 were made in the context of the total project comprising the Applied Sciences South building, catering facilities at the Kluyverpark, the PULSE education building and the Sports & Culture upgrade.

The investments in equipment and inventory increased from 19.2 million to 27.3 million euros. A total of 6.2 million euros of investments in equipment and inventory related to teaching rooms. The total investment level in 2016 therefore amounted to 67.7 million euros.

The chart below shows the investments for the 2011-2016 period, which makes it clear that the period 2010 to 2013 was used to develop and prepare the real-estate work programme. Therefore, a deliberate decision was made to invest less at the time. The effect of the implementation of the real-estate programme is visible from 2014 onwards.



## 6.6 Provisions

Total provisions increased by 4.4 million euros in 2016, from 57.6 million at the beginning of the year to 62.0 million euros at the end of the year. An increase in staff benefits accounted for 2.6 million euros. There was an increase of 1.8 million euros in non-staff provisions. Student provisions are dealt with in greater detail in the next section.

<b>Provisions</b>					
<i>in millions of euro's</i>	year-end 2015	allocation	changes in 2016 vrijval	onttrekking	year end 2016
<b>Staff benefits</b>					
Review provision	3,8	0,0	0,3	0,5	3,0
Reorganisation provision	4,5	1,5	0,9	0,8	4,3
Transition provision	0,0	0,0	0,0	0,0	0,0
Redundancy pay provision	10,2	7,1	0,6	3,7	13,0
Anniversary bonuses	6,2	1,6	0,0	0,6	7,2
Sabbatical	1,2	0,0	0,0	0,2	1,0
<b>Total staff benefits</b>	<b>25,9</b>	<b>10,2</b>	<b>1,8</b>	<b>5,0</b>	<b>28,5</b>
<b>Non-staff provisions</b>					
Student provisions	1,5	1,8	0,0	1,8	1,5
Fissionable materials provision	2,0	0,8	0,0	0,0	2,8
Asbestos provision	3,5	3,4	0,0	4,1	2,8
Sewer system provision	12,5	0,5	0,0	1,5	11,5
RID removal provision	12,2	2,7	0,0	0,0	14,9
<b>Total non-staff provisions</b>	<b>31,7</b>	<b>9,2</b>	<b>0,0</b>	<b>7,4</b>	<b>33,5</b>
<b>Total</b>	<b>57,6</b>	<b>19,4</b>	<b>1,8</b>	<b>13,2</b>	<b>62,0</b>

### Profiling Fund

The student provisions mentioned above relate to the Profiling Fund. In 2016, payments made from the Profiling Fund totalled €1,823 K. The payments are shown in the table below, by type:

Type of payment		
Total realised	exceptional circumstances	administration
k€ 1,823	k€ 857	k€ 966

In 2016, Profiling Fund payments were made to a total of 1,346 students. The number of grant months paid out was 4,267, an average of 3.2 months per student in 2016. Payments for exceptional circumstances were set at €288.95 per month, and payments for administration were set at €260.06 per month.

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

EU/non-EU				
<b>Number of EU students</b>	Total payments to EU students (in € x 1,000)	<b>Number of non-EU students</b>	Total payments to non-EU students (in € x 1,000)	Total RAS grants (in € x 1,000)
<b>1,325</b>	1,704	<b>21</b>	119	1,823

During the 2015/2016 academic year, 1,471 Profiling Fund applications were submitted (869 with regard to administrative activities and 602 with regard to exceptional circumstances). The applications and the number of months allocated are specified in the tables below:

#### Applications Profiling fund 2015/2016 exceptional circumstances

2015/2016	Files						Months		
	applications	granted	DUO	TUD	rejected	under consideration	months allocated	DUO	TUD
Illness	470	435	283	153	9	26	5.108	3.922	1.186
Family circumstances	59	51	16	35	5	3	401	199	202
Handicap	20	20	17	3			100	72	28
Educational ascendency	42	30	1	29	9	3	69	3	66
Topsports	9	8	1	7		1	98	12	84
Pregnancy	2	1		1		1	4		4
Total	602	545	318	227	23	34	5.778	4.208	1.570

2015/2016	Files				Months
	applications	granted	rejected	under consideration	months allocated
Box 1 (social clubs)	236	215	21	0	943
Box 2a (study associations)	323	301	21	1	1,205
Box 2b (fraternities)	2	1	1	0	2
Box 3 (sports and culture)	141	126	14	1	524
Box 4 (administration and representation of student interests)	95	87	7	1	326
Box 5 (projects)	72	67	3	2	403
Subtotal	869	797	67	5	3,403

## 6.7 Capital position

In comparison to 2015, thanks to the positive result the university's equity capital increased by 19.5 million in 2016, to 383.1 million euros. 19.1 million euros of the equity capital will be added to the general reserve. In addition, an amount of 0.1 million euros was withdrawn from the special-purpose reserve, and 0.5 million euros was added to the fund for special purposes.

## 6.8 Financial key indicators

The solvency ratio (equity capital / total capital) meets the standards of the Ministry of Education, Culture and Science (30%). The current ratio also satisfies the applicable lower limit of 0.5.

Financial ratios					
<i>in millions of euros</i>					
	2016	2015	2014	2013	2012
<b>Revenues</b>	644,4	612,8	591,6	578,2	555,0
Government and other contributions	378,6	358,6	352,3	373,6	346,7
Work with third parties	184,8	177,1	175,4	143,2	150,0
<b>Expenditure</b>	625,1	606,7	582,0	551,1	533,0
Financial income and expenditure	0,3	1,5	3,7	4,4	2,6
Result	19,5	5,8	12,1	31,2	25,1
Depreciation on fixed assets	36,3	39,9	38,7	34,7	39,1
Investments in fixed assets	67,7	117,6	70,2	29,6	22,3
Net cash flow	-0,1	-40,2	-39,6	47,1	115,5
Liquidity position	198,8	199,8	240,0	279,7	232,5
Fixed assets	447,1	419,1	334,0	313,5	318,6
Working capital	-23,2	-20,2	53,8	61,0	28,9
Equity capital	383,1	363,6	357,9	345,8	314,6
Provisions	61,9	57,6	52,9	50,9	51,7
<i>Ratios</i>					
Total revenue growth	+5,2%	+3,6%	+2,3%	+4,2%	+1,9%
Work for third parties growth	+4,4%	+1,0%	+22,5%	-4,5%	+4,6%
Total expenditure growth	+3,0%	+4,2%	+5,6%	+3,4%	+1,6%
Government contribution/total revenues	58,8%	58,5%	59,6%	64,6%	62,5%
Work for third parties/total revenues	28,7%	28,9%	29,6%	24,8%	27,0%
Personnel expenses/total expenses	66,9%	65,4%	66,1%	67,7%	66,9%
Solvency ratio	47,5%	47,9%	49,4%	47,2%	46,6%
Current ratio	1,0	1,0	1,2	1,2	1,2

## 6.9 Summarised financial statements

### Consolidated balance sheet as at 31 December 2016

Amounts in thousands of euros (after processing the result appropriation proposal). Consolidated statement of income and expenditure 2016.

Assets	2016		2015	
	€	%	€	%
<b>Fixed assets</b>				
Intangible fixed assets	0	0	0	0
Tangible fixed assets	433.522	53	405.992	53
Financial fixed assets	13.604	2	13.124	2
	447.126	55	419.116	55
<b>Current assets</b>				
Inventories	396	0	321	0
Receivables	139.953	17	118.331	16
Securities	21.140	3	22.251	3
Cash and cash equivalents	198.794	25	199.778	26
	360.283	45	340.681	45
<b>Total assets</b>	<b>807.409</b>	<b>100</b>	<b>759.797</b>	<b>100</b>
<b>Liabilities</b>	<b>2016</b>		<b>2015</b>	
	€	%	€	%
Equity capital	383.108	47	363.622	48
Provisions	61.915	8	57.550	8
Long-term liabilities	0	0	0	0
Current liabilities	362.386	45	338.625	45
<b>Total liabilities</b>	<b>807.409</b>	<b>100</b>	<b>759.797</b>	<b>100</b>



## 6.10 Rights and obligations not included in the balance sheet

<i>amounts in thousands of euros</i>	<b>2016</b>	<b>2015</b>	<b>2016 Budget</b>
<b>Revenues</b>			
Government contribution	378,549	358,262	361,500
Other government contributions and subsidies	13	379	0
Tuition and examination fees	59,442	52,712	59,600
Revenues from work for third parties	184,778	177,094	172,356
Other income	21,604	24,369	30,871
<b>Total revenues</b>	<b>644,386</b>	<b>612,816</b>	<b>624,327</b>
<b>Expenditure</b>			
Personnel expenses	418,377	396,772	405,208
Depreciations	36,287	39,884	43,841
Accommodation costs	66,084	68,143	71,319
Other expenses	104,363	101,862	104,891
<b>Total expenses</b>	<b>625,111</b>	<b>606,661</b>	<b>625,259</b>
<b>Balance of income and expenditure</b>	<b>19,275</b>	<b>6,155</b>	<b>-932</b>
Financial income and expenditure	272	1,472	932
<b>Result</b>	<b>19,547</b>	<b>7,627</b>	<b>0</b>
Taxes	-5	0	0
Result from participating interests and value adjustments to financial fixed assets	-56	-1,789	0
<b>Result after taxes</b>	<b>19,486</b>	<b>5,838</b>	<b>0</b>
Third-party interest in consolidated parties	-4	2	0
<b>Net result</b>	<b>19,482</b>	<b>5,840</b>	<b>0</b>

### 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.

### 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. As of 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, three buildings of TU Delft have been secured by a mortgage. At the end of 2016, a provision of 14.9 million euros for the future dismantlement of the RID was included in the financial statements, to which an annual allocation will be made, proportional to the period of use. An extended lifespan of the RID as a result of the Oyster investment project will lead to new amounts of radioactive waste, for which TU Delft will have to make new agreements with the Central Organisation for Radioactive Waste (COVRA) concerning the processing and storage of this radioactive waste, because



this quantity cannot be covered by the current agreement. In cooperation with several other parties including EPZ (Borssele nuclear power plant), TU Delft is currently in talks with COVRA about a new basic customer agreement. This will contain agreements on TU Delft's share in the funding of the necessary expansion of the storage capacity at COVRA.

### 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. The total estimated cost for the whole TU campus is nominally calculated at 27.0 million euros.

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.

The facility included is for expenditure expected in the 2017 financial year only.

### Investment obligations

At the end of the financial year, TU Delft had outstanding investment obligations equivalent to 25.4 million euros.

### Mapper Lithography Holding B.V.

TU Delft has concluded a conversion agreement with Mapper Lithography Holding B.V. In accordance with this agreement, the services from TU Delft are converted into shares in Mapper Lithography Holding B.V. The conversion agreement ended on 1 January 2017. From 2017, Mapper Lithography Holding B.V. will pay TU Delft for the services provided and invoiced.

### Guarantee for Technology Promotion Foundation

For the operation of Stichting Techniek Promotie ('Technology Promotion Foundation'), it has been agreed that a guarantee amounting to €300 K 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 €100 K to the financial management foundation of the 4TU.Federation.

### Forward exchange contract

In order to sharply reduce substantial 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 is 20.3 million US dollars, corresponding to the contribution from external parties laid down contractually. These future incoming funds will be received from 2016 to 2020. The value adjustment of the transactions of the hedged items amounted to -€834 K at year-end 2016. 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 euros 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 2016, HollandPTC had taken out a total of 48.5 million euros in loans from the EIB. This corresponds to 16.2 million euros in guarantees per shareholder.

### Quantum Technology (QuTech)

TU Delft, the Ministry 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 agreed upon 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 euros per year and a cash contribution of 2 million euros 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.

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.

### 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 cooperation agreement, the control is exercised jointly by the participants.

## 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 as 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 in the cash flow statement consists 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. The method used for valuation of balance sheet projects and the associated revenue recognition was further refined in 2015. This change in accounting estimates is due to the altered accrual method of the implementation costs to subsidy projects. The altered accrual method involves the use of hourly rates based on absorption costing as well as the full allocation of the time spent. The revenue from the subsidy projects is allocated to the years in line with the development of the implementation costs. This altered method therefore influences the revenue recognition of the subsidy projects.

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 consequences for the valuation of these existing buildings. The estimated depreciation periods for a number of buildings were shortened as a result.

According to the most recent plans in 2016, the CEG building will remain in use until at least 2026. As a result, the depreciation periods were extended in 2016 (after being shortened in 2014). Depreciation costs in 2016 and further are therefore reduced. The value of the impact of the revised depreciation periods in 2016 is €2,600 K.

## Comparative figures

A number of comparative figures for the 2015 financial year have been amended to ensure accurate comparison and presentation. This reclassification has no impact on the result or equity capital.

## 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 a tangible fixed asset concerns an impairment, refer to the paragraph below:

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.

### 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 for 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.

#### *Other receivables*

The 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.

### **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 work for 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 work for third parties is deducted from the receivable.

The method used for valuation of balance sheet projects and the matching of revenues and costs has been further refined since 2014.

### **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.

## Provisions

### 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 (2015: 3%).

### Sewer system provision

In calculating the sewer-system provision, a discount rate of 1.5% has been applied (2015: 2.5%).

### 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 concentrations of credit risk.

## 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 relating 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.

### 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.

#### 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 105%, 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.

As of 31 December 2016, the policy funding ratio of the ABP Pension Fund is 91.7 %.

### 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.

#### *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.

## 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:

	Commencement date of employment	End date of employment	Scope of task	Remuneration	Taxable fixed and variable expenses	Provisions for remuneration payable in the long term	Payment due to termination of employment
			FTE	2016	2016	2016	2016
<b>Administrators</b>							
Prof. T.H.J.J. van der Hagen (President)**	01-09-1987	*	1.0	108,892	-	10,486	-
Prof. K.Ch.A.M. Luyben (Rector Magnificus)	01-04-1983	*	1.0	187,340	8,263	16,341	-
Ms. drs. J.L. Mulder (Vice President for Education & Operations)	01-05-2003	*	1.0	179,166	8,263	15,718	-

\* : still employed at the year-end 2016

\*\* : Prof.dr.ir. T.H.J.J. van der Hagen was dean of the Faculty of Applied Sciences and was appointed as President of the Executive Board as of May 2016.

	Commencement date of employment	End date of employment	Remuneration	Payment taxable fixed and variable expenses	Provisions for remuneration payable in the long term	Payment due to termination of employment
			2016	2016	2016	2016
<b>Supervisors</b>						
Drs.ir. J. van der Veer (President)	01-07-2013	01-07-2017	20,850	-	-	-
Prof.dr. D.D. Breimer	01-05-2007	01-05-2017	17,757	-	-	-
Drs. J.C.M. Schonfeld	01-04-2008	01-05-2016	4,767	-	-	-
Mw. ir. L.C.Q.M. Smits van Oyen MBA	01-01-2013	01-01-2017	14,300	-	-	-
Drs. G. de Zoeten RC	01-05-2016	01-02-2020	9,533	-	-	-
Mw. Drs. C.G. Gehreis	01-06-2015	01-06-2019	14,300	-	-	-

## 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.

Amounts in euros	2016
<b>Prof.dr.ir. T.H.J.J. van der Hagen</b> (President)	
Travel expenses within the Netherlands	-
Travel expenses outside the Netherlands	-
Representation expenses	-
Other expenses	-
Total	-
<b>Prof.ir. K.Ch.A.M. Luyben</b> (Rector Magnificus)	
Travel expenses within the Netherlands	-
Travel expenses outside the Netherlands	-
Representation expenses	-
Other expenses	-
Total	-
<b>Ms drs. J.L. Mulder</b> (Vice President for Education and Operations)	
Travel expenses within the Netherlands	-
Travel expenses outside the Netherlands	620
Representation expenses	122
Other expenses	251
Total	993

The table below presents an overview of all expenses incurred by TU Delft on behalf of the members of the Executive Board in 2016:

Amounts in euros	2016
<b>Prof.dr.ir. T.H.J.J. van der Hagen</b> (President)	
Travel expenses within the Netherlands	226
Travel expenses outside the Netherlands	533
Representation expenses	124
Other expenses	465
Total	1,348
<b>Prof.ir. K.Ch.A.M. Luyben</b> (Rector Magnificus)	
Travel expenses within the Netherlands	-
Travel expenses outside the Netherlands	4,769
Representation expenses	452
Other expenses	
Total	5,211
<b>Ms drs. J.L. Mulder</b> (Vice President for Education and Operations)	
Travel expenses within the Netherlands	-
Travel expenses outside the Netherlands	3,209
Representation expenses	277
Other expenses	404
Total	3,890
<b>Joint expenses</b>	
Travel expenses within the Netherlands	87,247
Travel expenses outside the Netherlands	-
Representation expenses	-
Other expenses	-
Total	87,247

In 2016, TU Delft had two university vehicles. The total cost of owning and running these vehicles was €87 K. The vehicles were sold in December 2016. Other forms of transport have been used since that date.



## 6.16 Board statement

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 information important to the audit report on the financial statements and the funding data was 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

### ***Auditor's report by the independent accountant***

To: management and supervisory board of Delft University of Technology

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### ***Report on the financial statements 2016 included in the financial annual report***

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#### ***Our conclusion***

We have audited the 2016 financial statements of Delft University of Technology, Delft.

In our opinion:

- the financial statements included in the annual report give a true and fair view of the financial position of Delft University of Technology as at 31 December 2016, and of the results for the year 2016, in accordance with the Annual Reporting Regulations for Education (*Regeling jaarverslaggeving onderwijs*);
- the income and expenditure recorded in the financial statements, and the balance sheet movements in 2016, are in all material aspects in accordance with the provisions of relevant legislation and regulations, as specified in Section 2.3.1. (Reference Framework) of the *Onderwijsaccountantsprotocol OCW/EZ 2016* (protocol for education accountants, issued by the Ministry of Economic Affairs and the Ministry of Education, Culture and Science).

The financial statements comprise:

1. the consolidated and company balance sheet as at 31 December 2016;
2. the consolidated and company statement of income and expenditure for the year 2016; and
3. the notes, comprising a summary of the accounting policies and other explanatory information.

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#### ***The basis for our conclusion***

We conducted our audit in accordance with Dutch law, including the Dutch Standards on Auditing and the *Onderwijsaccountantsprotocol OCW/EZ 2016* (protocol for education audits, issued by the Ministry of Economic Affairs and the Ministry for Education, Culture and Science).

Our responsibilities under these regulations are further described in the section 'Our responsibilities with respect to the auditing of the financial statements'.

We are independent of Delft University of Technology in accordance with the *Verordening inzake de onafhankelijkheid van accountants bij assuranceopdrachten* (ViO, the Dutch auditor-independence regulations for assurance engagements) and other independence regulations that apply to audits in the Netherlands. We have also complied with the *Verordening gedrags- en beroepsregels accountants* (VGBA, code of conduct and professional practice for accountants).

Ref.: eo401948

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We believe that the audit information we have obtained is sufficient and appropriate to provide a basis for our conclusion.

### **Materiality**

We used our professional judgement to determine that materiality for the fairness of the financial statements as a whole was set at 6.44 million euros. The materiality is based on 1% of the total income. The materiality for financial legitimacy was set at 12.97 million euros. This materiality is based on 3% of the total public assets, as prescribed in the materiality table in Section 2.1.3 of the *Onderwijsaccountantsprotocol OCW/EZ 2016*. That section of the protocol also specifies a number of auditing and reporting tolerances that we applied.

We have also taken account of misstatements and/or possible misstatements that are, in our opinion, material for qualitative reasons. In auditing the information relating to the WNT (Public and Semi-public Sector Senior Officials (Standard Remuneration) Act) in the financial statements, we complied with the materiality provisions in the 2016 WNT audit protocol (*Regeling controleprotocol WNT 2016*).

We also agreed with the supervisory board that misstatements in excess of 322,000 euros, which are identified during the audit, would be reported to them, as would smaller misstatements that we believe must be reported on qualitative grounds or in accordance with the WNT.

### **Scope of the group audit**

Delft University of Technology is at the parent company of a group of entities. The financial information of this group is included in the consolidated financial statements of Delft University of Technology.

The group audit focussed on all entities that are part of the consolidation. We performed the audit ourselves at these entities, and did not make use of the services of other accountants in the audit.

By performing the procedures above at components, combined with additional procedures at group level, we have obtained sufficient and appropriate audit evidence regarding the financial information of the group as a whole to provide a basis for our opinion on the consolidated financial statements.

### **Key audit matters**

These key audit matters include matters which, in our professional judgement, were of most significance in our audit of the financial statements. We communicated the key audit matters to the supervisory board. The key audit matters are not a comprehensive reflection of all matters discussed.

Our auditing procedures for these key matters were determined as part of our audit of the financial statements as a whole. Our description of individual key matters must therefore be seen in this context, and not as individual opinions about the matters.

<i>Key audit matter</i>	<i>How our audit addressed the matter</i>
<p><b><i>Allocation of income from work for third parties</i></b></p> <p><i>The notes on income from work for third parties (subsidy projects) are included in the accounting policies and references 1.5, 2.4 and 3.4.</i></p> <p>The balance sheet position as at 31 December 2016 comprises a prepaid costs position of 92.8 million euros for multi-year projects and a position of 158.3 million euros for amounts received in advance for multi-year projects. These positions relate to research projects. Income from work for third parties was 184.8 million euros in 2016.</p> <p>Responsibility for the implementation and control of the subsidy projects rests with the faculties. Project administration and financial accounting comply with centrally established procedures.</p> <p>These subsidy projects often continue for several years, and the income is allocated to the years in line with the (expected) development of the implementation costs. Research is inherently unpredictable. This requires periodic re-assessment of expected implementation costs, particularly with regard to staffing and the related allocation of income. Consequently, revenue recognition is affected by the expectation regarding implementation costs to be incurred.</p> <p>We regard this as a key audit matter because of the size of the income from work for third parties, and the estimation element for the implementation costs to be incurred</p>	<p>As part of our audit procedures we assessed the system for, and the internal control of, allocating staff costs, overheads and material costs to research projects, given that income is allocated on the basis of implementation costs.</p> <p>Our procedures for the selected projects included an assessment of the accuracy of the allocated staffing costs, based on authorised registration of hours and correct hourly rates.</p> <p>We tested the most important assumptions that underpin the hourly rates (for the recognition of project hours charged), such as direct staff costs, overheads and productivity, against actual wage costs, productivity and compliance with the subsidy conditions.</p> <p>We assessed the completeness of the allocated hours by comparing them to the hours registered. We also assess the completeness of hour registration by performing checks on the hour registration system. In the context of our audit we can rely on these control measures.</p> <p>For the selected projects, we also checked the allocation of income and expenditure to the financial year by comparing actual and expected costs to the costs stated in the budget and updated forecasts, and to the subsidies allocated by means of award decisions.</p> <p>Finally, we assessed previous estimates for projects that were concluded in 2016, in order to determine the quality of the management's estimates. During these procedures, we discovered no material exceptions</p>

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### ***Appointment***

We were appointed by the supervisory board as auditor of Delft University of Technology on 8 May 2013 as of the audit for the 2013 financial year, and have operated as the external auditor since that date.

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### ***Report on the other information included in the annual report***

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In addition to the financial statements and our auditor's report thereon, the annual report contains other information that consists of:

- the director's report; and
- the other information.

Based on the procedures performed as set out below, we conclude that the other information:

- is consistent with the financial statements and does not contain material misstatements ;
- contains all information that is required by the Annual Reporting Regulations for Education and under Section 2.2.3 (on management board reports) of the Onderwijsaccountantsprotocol OCW/EZ 2016.

We have read the other information. Based on our knowledge and understanding obtained in our audit of the financial statements or otherwise, we have considered whether the other information contains material misstatements.

By performing these procedures, we comply with the requirements of the Annual Reporting Regulations for Education, with Section 2.2.3 (on management board reports) of the Onderwijsaccountantsprotocol OCW/EZ 2016, and with the Dutch Standard 720. The scope of such procedures was substantially less than the scope of those performed in our audit of the financial statements.

Management is responsible for the preparation of the other information, including the directors' report and the other information pursuant to the Annual Reporting Regulations for Education and the other legislation and regulations issued by the Ministry of Education, Culture and Science.

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### ***Responsibilities for the financial statements and the audit***

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#### ***Responsibilities of management and the supervisory board for the financial statements***

Management is responsible for the preparation and fair presentation of the financial statements, in accordance with the Annual Reporting Regulations for Education. Management is also responsible for the lawful realisation of the income and expenditure recorded in the financial statements, and for the balance sheet movements, in accordance with the provisions in the relevant legislation and regulations.

In that context, management is also responsible for such internal control as management determines is necessary to enable the preparation of the financial statements that are free from material misstatement, whether due to fraud or error.

As part of the preparation of the financial statements, management is responsible for assessing the foundation's ability to continue as a going concern. Based on the financial reporting framework mentioned, management should prepare the financial statements using the going-concern basis of accounting unless management either intends to liquidate the foundation or to cease operations, or has no realistic alternative but to do so. Management should disclose events and circumstances that may cast significant doubt on the foundation's ability to continue as a going concern in the financial statements.

The supervisory board is responsible for overseeing the foundation's financial reporting process.

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### *Our responsibilities with respect to the auditing of the financial statements*

Our responsibility is to plan and perform an audit engagement in a manner that allows us to obtain sufficient and appropriate audit evidence to provide a basis for our opinion. Our audit opinion aims to provide reasonable assurance about whether the financial statements are free from material misstatement. Reasonable assurance is a high but not absolute level of assurance which makes it possible that we may not detect all misstatements. Misstatements may arise due to fraud or error. They are considered to be material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements.

Materiality affects the nature, timing and extent of our audit procedures and the evaluation of the effect of identified misstatements on our opinion.

A more detailed description of our responsibilities is set out in the appendix to our report.

Amsterdam, 19 May 2017  
PricewaterhouseCoopers Accountants N.V.

Original signed by:  
R. Goldstein RA



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## *Appendix to the auditor's report*

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We exercised professional judgement and have maintained professional scepticism throughout the audit, in accordance with Dutch Standards on Auditing, the Onderwijsaccountantsprotocol OCW/EZ 2016, ethical requirements and independence requirements. Our audit consisted, among other things of the following:

- Identifying and assessing the risks of material misstatement of the financial statements, whether due to fraud or error, designing and performing audit procedures responsive to those risks, and obtaining audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the intentional override of internal control.
- Obtaining an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the foundation's internal control.
- Evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Concluding on the appropriateness of management's use of the going concern basis of accounting, and based on the audit evidence obtained, concluding whether a material uncertainty exists related to events and/or conditions that may cast significant doubt on the foundation's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report and are made in the context of our opinion on the financial statements as a whole. However, future events or conditions may cause the foundation to cease to continue as a going concern.
- Evaluating the overall presentation, structure and content of the financial statements, including the disclosures, and
- evaluating whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

Considering our ultimate responsibility for the opinion on the company's consolidated financial statements we are responsible for the direction, supervision and performance of the group audit. In this context, we have determined the nature and extent of the audit procedures for components of the group to ensure that we performed enough work to be able to give an opinion on the financial statements as a whole. Determining factors are the geographic structure of the group, the significance and/or risk profile of group entities or activities, the accounting processes and controls, and the industry in which the group operates. On this basis, we selected group entities for which an audit or review of financial information or specific balances was considered necessary.

We communicate with the supervisory board regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We provide the supervisory board with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

From the matters communicated with the supervisory board, we determine those matters that were of most significance in the audit of the financial statements of the current period and are therefore the key audit matters. We describe these matters in our auditor's report unless law or regulation precludes public disclosure about the matter or when, in extremely rare circumstances, not communicating the matter is in the public interest.

7

# Continuity section

## 7.1 Introduction

In accordance with the letter of the Ministry of Education, Culture and Science of 20 December 2013, a continuity section must be included in the annual report. The purpose of this section is to enable any stakeholder or interested party to examine how TU Delft handles the financial implications of the policy or proposed policy. The expected operating result in the coming years and the development of the capital position are thereby made transparent. This is discussed in part A of the continuity section. Part B of the continuity section discusses the manner in which the internal risk management system is organised and how this functions in practice. Furthermore, the description in part B also focuses on the risks and uncertainties that TU Delft will encounter in the coming years and the appropriate measures the university will take to deal with these risks and uncertainties.

## 7.2 1 Long-Term Budget (part A)

In recent years, TU Delft has consistently achieved positive operating results, due to the Review and limited expenditure on campus development. A negative financial result of 7.9 million euros is budgeted for 2017. The negative result is due to two main factors. First, TU Delft's costs are increasing as a result of the predicted increase in student numbers and the pre-investment (8.0 million euros) in anticipation of the student loan system. Second, a number of real-estate projects will be implemented in 2017. This pattern is set to continue for a number of years, and will have a growing negative impact on the operating result.

A long-term budget is drawn up twice a year, and any necessary amendments are made to the real-estate plans on the basis of changes in student numbers. These are also taken into account when estimating staffing numbers and cost, the government contribution and tuition fees. In the coming years (2017-2021), the real-estate programme will be fundable and affordable. The major projects in the programme are sequentially phased, which means that timely adjustments can be made if risks arise. The presented long-term budget is based on the numbers at the time of the budget approved by the Supervisory Board in December 2016.

## Key points of the 2017 budget

In 2017, the focus will be on optimising the Real Estate Strategy, improving the utilisation of space, and the related administrative aspects. Staff intake in relation to increases in student numbers will be closely monitored. The challenge will be to lay a foundation for the future that will enable TU Delft to continue operating in sufficient financial health, without compromising quality.

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

The budget includes a number of non-recurring accommodation costs. This involves a total amount of 9.0 million euros in demolition costs, operating expenses from projects and maintenance relating to the buildings of Civil Engineering, Electrical Engineering and Applied Sciences.

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 2017.

### *Investments*

Investments of 81.0 million euros in campus development have been taken into account. The investments concern a large number of ongoing projects and new projects to be started, including the PULSE teaching building, new construction and renovation of the Reactor Institute Delft, the relocation of Faculty of Electrical Engineering, and the implementation of functional user requirements. In addition to the real-estate investment, a sum of 27.3 million euros will be invested in equipment and inventory. Of this amount, 12.0 million euros will be invested by the faculties, 4.9 million euros will be invested in ICT, and 10.0 million euros will be invested in teaching rooms and catering facilities.

### *Student Loans (Higher Education) Act*

With effect from 2016, the Executive Board made available a budget of 6.0 million euros on a structural basis for pre-investment in anticipation of the Student Loans (Higher Education) Act. As of 2017, this pre-investment will be increased on a structural basis to 8.0 million euros per year. The prevention of undesirable developments in teaching loads was a decisive factor in dividing the additional 2.0 million euros among the faculties. The distribution of the 6 million euros allocated

to the faculties in the 2016 budget round remains unchanged, since it will be mainly used to finance long-term plans.

### Long-term budget

An overview of the budget for the period 2017 to 2021 is given below. The effects of wage and price adjustments are disregarded, and the 2017 price level has therefore been used for the 2018-2021 period. The pre-investment in anticipation of the student loan system is 8.0 million euros per year with effect from 2017, and this is the amount budgeted for the years 2018-2021.

We expect to see negative operating results in the coming five years. In 2018, the result will be influenced by non-recurring accommodation costs, due to the disposal of the Biotechnology, Kramers Lab and Yellow Chemistry buildings.

Based on the currently expected development of

the government contribution and tuition fees, it will not be possible to fund the increasing costs without intervention, and this will lead to negative operating results in the coming years. With regard to 4TU, it has been indicated to the Ministry for Education, Culture and Science that variability in income (government contribution and tuition fees) means that there is not sufficient funding to cover rising indirect accommodation costs and direct personnel costs.

Discussions are currently being held with the Ministry to find solutions to this problem. Policy-rich interventions and the provision of additional resources are among the possibilities being discussed.

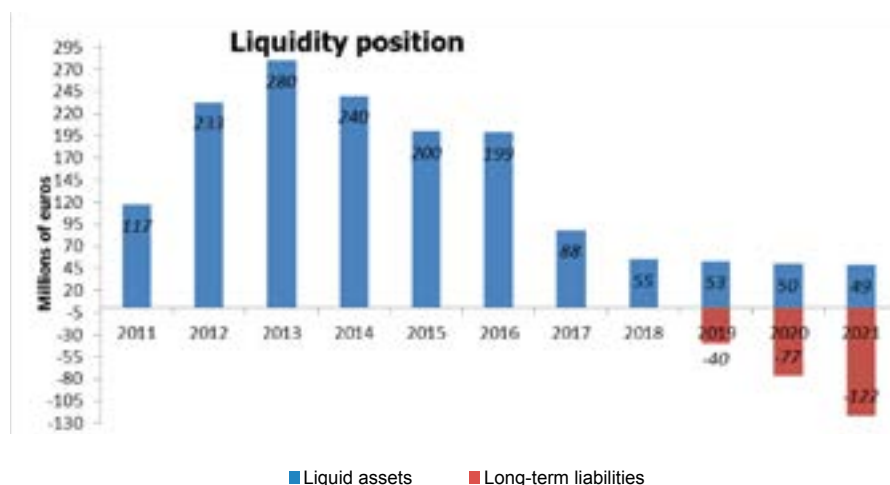
Multi-annual budget						
amounts in millions of euros	realised in 2016	2017 budget	2018 budget	2019 budget	2020 budget	2021 budget
<b>Revenues</b>						
Government contribution (incl. other government contributions and subsidies)	379	371	373	374	376	386
Tuition and examination fees	59	64	67	68	69	70
Revenues from work for third parties	185	180	180	180	180	180
Other income	22	26	26	26	26	26
<b>Total revenues</b>	<b>644</b>	<b>641</b>	<b>646</b>	<b>648</b>	<b>652</b>	<b>663</b>
<b>Expenditure</b>						
Personnel expenses	418	424	425	426	429	432
Depreciations	36	42	42	44	53	55
Accommodation costs	66	66	80	68	59	66
Other expenses	104	115	115	115	115	115
<b>Total expenses</b>	<b>625</b>	<b>646</b>	<b>661</b>	<b>652</b>	<b>655</b>	<b>667</b>
<b>Balance of income and expenditure</b>	<b>19</b>	<b>-6</b>	<b>-16</b>	<b>-5</b>	<b>-3</b>	<b>-4</b>
Financial income and expenditure	0	1	1	0	-1	-2
<b>Result</b>	<b>19</b>	<b>-5</b>	<b>-15</b>	<b>-5</b>	<b>-4</b>	<b>-6</b>
Result from participating interests and value adjustments to financial fixed assets	-1	-3	-2	0	0	0
<b>Result before taxes</b>	<b>19</b>	<b>-8</b>	<b>-17</b>	<b>-5</b>	<b>-4</b>	<b>-6</b>
Taxes	0	0	0	0	0	0
<b>Result after taxes</b>	<b>19</b>	<b>-8</b>	<b>-17</b>	<b>-5</b>	<b>-4</b>	<b>-6</b>
Third-party interest in consolidated parties	0	0	0	0	0	0
<b>Net result</b>	<b>19</b>	<b>-8</b>	<b>-17</b>	<b>-5</b>	<b>-4</b>	<b>-6</b>

The balance sheet below shows the budget for the period 2017-2021:

Assets	realised in 2016	2017 budget	2018 budget	2019 budget	2020 budget	2021 budget
amounts in millions of euros	ME	ME	ME	ME	ME	ME
<b>Fixed assets</b>						
Intangible fixed assets	0	0	0	0	0	0
Tangible fixed assets	434	494	514	556	596	640
Financial fixed assets	14	17	17	18	18	19
	447	510	531	574	614	659
<b>Currents assets</b>						
Supplies	0	0	0	0	0	0
Receivables	140	137	135	133	131	128
Securities	21	22	22	22	23	22
Liquid assets	199	88	55	53	50	49
	360	247	213	208	204	200
<b>Total assets</b>	<b>807</b>	<b>758</b>	<b>744</b>	<b>782</b>	<b>818</b>	<b>859</b>
<b>Liabilities</b>	<b>realised in 2016</b>	<b>2017 budget</b>	<b>2018 budget</b>	<b>2019 budget</b>	<b>2020 budget</b>	<b>2021 budget</b>
	ME	ME	ME	ME	ME	ME
<b>Equity capital</b>						
General reserve	360	373	357	350	346	340
Special-purpose reserve	-2	0	-1	1	2	2
Fund for special purposes	25	-2	-2	-2	-2	-2
	383	371	354	349	345	339
Provisions	62	46	49	52	55	57
Long-term liabilities	0	0	0	40	77	122
Current liabilities	362	341	341	341	341	341
<b>Total liabilities</b>	<b>807</b>	<b>758</b>	<b>744</b>	<b>782</b>	<b>818</b>	<b>859</b>

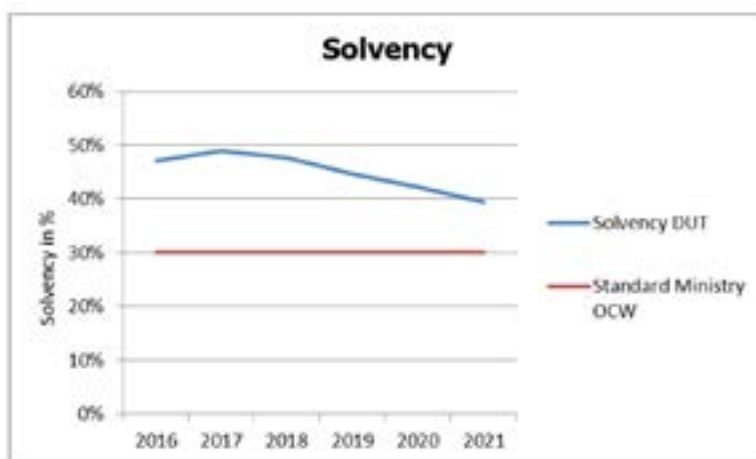
Investment in campus development will result in an increase in tangible fixed assets in the coming years. On the other hand, this will result in decreasing liquid assets. This trend will continue,

and will lead to TU Delft borrowing money from 2019 onwards. There will then no longer be a surplus of financial resources. Liquid assets are shown in the chart below.





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



### Expected staff numbers

The table below shows the expected development of the FTE numbers. A distinction is made between the job groups 'academic staff', 'administrative and support staff' and 'student assistants'. The classifications in this system are different from the format prescribed in the letter from the Ministry of Education, Culture and Science, but they are in line with the system generally used at TU Delft. The FTE numbers are based on the numbers realised in 2016 and the budget approved by the Supervisory Board in December 2016 for the following years.

In 2016, the number of teaching staff appointed was less than expected. It is proving difficult to find good teaching staff. The figures for 2017 reflect this surplus from 2016, with some growth through the additional resources relating to the Student Loan Act. We also see a shift from temporary staff to permanent staff in 2017. In the subsequent years we see an increase in the total number of academic staff (in FTEs), which will be mainly visible in the number of temporary academic staff.

FTE development	2016	2017	2018	2019	2020	2021
<b>Academic staff (WP)</b>	<b>2.879</b>	<b>2.903</b>	<b>2.922</b>	<b>2.959</b>	<b>2.996</b>	<b>2.996</b>
of which temporary WP	1.770	1.718	1.734	1.768	1.805	1.805
of which permanent WP (or prospect of permanent)	1.109	1.185	1.188	1.191	1.191	1.191
<b>Administrative and support staff (OBP)</b>	<b>2.017</b>	<b>2.055</b>	<b>2.059</b>	<b>2.056</b>	<b>2.057</b>	<b>2.057</b>
<b>SA</b>	<b>43</b>	<b>34</b>	<b>41</b>	<b>39</b>	<b>34</b>	<b>34</b>
	<b>4.939</b>	<b>4.992</b>	<b>5.022</b>	<b>5.054</b>	<b>5.087</b>	<b>5.087</b>

### Expected student numbers

The TU Delft assumes that student numbers will approach 25,000 in 2025. The estimate below for the period until 2021 was made when the budget was approved in December 2016.

	2016	2017	2018	2019	2020	2021
Student numbers	21,750	21,950	22,250	22,800	23,400	23,800

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

The internal risk management and control system at TU Delft is organised as follows.

### Planning and Evaluation Cycle (P&E cycle)

The institution-wide Planning & Evaluation Cycle (P&E cycle) is the core process systematically supporting the strategic planning for TU Delft. The P&E cycle is an instrument consisting of processes and products, administrative dialogue and agreements that allow the administration and management of TU Delft (Executive Board, deans, departmental directors and managers) to find answers to the core questions: 'Are we doing the right things?' (strategy and planning) and 'Are we doing them well?' (monitoring & evaluation). This TU Delft-wide cycle is an accepted working method within the academic community.

The P&E cycle forms the framework that enables the administration and management of the university to formulate objectives, identify risks, monitor processes and adjust them in time.

### Nature of the university organisation

The university is an open network organisation. 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. Furthermore, universities are publicly financed organisations that are required to give proper account of their actions. To achieve this, it is essential that the many internal processes which keep the university in operation are strictly controlled.

### Internal process control

Internal process control enables the institution's administration and management to aim for set objectives and to identify and manage risks to those objectives in time. 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.

### Four perspectives

The approach to and quality of the internal process control forms an important part of the administrative agenda. To this end, the control instruments are organised into four groups:

- Culture, behaviour and integrity. What core values are part of the culture of the organisation? One example is delivering high academic quality in view of academic integrity.
- Communication. What strategic plans, risks, opportunities and uncertainties 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?

TU Delft: Governance / Internal Control - Principles of Design



This approach allows TU Delft to pay attention to both 'hard' management instruments, such as regulations and monitoring reports, and to 'soft' aspects, such as values and dialogue. The strategic planning and internal process management can thus be analysed and discussed from four different perspectives. Strategic planning and internal process management (and its quality) dominate the agenda of the administrative meetings in the P&E cycle.

### TU Delft Vision on Management Control

The planning approach from four perspectives mainly addresses the best method for approaching the internal process management. TU Delft has developed a frame of reference to implement management control within a university context. The COSO framework was an important source of inspiration.

#### *Inspiration and reference*

The COSO framework – ‘translated’ to the university setting – has been able to inspire the various organisational levels of TU Delft to give closer consideration to the meaning of management control in an academic context, and which aspects are important in this respect. The framework has streamlined and supported discussions.

In practice, TU Delft management control uses the COSO framework to determine where intended activities with regard to risk management (in combination with internal audit working plan) can be best positioned and whether all relevant aspects have been considered. This pragmatic approach to the COSO model has proven to be best suited to a university context.

#### *Relationship to P&E cycle*

Naturally, the P&E cycle is crucial in this respect, because this system and the associated administrative consultations clarify how the internal process control functions and thus provide primary input for a thorough risk analysis.

#### *Internal Audit Function (IAF)*

The IAF provides (additional) certainty to the Executive Board regarding the extent to which the risks that threaten the objectives of TU Delft are controlled. The IAF also provides recommendations to improve the governance, risk management and internal management & control processes at TU Delft. The audit of the financial statements and specific external accounts of TU Delft is the responsibility of the external auditor.

*1 COSO = Committee of Sponsoring Organizations of the Treadway Commission. COSO assumes that this framework allows organisations to effectively and efficiently develop and maintain their internal process control, thereby improving the feasibility of strategic objectives*

## 7.4 Description of the most important risks and uncertainties (part B2)

### SWOT analysis

The SWOT analysis below is based on the environmental analysis included in the Roadmap TU Delft 2020, the strategic plan of TU Delft.

The SWOT analysis will be updated as part of the new strategic plan for the period 2018- 2024.

#### *Own strengths*

- International academic reputation
- Clear technical and scientific profile
- Perspectives: Science, Engineering, Design
- High-quality, broad engineering degree programmes
- Leading infrastructure
- Strong strategic partnerships
- Lively student culture

#### *External threats*

- Autonomy of universities under pressure
- Minor investments in knowledge system
- Increasing bureaucracy and regulatory burden
- Uncertainty regarding the stability of government funding
- Decrease in NWO resources
- Competition for academic talent
- Rising costs of infrastructure and accommodation

#### *Essential improvements*

- The right student in the right place at the right time
- Substantial acceleration of the study duration
- Investment in the teaching qualities of staff
- Keeping the infrastructure and accommodation vibrant
- Improving the pass rate and shortening the PhD programme duration
- Continuing the development of the valorisation activities
- Improving entrepreneurship training

#### *External opportunities*

- Grand Challenges for Society
- Dominant role of the European Union: Horizon 2020
- Strategic alliance with Leiden & Erasmus
- Increased coordination in the 4TU.Federation
- Innovative top sectors
- Public-private partnerships
- Emerging knowledge economies
- Modern teaching methods, including digital forms

TU Delft has the following strategic priorities:

#### *Students & Education*

- Differentiation and breadth in Bachelor's degree programmes
- Profiling of Master's degree programmes
- Professional Doctorate in Engineering
- Graduate School – Doctoral Education
- Postgraduate courses
- Quality of student intake
- Study success
- Development of excellence programmes
- Modern teaching methods, including digital forms
- Teaching abilities of academic staff
- Institutional accreditation, quality assurance and student satisfaction
- 4TU and Leiden-Delft-Erasmus partnerships

#### *Research*

- Scientific profile: science, design, engineering
- Interfaculty alliances (TU Delft Institutes)
- Grand Challenges for Society – four priority areas
- Strategic research cooperation
- International peer reviews and rankings
- Individual and group quality
- Top sectors and Horizon 2020
- Fundraising
- State-of-the-art research infrastructure

#### *Valorisation*

- TU Delft valorisation profile 2012-2020
- TU Delft Valorisation Agenda 2020
- Structural cooperation with businesses and government
- Cooperation with SMEs
- Delft Technological Innovation Campus
- Support organisation for knowledge valorisation: TU Delft Valorisation Centre
- Entrepreneurship training and development of new commercial activity
- Intellectual property
- Debate on ethical aspects of public-private partnerships

The realisation of the strategic priorities listed above will be ensured by using, among other things, the available management information and the results of the investigations conducted by the internal audit function.

## 7.5 Report of the supervisory body (part B3)

The report by the Supervisory Board can be found on page 13 of this report.









## Faculties and departments (at 31 December 2016)

### Faculty of Architecture and the Built Environment

#### Department

Architecture  
Management in the Built Environment  
Architectural Engineering + Technology  
Urbanism  
OTB - Research for the Built Environment

#### Chair

Prof.dr. D.E. (Dick) van Gameren  
Prof.dr. *ir.* J.W.F. (Hans) Wamelink  
Prof.dr. *ir.* A.A.J.F. (Andy) van den Dobbelsteen  
Dr.*ir.* M.J. (Machiel) van Dorst  
Prof.dr. P.J. (Peter) Boelhouwer

### Faculty of Civil Engineering and Geosciences

#### Department

Structural Engineering  
Transport & Planning  
Geoscience & Engineering  
Geoscience & Remote Sensing  
Hydraulic Engineering  
Water Management

#### Chair

Prof.dr.*ir.* J.G. (Jan) Rots  
Prof.dr.*ir.* B. (Bart) van Arem  
Prof.dr.*ir.* J.D. (Jan Dirk) Jansen  
Prof.dr.*ir.* H.W.J. (Herman) Russchenberg  
Prof.dr.*ir.* W.S.J. Uijtewaal  
Prof.dr.*ir.* L.C. (Luuk) Rietveld

### Faculty of Electrical Engineering, Mathematics and Computer Science

#### Department

Software and Computer Technology  
Microelectronics  
Electrical Sustainable Energy  
Intelligent Systems  
Applied Mathematics

#### Chair

Prof.dr. A. (Arie) van Deursen  
Prof.dr. K.A.A. (Kofi) Makinwa  
Prof.dr.*ir.* M. (Miro) Zeman  
Prof.dr.*ir.* R. (Inald) Lagendijk  
Prof.dr.*ir.* G. (Geurt) Jongbloed

### Faculty of Industrial Design Engineering

#### Department

Design Engineering  
Industrial Design  
Product Innovation Management

#### Chair

Prof.dr. P. Vink  
Prof.dr.*ir.* R.H.M. Goossens  
Prof.dr. H.J. (Erik Jan) Hultink

### Faculty of Aerospace Engineering

#### Department

Aerodynamics, Wind Energy, Flight  
Performance and Propulsion  
Control and Operations  
Aerospace Structures & Materials  
Space Engineering

#### Chair

Prof.dr. F. (Fulvio) Scarano  
Prof.dr.*ir.* M. (Max) Mulder  
Prof.dr.*ir.* R. (Rinze) Benedictus  
Prof.dr. E.K.A. (Eberhard) Gill

### Faculty of Technology, Policy and Management

#### Department

Multi Actor Systems  
Engineering Systems and Services  
Values, Technology and Innovation

#### Chair

Prof.mr.dr. J.A. (Hans) de Bruijn  
Prof.dr.*ir.* P.M. (Paulien) Herder  
Prof.dr.*ir.* I.R. (Ibo) van de Poel

## Faculty of Applied Sciences

### Department

Bionanoscience  
Biotechnology  
Chemical Engineering  
Imaging Physics  
Quantum Nanoscience  
Radiation Science & Technology

### Chair

Prof.dr. M.( Marileen) Dogterom  
Prof.dr. I.W.C.E. (Isabel) Arends  
Prof.dr.*ir.* M.T. (Michiel) Kreutzer  
Prof.dr.*ir.* L.J. (Lucas) van Vliet  
Prof.dr. L. (Kobus) Kuipers  
Prof.dr. H.T. (Bert) Wolterbeek

## Faculty of Mechanical, Maritime and Materials Engineering

### Department

Process and Energy  
Biomechanical Engineering  
Maritime and Transport Technology  
Materials Science and Engineering  
Precision and Microsystems Engineering  
Delft Center for Systems and Control

### Chair

Prof.dr.*ir.* B.J. (Bendiks Jan) Boersma  
Prof.dr. H.E.J. (Dirk Jan) Veeger  
Prof.*ir.* J.J. (Hans) Hopman  
Prof.dr. I.M. (Ian) Richardson  
Prof.dr. U. (Urs) Staufer  
Prof.dr.*ir.* J. (Hans) Hellendoorn









## Glossary

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 <b>students who discontinue their studies</b> 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* (obtained a degree certificate). This can be broken down into different groups (such as foreign citizens, women and joiners from pre-university education). * or institution, faculty

Bridging class Bridging programme	<p>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.</p> <p>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.</p>
Student (degree student)	<p>A student is a person who is enrolled 'as a student' at TU Delft in accordance with the Higher Education and Research Act.</p> <p>The following students are included in the education statistics of TU Delft (on the reference date of 1 December):</p> <ul style="list-style-type: none"> <li>• those who are enrolled as full-time or external students</li> <li>• those who intend to complete a TU Delft programme and obtain a degree certificate</li> <li>• those who paid tuition or examination fees to TU Delft<sup>1</sup></li> </ul> <p>Only their main study programme counts (a student can be enrolled in multiple study programmes, but will only be counted once).</p> <p>The counts do not include the following students, unless specified otherwise:</p> <ul style="list-style-type: none"> <li>• exchange students</li> <li>• freemover students</li> <li>• minor students</li> <li>• guest students</li> <li>• contract students</li> </ul> <p>These exceptions concern students who do study at TU Delft, but who <b>do not</b> intend to take a degree audit here.</p>
Duration of study	<p>The time that elapses (in years) between the first-time enrolment and the time at which the relevant diploma has been achieved.</p> <p>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.</p>
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).
Joiner from pre-university education	A student who earned the VWO diploma in the same academic year as the one in which he or she enrolled at TU Delft as a first-year student.

<sup>1</sup> The condition 'Has paid the tuition fee to TU Delft' means that some of the students active in the so-called shared programmes are NOT included in these indicators! (Shared programmes are organised in collaboration with another university, such as the B-LST, B-MST and M-IE programmes, organised by Applied Sciences in collaboration with Leiden University). In the case of the faculty of Applied Sciences, this means a total of more than 450 students.







## Clarity notes

### **TU Delft personnel and initial degree programmes**

Data on the enrolment of personnel in initial degree programmes is not aggregated. If this does occur, 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 (excluding the Architecture and the Built Environment intake in February) and are enrolled in a Bachelor's degree programme in order to follow a bridging programme in accordance with an agreement with the Ministry. In addition, there was a group of about ten freemovers each year; these are independent international students who take several courses at TU Delft and are not involved in exchange contracts. Freemovers are not entered for funding. The intake of freemovers will be phased out from September 2016 onwards.

### **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 always 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 an exchange agreement with 56 knowledge institutions outside the Netherlands. In the 2015-2016 academic year, 614 foreign students participated in an exchange programme at TU Delft and there was an equivalent number of outgoing exchange students. There were no applications for funding for any of these students. More than 2,000 Dutch students gained international experience during the course of their degree programme this year. An overview of the knowledge institutions with which TU Delft has an exchange agreement can be found at <http://www.tudelft.nl/studeren/exchange>.



## Full-professor appointments

Name	m/f	chair/work area	faculty	date of decision	FTE	duration
Dr. B.H.W. Hendriks	m	Optics for Minimally Invasive Instruments	3mE	26 January 2016	0.2	5 years
Dr. J.R. van Ommen	m	Antoni van Leeuwenhoek Professor	AS	2 February 2016	1.0	indefinite period
Dr. M. Verlaan	m	Data Assimilation	EEMCS	1 March 2016	0.2	5 years
Dr. S.C. Pont	f	Antoni van Leeuwenhoek Professor	IDE	22 March 2016	1.0	indefinite period
Prof. R.G.H.H. Nelissen	m	Medical Delta Professor	3mE	22 March 2016	0.0	indefinite period
Prof. C.L. Wyman	f	Molecular Biology	AS	22 March 2016	0.0	4 years
Dr. S.G.J. Aarninkhof	m	Coastal Engineering	CEG	12 April 2016	1.0	indefinite period
Prof. L.A. Tavasszy	m	Freight and Logistics	CEG and TPM	10 May 2016	1.0	indefinite period
Prof. C.A.M. Marijnen	m	Medical Delta Professor	EEMCS	24 May 2016	0.2	5 years
Dr. D. Casalino	m	Aeroacoustics	AE	7 June 2016	1.0	indefinite period
Dr. C.S. Vaucher	m	Integrated Mm-Wave Frontends	EEMCS	21 June 2016	0.2	5 years
Dr. M. Bakker	m	Computational Groundwater Dynamics	CEG	5 July 2016	1.0	indefinite period
Dr. A. Martinius	m	Petroleum Geology	CEG	20 Sept 2016	0.3	5 years
Prof. D.P. DiVincenzo	m	Quantum Computing	EEMCS	27 Sept 2016	0.2	indefinite period
Prof. B.M. Terhal	f	Quantum Computing	EEMCS	27 Sept 2016	0.8	indefinite period
Dr. L. Nicola	f	Computational Materials Science	3mE	27 Sept 2016	1.0	indefinite period
Dr. S.D.C. Wehner	f	Antoni van Leeuwenhoek Professor	EEMCS	25 October	1.0	indefinite period
Prof. P.G. Steeneken	m	Dynamics of Micro and Nano Systems	3mE	15 November	1.0	indefinite period
Dr. W. de Jong	m	Large-scale Energy Storage	3mE	15 November	1.0	indefinite period
Prof. P.H. Hartel	m	Cyber Security	EEMCS	15 November	0.8	3 September 2019 (pension)
Prof. L.P. Kouwenhoven	m	University Professor of Quantum Nanoscience	AS	13 December	0.0	5 years



## Administrative positions of members of the Executive Board as at 31 December 2016

### **Tim van der Hagen**

*President of the Executive Board of TU Delft (since 1 May 2016)*

- Member of the Advisory Council for Science, Technology and Innovation (AWTI)
- Member of the Supervisory Board of the Energy research Centre of the Netherlands (ECN)
- Member of the Supervisory Board of the Central Organisation for Radioactive Waste (COVRA)
- Member of the Board of Growth through Research, Development and Demonstration in Offshore Wind (GROW)
- Member of the Board of the Netherlands Energy Research Alliance (NERA)
- Member of the Governing Board of the 4TU.Federation
- Member of the General Board of the Association of Universities in the Netherlands (VSNU)
- Member of the Steering Committee of the Leiden-Delft-Erasmus alliance (LDE)
- Member of the TNO Strategic Advisory Board on Energy
- Member of the Program Board of Advanced Dutch Energy Materials (ADEM)

### **Karel Luyben**

*Rector Magnificus of TU Delft*

- Chairman of the Supervisory Board of QuTech
- Chairman of the Supervisory Board of NanoNextNL
- Chairman of the Supervisory Board of the Netherlands Bioinformatics Centre (Stichting NBIC)
- Chairman of the Board of the Dutch Techcentre for Life Sciences (DTL)
- Chairman of the Supervisory Board of the Institute for Human Organ and Disease Model Technologies (Stichting hDMT)
- Chairman of the board of the Stichting Justus en Louise van Effen Fonds
- President of CESAER
- Chairman of the Supervisory Board of Applikon Biotechnology
- Member of the Board of the Netherlands Institute for Conservation, Art and Science (NICAS)
- Member of the Economic Programme Council of the South Wing
- Member of the Executive Committee of the Economic Programme Council of the South Wing
- Member of the Executive Committee of The Hague Security Delta (HSD)
- Member of the General Meeting of Shareholders of InnovationQuarter
- Member of the Coordination Council of Medical Delta
- Member of the Board of Stichting Medical Delta
- Member of the Supervisory Board of Wetsus
- Member of the Supervisory Board of Theater De Veste Delft
- Member of the Supervisory Board of the Dutch Polymer Institute (DPI)
- Member of the Supervisory Board of BE-Basic
- Member of the Top Team Water
- Member of CleanTech Delta
- Member of Maritime Delta
- Member of the High-Level Advisory Group of the European Open Science Policy Platform (OSPP)
- Member of the Sector Council for the Top Sector of Chemistry



**Anka Mulder**

*Vice-President for Education & Operations, TU Delft*

- Member of the University Advisory Board of edX
- Member of the Comité d'orientation stratégique, Sorbonne Université
- Member of the Hochschulrat Technische Universität Hamburg
- Member of the Supervisory Board of Hotelschool The Hague
- Member of the Advisory Board for student housing provider DUWO
- Member of the Advisory Council of Stichting Future NL

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.

## Administrative positions of Supervisory Board members as at 31 December 2016

### Jeroen Van der Veer:

- President of the Supervisory Board of the Delft University of Technology
- President of the Supervisory Board of ING
- Chairman of the Supervisory Board of Philips
- Member of the Supervisory Board of BosKalis
- Chairman of the Science and Technology Platform
- Member of the Supervisory Board of the Netherlands Open Air Museum
- Member of the Supervisory Board of The Concertgebouw Amsterdam
- Member of the Board of the Dutch National Theatre
- Co-Chair of the Global Agenda Council The Future of Oil and Gas
- Chairman of the Advisory Council of the Rotterdam Climate Initiative

### Douwe Breimer:

- Vice-president of the Supervisory Board of Delft University of Technology
- Member of the Executive Board of KU Leuven
- Chairman of the Supervisory Board of Museum Boerhaave
- Chairman of the Supervisory Board of Life Sciences Partners Amsterdam
- Chairman of the Supervisory Board of the University Campus Fryslan
- Chairman of the Advisory Council of the Medicines Evaluation Board
- Member of the Board of the Modern East Asia Research Center (MEARC)
- Chairman of the Physics and Chemistry Sector Plan Committee of the Ministry of Education, Culture and Science
- Member of the National Advisory Council of the Netherlands Cancer Institute (NKI)

### 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
- Chairwoman of Ambassadors of Music Education Platform
- Member of the Board of Amports
- 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 Friends of the Onze Lieve Vrouwe Gasthuis

### Laetitia Smits van Oyen:

- Member of the Supervisory Board of Delft University of Technology
- Member of the board of Stichting 'Zorg en Bijstand' in The Hague
- Member of the board of the African Parks Conservation
- Treasurer of the Ocean Heritage Foundation
- Supervisor of the Curaçao Dolphin Academy NV

### 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
- Treasurer of the Stichting HDM Youth Academy



ERC Advanced Grant	
Prof. Y. Nazarov (AS)	HITSUPERJU: Higher-dimensional topological solids realized with multi-terminal superconducting junctions.
Prof. J. Pronk (AS)	ELOXY: Eliminating Oxygen Requirements in Yeasts
ERC Consolidator Grant	
Dr. L. Nicola (3mE)	Metal friction and lubrication.
Dr. L. De Smet (AS)	Recovery of nutrients from waste water.
Dr. G. Steele (AS)	Optomechanics
Prof. C. Chorus (TPM)	Moral decision-making model.
Dr. R. Eelkema (AS)	Communication in synthetic soft materials
Prof. C. Poelma (3mE)	Flows Unveiled: Multimodal Measurement in Opaque Two-Phase Flows (OpaqueFlows).
ERC Starting Grant	
Dr. A.A. Nuijens (CEG)	Cloudbrake - How nature's smallest clouds slow down large-scale circulations critical for climate
Dr. A. Houtepen (AS)	Doping on Demand
Dr. S. Otte (AS)	Spin correlations by atomic design (SPINCAD)
Prof. J. Stoter (A+BE)	Urban modelling in higher dimensions
Dr. M. Vizcaino	Coupled climate and Greenland ice sheet evolution: past, present and future
Dr. A. Caviglia (AS)	AlterMateria
Dr. S. Gröblacher (AS)	STRONG-Q
Prof. S. Wehner (AS)	Quantum communication networks
Dr. H. Youk (AS)	MultiCellSysBio
Dr. A.A. Zadpoor (3mE)	3D printing meets Origami
Dr. D. Tam (3mE)	Origins of spontaneous and coherent motion in three model systems of bioliquids.
Dr. S. Wahls (3mE)	Fast nonlinear Fourier transforms for two prototypical applications
VICI	
Prof. T.J.H. Vlucht (3mE)	New solvents for separation processes
Prof. R. Hanson (AS)	Quantum internet: making interception impossible
VIDI	
Dr. H. Vallery (3mE)	Robotic assistance for human balance
Dr. M.W.A. Wijnjes (IDE)	Communicating materials visually
Dr. S. Groeblacher (AS)	Mechanical vibrations on a quantum chip
Dr. H.S. Hung (EEMCS)	Quality of non-verbal behaviour during networking
Dr. M.K. de Kreuk (CEG)	Effects of suspended solids on granular sludge
Dr. L.J.J. van Iersel (EEMCS)	Networks between species of plants, bacteria and fungi
Dr. W.A. Smith (AS)	Low-cost materials for clean energy
Dr. H.O. Youk (AS)	Recreating life brick by brick
Prof. A. Iosup (EEMCS)	Data centres made transparent
Dr. M. Veldhorst (AS)	Quantum computer with less noise

VENI	
Dr. G. Smit (3mE)	Simultaneous control of multiple movements in hybrid-powered arm prostheses
Dr. M.A. de Schipper (CEG)	Feeding starved coasts by natural morphological diffusivity
Dr. M. Vleugel (AS)	Reconstructing cellular structures for chromosome segregation
Dr. A.L. Smith (AS)	A new approach for comprehensive modelling of molten salt fuel properties
Dr. F. Versluis (AS)	Building nanostructures in living cells
Dr. T. Geijtenbeek (3mE)	A predictive simulation model for human walking
Dr. V. van der Wijk (3mE)	Fast vibration-free spatial manipulators
Dr. G. Li (AS)	Simple to complex: methane upgrading
Rubicon	
Dr. R.Frisenda (AS)	Molecular functionalization of two-dimensional materials for novel optoelectronics devices
Dr. M.G. Goesten (AS)	Molecular-level design: superconductors
Dr. H.Tan (EEMCS)	Stable perovskite materials for low-cost high-performance photovoltaic cells
Dr. C. Plesa (AS)	Construction of new signal transduction cascades in human cells











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