Delft University of Technology

Roadmap 2020

Strategic Plan TU Delft

TU Delft Delft University of Technology

Challenge the future

TU Delft Road Map for 2020

Freedom to excel

Delft University of Technology
Strategic plan

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Foreword

Delft University of Technology is publishing this institutional plan, the TU Delft Road Map for 2020, at a time of global economic turmoil. Despite that, the university wants to be able to continue to measure up to other world-class academic institutions. For us, quality and innovation come before everything else. This is what we mean by 'Freedom to Excel'.

TU Delft operates on a complex and ever-changing playing field – an international environment in which the competition between universities for talent and money is increasing all the time. With this in mind, it is more important than ever that we pool resources and forge alliances. Hence our regional co-operation with Leiden University and Erasmus University Rotterdam, our sectoral collaboration as a member of the 3TU Federation and our concerted joint efforts with partners at the European level.

Quality in diversity

As well as setting out TU Delft's medium-term strategy, the *Road Map for 2020* is our answer to the policy document issued by the Netherlands Ministry of Education, Culture and Science (OCW) in 2011: *Kwaliteit in verscheidenheid* (Quality in Diversity), subtitled 'a strategic agenda for higher education, research and science'. This expresses the intention of maintaining the Dutch HE system's prestigious position on the international stage in the long term.

'Quality' and 'profile' are key terms in this vision. The Dutch government is asking universities to make clear choices. They are expected to make the most of their academic and scientific strengths. In education, the priority is to develop and implement measures to improve quality and success rates. It is also very important that the portfolio of courses be properly profiled. In research, meanwhile, the government wants universities to choose clear priority areas and to intensify their knowledge valorisation activities.

Quality and profiling are hardly new to TU Delft, of course. A university like ours, with a leading international position and reputation to protect, is always working on these factors. Over the past fifteen years we have carried through a series of far-reaching strategic and profile-defining decisions. They include:

- regrouping and merging faculties (1997);
- setting up the IDEA League, in partnership with ETH Zürich, Imperial College London, RWTH Aachen and Paris Tech (1999);
- university-wide reorientation of the entire research portfolio at programme level (2001);
- combining programmes in line with our research priorities, to establish the Delft research centres (2002);
- university-wide implementation of the Bachelor-Master system (2002/2003);
- co-ordinating knowledge valorisation efforts through the TU Delft Valorisation Centre (2004);
- university-wide reorganisation of all support services to create a single Corporate Office (2005/2006);

- establishment of the 3TU Federation, including the corresponding centres of excellence (2007);
- selection of four 'public position themes', the Delft Research-Based Initiatives (2007/2008);
- establishing a support function to assist academics in submitting proposals for funding under the European Commission's Seventh Framework Programme;
- developing an investment programme to improve the quality of our educational and research infrastructure, with a view to keeping TU Delft on a par with its major international peers (2009/2010); and,
- university-wide reorganisation of the faculties at departmental level: the TU Delft Review Agenda (2010).

Every one of these initiatives centres on 'quality' and 'profile', the very aspects highlighted by OCW in *Kwaliteit in verscheidenheid*.

Medium-term and performance agreements, 2012-2016

At the end of 2011 the Minister of State for Education, Culture and Science signed an 'outline accord' with Dutch universities on their implementation of the strategic agenda described in *Kwaliteit in verscheidenheid*. Under this, the universities are required to state in their own strategic plans what they intend to do to achieve the agreed targets with regard to quality and profiling. To monitor progress to that end, in mid-2012 OCW is signing detailed individual medium-term and performance agreements with each university, covering educational quality and success rates, educational and research profiles and valorisation.

These agreements apply to the period 2013-2016. The agreed targets relating to education and success rates are linked to a form of conditional funding, which means that failure to achieve them either in full or in part would put even greater pressure on TU Delft's revenues. In addition, we shall be submitting applications for the funding of specific proposals from a new selective national budget.

Our proposed version of the medium-term and performance agreements has been issued as a separate document,[1,2] although that corresponds fully with this institutional plan in terms of its content. In other words, it contains no policy proposals which are at odds with those found in the present document. The proposed agreements are to be assessed by the government's Higher Education and Research Review Committee.

From Outlines Sketch to Road Map

A university-wide consultation process to discuss the future strategic direction of TU Delft was launched in the spring of 2011. The initial framework for this was provided by the TU Delft Outlines Sketch for 2020 *(Contourenschets TU Delft 2020)*.

Between March and November 2011, about 50 internal meetings of various sizes were held. These attracted a broad cross-section of the TU Delft community: academics, students, support personnel, staff council members and representatives of businesses and public bodies important to the university. The issues were also covered in depth by TU Delta, the university's independent news medium.

The debate brought forth many new ideas, elicited numerous questions and raised a number of dilemmas. These can be subdivided into six core themes: quality, knowledge, people, society, economics and co-operation.

Most of the questions relating to 'co-operation' concerned the intensification of ties with our sister universities in Leiden and Rotterdam. For example, 'What does it mean to be 'a single academic entity'?' 'Will this collaboration not undermine the identity of the world-renowned institution that is 'TU Delft'?' 'Will degree certificates still bear the name 'Delft University of Technology'?' 'Is such a 'superuniversity' not too unwieldy and opaque?' And 'What about the future of our 3TU partnerships?'

Aspects of the themes 'knowledge' and 'quality' also prompted some fierce discussions. 'What is meant by publishing more in ISI journals?' 'How can you demand this when there are so few of these journals in my discipline?' 'How can we continue to deliver high-quality research when there's not enough money to buy essential equipment or attend conferences?' 'Do we really have to invest the income from the Review operation in new buildings – what do they contribute to our quality as a university?' And 'Today's students haven't done enough science at school to take my course!'

Consideration of 'society' and 'economics' in relation to the position of TU Delft produced some interesting observations, too. 'I simply need good Delft-trained engineers for my company.' 'Developing new know-how and designs – that's what it's all about!' 'Co-operation with the market has to fit our research.' 'Universities are too inward-looking.' 'What makes TU Delft distinctive now that everybody's working on the same societal themes?'

The theme 'people' focused mainly upon working within the TU Delft organisation. 'Avoid creating a manager-led culture, with no feeling for education and research!' 'TU Delft is really a sort of artists' colony, and you need to organise it accordingly.' 'Why is it so difficult to get rid of badly performing staff?' 'Flexible working is just another hype, isn't it, so how do you intend to introduce it here?' 'Why does it take so long to get anything done here?'

TU Delft is a multicultural society in miniature. This is apparent not only from its richly varied composition as an institution, but also from the broad spectrum of – often opposing – opinions, insights and ideas expressed on a wide range of subjects.

The Executive Board is extremely grateful to everyone who took part in the discussion. And it is important for this to continue over the years to come. Within a dynamic, resilient and self-confident TU Delft, it should go without saying that such themes are being discussed all the time, throughout the organisation. In 2012-2013 we are continuing the process with a wide-ranging debate about the ethical dilemmas raised by operating at the cutting edge of public-private partnership.

The Road Map for 2020: from 'what' to 'how'

You will find much of the recent debate reflected in this institutional plan, although perhaps not word for word. In general, things here are formulated in more abstract terms. Many of the ideas presented in this document are derived from past decisions about the direction TU Delft wishes to take, and from earlier plans. Nonetheless, the discussions of 2011 have helped us to hone, refine and update our mission, vision, strategy and policy.

Consequently, the *TU Delft Road Map for 2020* outlines a shared vision for the future of our university. In doing so, it also seeks to answer one key question: what specific strategic objectives must we set if we are to achieve our ambitious plans?

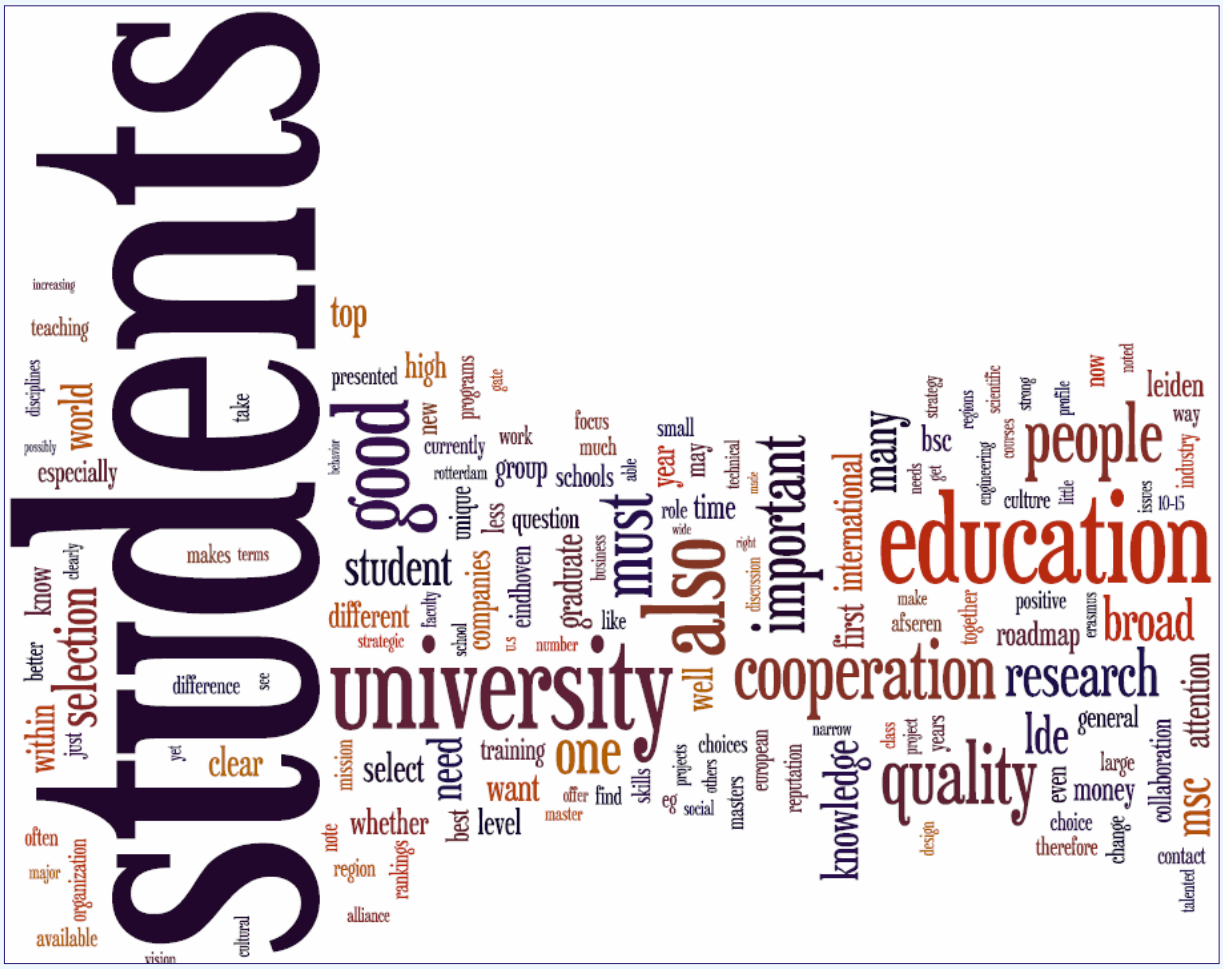
The emphasis in this document is on the 'what'. From now on, therefore, the path from 'what' to 'how' will guide the entire management cycle at TU Delft. As part of that process, the faculties and support services are now translating our general strategic goals into concrete implementation plans tailored to their specific situation.

The Executive Board, the deans of faculty, the heads of department and the directors of the university support services all believe that achieving the strategic objectives set out in this Road Map is essential to realising the ambitions being pursued by TU Delft.

The Executive Board of Delft University of Technology,

Dirk Jan van den Berg	Karel Luyben	Paul Rullmann
President	Rector Magnificus	VP Education & Operations

The 'road map' debate at TU Delft



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TU Delft in brief

Vision – *How do we view our role in society?*

The increasing number of people on the planet and their drive to achieve ever-higher levels of prosperity raises some major questions for society. Technology is essential in answering these, as is the underlying scientific knowledge generated and disseminated by modern universities of technology.

The modern university of technology is a source of new scientific understanding and technological breakthroughs. It also trains scientists and engineers, and provides them with a broad academic grounding. 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. It is they who develop the science-based technological solutions which enhance many people's lives.

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

Ambition – *What are we trying to achieve?*

TU Delft wishes to remain a technology university with a leading global reputation. To do this, our aim is to maintain a full range of high-quality disciplines, courses and unique facilities in the engineering sciences. Collaboration is an essential part of this, on the basis of our strong identity and reputation. TU Delft wants to be a breeding ground for cutting-edge technological scientific developments to meet the great societal challenges of our age.

It is also our 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 where new business activities are allowed to blossom and where the research and education have a significant impact on the competitive economic environment.

TU Delft wants to be a place where academics and students think in interdisciplinary and multidisciplinary terms, and where science, design and engineering are the primary driving forces behind teaching and research. We wish to be an inspiring, progressive and gender-aware institution, attracting the world's best scientists and most gifted students in the knowledge that their talents will be allowed to develop to the full here.

Mission – *What are our main tasks?*

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

Core Values – *What do we stand for?*

Respect, integrity, expertise, involvement, transparency and avoiding conflicts of interest. These are the core values guiding everyone

associated with TU Delft. Our modus operandi as an institution is trust – by which we mean that every member of our community is expected to comply with the core values, to draw inspiration from them and to feel responsible for upholding them. All at TU Delft should act with a sense of social responsibility and be aware of technology's value to and impact upon society.

Our staff, our students and our guests are all open about the roles they play and the activities they perform. Much of what the university does is situated on the interface between the public and private sectors. Avoiding conflicts of interests is therefore a key guiding principle for us. Ours is a learning organisation, with a culture in which drawing lessons from positive experiences elsewhere – as well as from 'what went wrong' – comes as second nature.

Respect. TU Delft stands for proper appreciation of everyone's qualities. Freedom to excel is at the heart of all we do, both academically and in supporting roles. There is no place here for any form of discrimination, for other kinds of intentional unfair treatment or for anything which prejudices TU Delft as an institution.

Integrity. TU Delft stands for honest staff and students who think and act in an open manner, who demonstrably put the interests of science and society before their own personal and private advantage, who interact critically and constructively and who are not afraid to challenge unacceptable behaviour.

Expertise. TU Delft stands for staff who always act with the utmost professionalism. Again, freedom to excel is crucial here, both academically in supporting roles. We expect all our staff to stay fully informed about their work and their discipline in general. They should strive to be leaders in developing knowledge, in pushing back the boundaries of research, in providing inspiring education, and in supporting one another, while upholding the interests of the university as a whole.

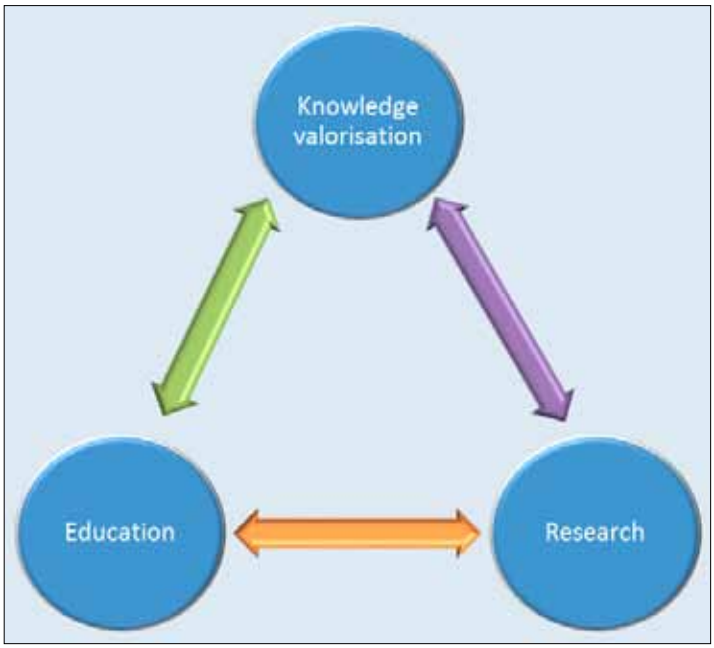
Involvement. TU Delft stands for staff and students who are actively involved in the development of both the university and wider society. Our public responsibility as an academic institution – helping to resolve the great societal challenges of the decades ahead – is firmly reflected in our educational curriculums, research, designs, student projects and support activities.

Transparency. TU Delft stands for an environment in which staff, students and guests communicate openly with one another. This ensures that education, research, valorisation, governance and decision-making processes at all levels within the university are verifiable.

These core values are integral to the way we want to operate as an institution and the manner in which we tackle the challenges presented to us by society.

Interaction between research, education and valorisation

It is a basic premise at TU Delft that education, research and valorisation are closely interrelated.



Effective scientific education demands that the very latest insights from research be shared with students. This tends to occur most directly during the MSc and, of course, the PhD phase. At the doctoral level, in particular, interaction between research and education is both intensive and natural.

Even for undergraduates, however, it is extremely important that an affinity with research and its methodology be nurtured. Introducing students to scientific research and methodologies at the earliest possible stage represents a basic pillar of their academic training.

Conversely, education and students have a contribution to make to research. Their creative input and feedback encourages their tutors – who are usually researchers, too – to formulate and explore unexpected lines of research. It is important, therefore, that the teaching environment allow scope for 'creative sparks' to jump from student to tutor and vice versa.

The interaction between research and education on the one hand and valorisation on the other is nothing new. Indeed, training professional engineers is a significant act of valorisation in itself.
In this era, the engineers of the future can pursue a valuable supplementary learning objective by taking special modules designed to prepare them for the challenges of entrepreneurship.

The relationship between research and valorisation remains the most highly developed, however. After all, most forms of valorisation – from setting up innovative new companies to securing patents and establishing partnerships with businesses or public bodies – still build directly upon research results.

For TU Delft, encouraging, organising and embedding interaction between education, research and valorisation – what we call the 'knowledge triangle' – is an essential part of our purpose as an academic institution.

Delft Engineers - *Making Ideas Work*

Delft engineers are a household word across the world. To keep it that way, TU Delft must ensure that their training continues to be guided by our vision on the task society has set us. Universities today are expected to come up with solutions for a whole range of societal issues. So the challenges are enormous.

Technology and the science underlying it are indispensable in finding those solutions. And the questions associated with them, especially when they have to be answered sustainably, are so complex that they can only be addressed by different disciplines working together – often in new combinations.

Students at TU Delft are trained to be able to fill demanding professional positions, at the national or international level, in which they can make the best possible contribution to effective solutions. To do this successfully, they need to have been provided with a broad palette of knowledge, skills and understanding. We therefore teach them in such a way that, wherever they end up as a Delft Engineer, they can:
- deliver substance and quality;
- put forward innovative solutions;
- take responsibility;
- assume convincing leadership;
- co-operate effectively; and,
- have an independent, enterprising and self-critical attitude.

Delft students are active and involved. Even during their studies, many of them already devise innovative solutions for pressing issues in society. And Delft's strong student culture fosters their broader development.

The demands being made of the engineers of the future are evolving all the time. But TU Delft takes the changes on board and translates them into its teaching programmes. As well as

acquiring the generic abilities needed by all engineers in the twenty-first century, Delft Engineers of the future are trained to develop socially responsible solutions. They receive this training in a multidisciplinary intellectual and practical framework, constructed around a thorough knowledge of physics, chemistry and mathematics.

Above all, Delft students are taught to turn their ideas into something concrete. To make ideas work.

Strategic priorities for TU Delft in 2020

Students and education

- Differentiation and breadth in BSc programmes.
- Profiling of MSc programmes.
- Excellence programmes.
- Professional Doctorate in Engineering.
- Graduate School – doctoral education.
- Postacademic courses.
- Modern teaching methods, including digital forms.
- 3TU and Leiden-Delft-Erasmus partnerships.
- Quality of student intake.
- Success rates: graduating within the standard term is the norm.
- Teaching abilities of academic staff.
- Institutional accreditation, quality assurance and student satisfaction.

Research

- Scientific profile: science, design, engineering.
- TU Delft research priority areas.
- Focus and mass in research programming.
- Interfaculty alliances – TU Delft institutes.
- 'Grand challenges for society' – four priority areas.
- Strategic research co-operation.
- International peer reviews and rankings.
- Individual and group quality.
- Top sectors and Horizon 2020
- Fundraising.
- Need for state-of-the-art research infrastructure.

Knowledge valorisation

- TU Delft valorisation profile, 2012-2020
- Structural co-operation with business and government.
- Co-operation with SMEs.
- Delft Technological Innovation Campus.
- Support organisation –TU Delft Valorisation Centre.
- Entrepreneurship training and development of new commercial activity.
- Intellectual property.
- Debate on ethical aspects of public-private partnerships.

Campus and facilities

- Investment agenda: new buildings and essential maintenance.
- Expansion of student accommodation.
- More 'e-based' educational facilities.
- TU Library – open access and national role.

People and work

- From financial control to management control.
- Excellent academic and support staff.
- State-of-the-art ICT infrastructure – wireless campus.
- Transparent information management and management information.
- Corporate Office 2020 – sustainable bundled services.
- Social innovation.

1

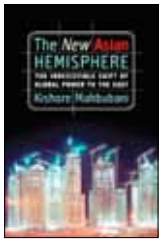
Dynamic context

In a rapidly changing environment, TU Delft must adopt a strong and stable position if it is to fulfil its task in society effectively. The themes outlined below now largely shape the context we are operating in and the scope we have to engage actively with the challenges ahead.

External challenges

- **Solutions to important societal issues** – Universities around the world are now expected to help find solutions to the pressing societal issues of the decades to come.
- **New scientific world order** – Emerging knowledge economies are investing so much in science that its geographical centre of gravity appears to be shifting towards Asia.
- **Fierce global competition for scientific talent** – The development of a new scientific world order is reflected in a fierce competitive struggle to secure the best talent.
- **Dominant role of the European Union** – For 'Brussels', universities and academic alliances have a vital role to play in stimulating the European knowledge economy.
- **'Outline accord': quality, profile and 'top sectors'** – for 'The Hague', the themes 'quality' and 'profile' are priorities. They are being combined with an effort to develop the so-called economic 'top sectors'.
- **Government funding uncertain** – National and international economic developments are fuelling uncertainty about the stability of government funding of the Dutch universities.
- **Academic alliances: global, European, regional and sectoral** – it is essential that universities forge alliances at all these levels if they are to succeed in a fiercely competitive international environment.

Solutions to important societal issues. Universities today are expected to devise solutions to numerous major issues in society, in such fields as energy, water, natural resources, transport, construction, health, materials, industrial production, safety and urban development.[4] The questions associated with these topics are so complex that they can only be tackled by different disciplines working together – often in new combinations. That is, through multidisciplinary collaboration built upon excellent monodisciplinary research. Learning to work and co-operate across disciplinary boundaries is becoming a more and more common part of engineering degree courses throughout the world.[5]



New scientific world order – Increasing numbers of companies are basing themselves in emerging economic regions where vast amounts of money are being invested in higher education, science and technology. As a result, new knowledge economies like China, Singapore, Brazil, South Korea and the Gulf states are becoming formidable competitors for the established scientific centres in Europe and the United States. Their demand for graduates, especially in the engineering sciences, is growing apace. Indeed, a new scientific world order is emerging, with its geographical centre of gravity shifting from Europe and the US towards Asia. In part, this is being fuelled by the rapid development of universities in that part of the world.[6] As a consequence, the 'playing field' on which we operate is becoming increasingly complex.

Fierce global competition for scientific talent – The universities of today find themselves engaged in a fierce competitive struggle for scientific talent. If they are to have any chance of securing the best minds, they must present themselves convincingly in the global marketplace as attractive employers. And to do this they need to offer an inspiring academic environment with modern teaching and research facilities, competitive terms of employment, an open organisational culture and an appealing working and living climate. For many universities, creating such an environment is now a major priority.[7]

Dominant role of the European Union – Due to the Horizon 2020 programme, 'Brussels' is becoming a dominant factor for many European universities. And conversely, they are important institutions for the EU. Universities are where the know-how needed to resolve the great issues in society is developed, after all, and where its innovative application is stimulated. Brussels views technological universities, in particular, as vital links in the knowledge economy. To have a realistic chance of securing European funding, however, it is essential for universities to demonstrate that they are collaborating with sister institutions and the private sector.[8]

'Outline accord': quality and profile. The Dutch higher-education sector is currently undergoing fundamental reforms. In the wake of the Ministry of Education, Culture and Science (OCW) policy document *Kwaliteit in verscheidenheid* (Quality in diversity) and the so-called 'outline accord' between the ministry and the universities, improving quality and developing a clear profile have become the top priorities for Dutch academic institutions. In practice, this means that they must, among other things, improve student success rates and the quality of the education they provide, define and develop research priority areas and reinforce their knowledge valorisation activities.[9]

Investment in 'top sectors'. Current Dutch government innovation policy is focusing upon what it defines as 'top sectors': water, food, horticulture, high technology, life sciences, chemicals, energy, logistics and the creative industry. The Netherlands already has a strong international position in these nine fields, with considerable co-operation between science, the business community and government agencies. They are also in a good position to contribute towards solutions for important issues in society. So-called 'triple-helix' collaboration – academia and the private and public sectors working together – is a core aspect of Dutch 'top sectors' policy.[10]

Uncertain government funding. The Dutch universities' revenue streams are under pressure. The government has not ruled out further funding cuts, the potential effects of which on universities are anything but clear. Dutch universities remain heavily reliant upon direct government financing in the form of block grants, as well as upon indirect injections of public money through the Netherlands Organisation for Scientific Research (NWO) and contracts under such programmes as the Top Sectors Initiative. The introduction of a new national funding allocation system - partially based on performance - is only increasing the unpredictability of the future situation. Students, too, face uncertainty: they are probably going to have to pay more for their studies.[11]

ACADEMIC ALLIANCES AND MANAGEMENT NETWORKS. It is essential that universities forge a whole spectrum of alliances if they are to succeed in the new scientific world order which is now unfolding, with its fierce competition for people and resources. Successful institutional alliances are rooted in academic endeavour: they build upon the practical collaborations developed by scientists and researchers. For this reason, copublication is becoming an increasingly good indicator of the strength of co-operative arrangements. In many cases, peer-to-peer contacts made on the academic shop floor are the starting point from which more intensive partnerships emerge. Because of this potential, TU Delft cherishes its wide-ranging national and international networks.

In addition, it is becoming increasingly necessary for universities to demonstrate their presence on the international stage at the administrative level, by participating in prestigious networks like the IDEA League, the European Universities Association (EUA) and the Conference of European Schools for Advanced Engineering Education and Research (CAESAR).[12]

Sectoral alliances - the 3TU Federation. In 2007 TU Delft, Eindhoven University of Technology (TU/e) and the University of Twente founded the 3TU Federation. At the time, the Dutch government released €50 million to help them bring together research activities in five centres of excellence (CoEs). These have since made successful agreements to gradually concentrate work in a number of shared priority areas at one or other of the three participating universities.

In 2011 the Minister of State for Education, Culture and Science approved the Technology Sector Plan for 2011-2015. This provides for additional government investment in the 3TU Federation. Between 2011 and 2013, that will be channelled solely into areas identified as priorities in the ministerial policy document *Kwaliteit in verscheidenheid* (Quality in diversity). They include the revision of educational curriculums, maintaining tutor excellence, the digitisation and internationalisation of education and strengthening the teaching of mathematics.[13]

Adding Value

Why is the Leiden-Delft-Erasmus alliance strategically important?

The unique strategic alliance currently being forged by TU Delft, Leiden University and Erasmus University Rotterdam (EUR) is to be strengthened and formalised over the next period.

The alliance was inspired by positive experiences with partnerships involving the three universities, going back more than ten years, as well as the huge potential inherent in greater co-operation between complementary institutions in such close geographical proximity to one another. It covers a unique combination of academic disciplines, working together along substantive lines.

The arrangement is intended to further improve the quality of education and research at all three institutions, with clearer profiling of the range of courses they offer and better international positioning of their research activities. The complementary educational portfolio of each of the institutions will be made more accessible to students from the others, and harmonised even more than is currently the case. The alliance will also result in new multidisciplinary course combinations that are better able to compete for students on the international stage. The current range of joint programmes and joint tracks is to be expanded. Moreover, by working together the universities will be able to maintain relatively small – but important – programmes and so continue to offer students a broad choice of degree subjects. To achieve these objectives, however, it is important that the three institutions abandon the 'domicile principle' for their education so that students can be taught at any one of them.

The alliance also opens up - better opportunities to further support teaching and tutors. Expertise in this area is to be combined.

As well as adding value to education by improving it and making it more attractive, together the three institutions will also be able to develop their own distinctive research profiles. Collaboration between disciplines will better enable them to make an effective contribution to the 'grand challenges' formulated by the EU and the 'top sectors' being prioritised by the Dutch government. And, thanks to the combined volume of their scientific activity, it will put them in a better position to retain their global academic leadership. All of which will add value to the research position of the Netherlands as a whole. The ultimate ambition is that, by joining forces, all three universities will be in a better position than ever to attract outstanding academic talent and stand a greater chance of securing external financial backing for top-class research.

The combination of a broad-based general university (Leiden), a broad-based university of technology (TU Delft) and a more specialised institution (EUR), all situated relatively close to one another in a densely populated and economically important region – which includes the Port of Rotterdam and the 'third' UN city, The Hague – opens up huge opportunities to add value in education, research and valorisation alike.

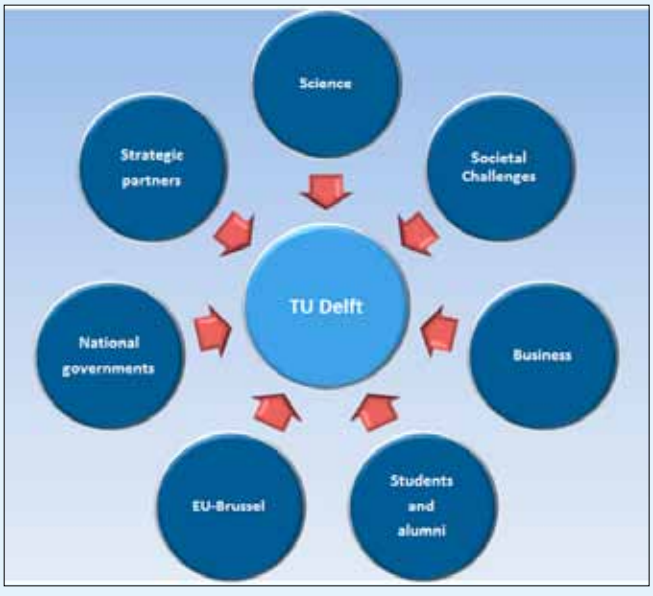
Intensifying our relationship with Leiden and EUR does not mean that the three universities are set to merge during the period covered by this institutional plan. Rather, the arrangement will take the form of a number of joint ventures governed legally by so-called 'common statutes' (Gemeenschappelijke Regelingen). The aim of the strategic alliance is facilitate such opportunities: together we are greater than the sum of our parts.

Source: the report *Meer Waarde – Strategische alliantie Leiden-Delft-Erasmus* (Adding Value – the Leiden-Delft-Erasmus strategic alliance, April 2012).

TU Delft – external influences

TU Delft is positioned within a complex playing field made up of numerous Dutch and international stakeholders. Each has its own expectations of the university, from specific short-term answers to abstract commitments. All of these are important us, and we do our very best to satisfy them. However, we are not always in a position to influence the outcomes ourselves.

- **Students and graduates** – They want a good academic qualification which retains its value in the international employment marketplace. A TU Delft degree is trademark.
- **Science and peer community** – It is our international scientific peers who take the measure of TU Delft and, together with the performance of our graduates, determine our reputation.
- **Business** – As well as employing our graduates, the business community demands know-how and solutions which can be brought to market. It is essential, therefore, that we tailor our activities to the commercial agenda.
- **Strategic academic partners** – At peer-to-peer, faculty and university levels, we work with numerous academic partners on the regional, sectoral, European and global stages.
- **Government** – TU Delft has to anticipate and respond to what are often far-reaching initiatives, restrictions and regulations emanating from all levels of government: local, provincial and national (ministries of Education, Culture and Science, of Economic Affairs, Agriculture and Innovation and of Infrastructure and the Environment).
- **European Union** – 'Brussels' is relevant to TU Delft not only with regard to European regulations, but also as the source of initiatives which can both generate income and enhance our reputation.
- **Society at large** – TU Delft is expected to play its part in resolving a whole range of issues affecting society, both short-term and long-term, through groundbreaking scientific research.



TU Delft – external opportunities

There is no standard recipe for becoming and remaining a world-class university. But we can identify a number of critical contributing factors. The diagram above shows the thematic consistency for specific measures to be taken to achieve our ambition.

- Talented and motivated students.
- High-quality academic personnel.
- Accepted excellent educational and research performance and an outstanding academic reputation.
- A strong national and international presence and strategic alliances.
- A broad portfolio of disciplines and a strong academic profile.
- A high-quality infrastructure.
- Decisive and excellent support services.

These factors were used to structure the university-wide discussion about our strategic direction.

The above classification was inspired by John Niland, *The Challenge of Building World-Class Universities* (2007), and Jamil Salmi, *The Challenge of Establishing World-Class Universities* (2006).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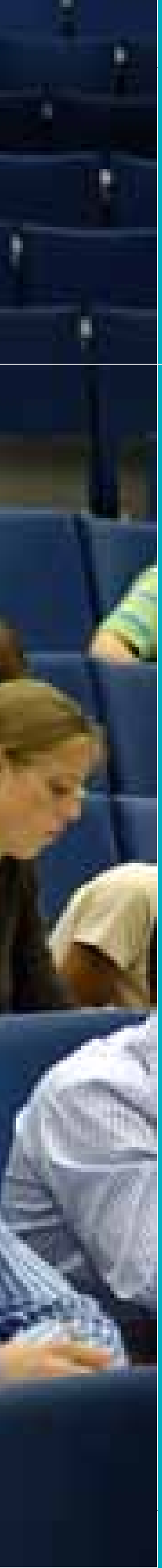
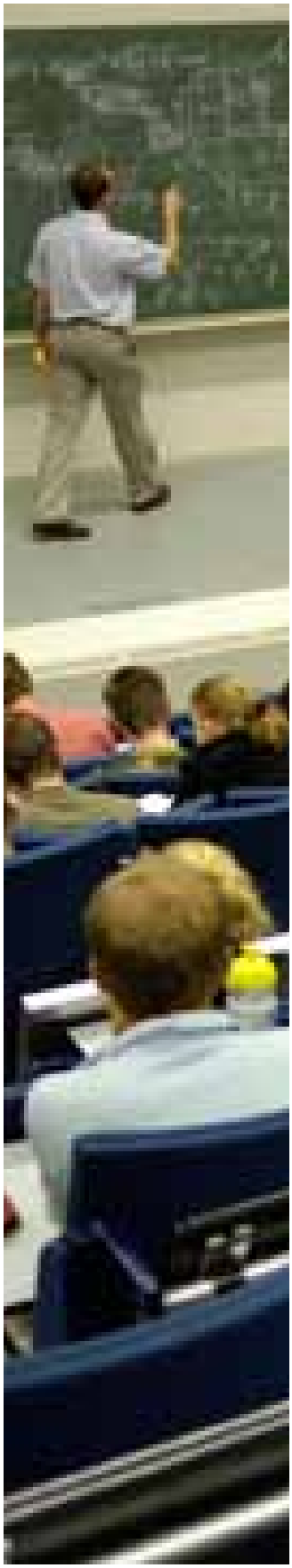


Students & education



Delft students are inspired by the future. They are trained for positions in which they can make their contribution to solving complex scientific problems and to resolving important issues in society. The Delft Engineer of the future learns to apply technical and scientific know-how and to translate it into innovative product and process designs. During their studies they get a taste of entrepreneurship, gain international experience and are actively involved in student projects. At TU Delft, the transfer of knowledge is rooted in world-class scientific technology research. Our ambitions – and specific policy measures – are closely aligned with the Science and Technology Master Plan compiled for the 'top sectors' of the Dutch economy. To guarantee the quality of the education we provide, we facilitate intensive interaction between our students, academics and management. As the most comprehensive engineering university in the Netherlands, TU Delft teaches its students to think critically, to take the initiative, to operate independently and to work in multidisciplinary project teams. Whilst here, they also develop an insight into ethical and social relationships and developments.

Strategic priorities in education at TU Delft for 2020

- Differentiation and breadth in BSc programmes.
- Profiling of MSc programmes.
- Excellence programmes.
- Professional Doctorate in Engineering.
- Graduate School – doctoral education.
- Postacademic courses.
- Modern teaching methods, including digital forms.
- 3TU and Leiden-Delft-Erasmus partnerships.
- Quality of student intake.
- Success rates: graduating within the standard term is the norm.
- Teaching abilities of academic staff.
- Institutional accreditation, quality assurance and student satisfaction.

1. Profiled course portfolio

TU Delft has opted for a compact portfolio of fourteen BSc programmes, which cover almost the entire range of engineering disciplines. There are more than thirty MSc programmes at TU Delft. Several of these are unique in the Netherlands, and as such help to define our profile as a university. Some of these Master's degrees are offered in conjunction with other institutions, under the auspices of either the 3TU Federation or our alliance with Leiden University and Erasmus University Rotterdam (EUR). Significant elements in our programmes are taught by multiple departments at TU Delft. All our MSc courses are taught in English. We encourage student mobility, since this helps to broaden the intellectual horizons of the engineers of the future.

Differentiation and breadth in BSc programmes.

The Bachelor's degree courses at TU Delft stand out because they combine a thorough grounding in three areas:

1) basic theoretical knowledge;
2) contact with professional and research practice from an early stage; and,
3) orientation in respect of issues affecting society.

BSc graduates of TU Delft can choose either:

1) to continue their studies in the same field;
2) to continue their studies in a different field; or,
3) to enter the labour market.

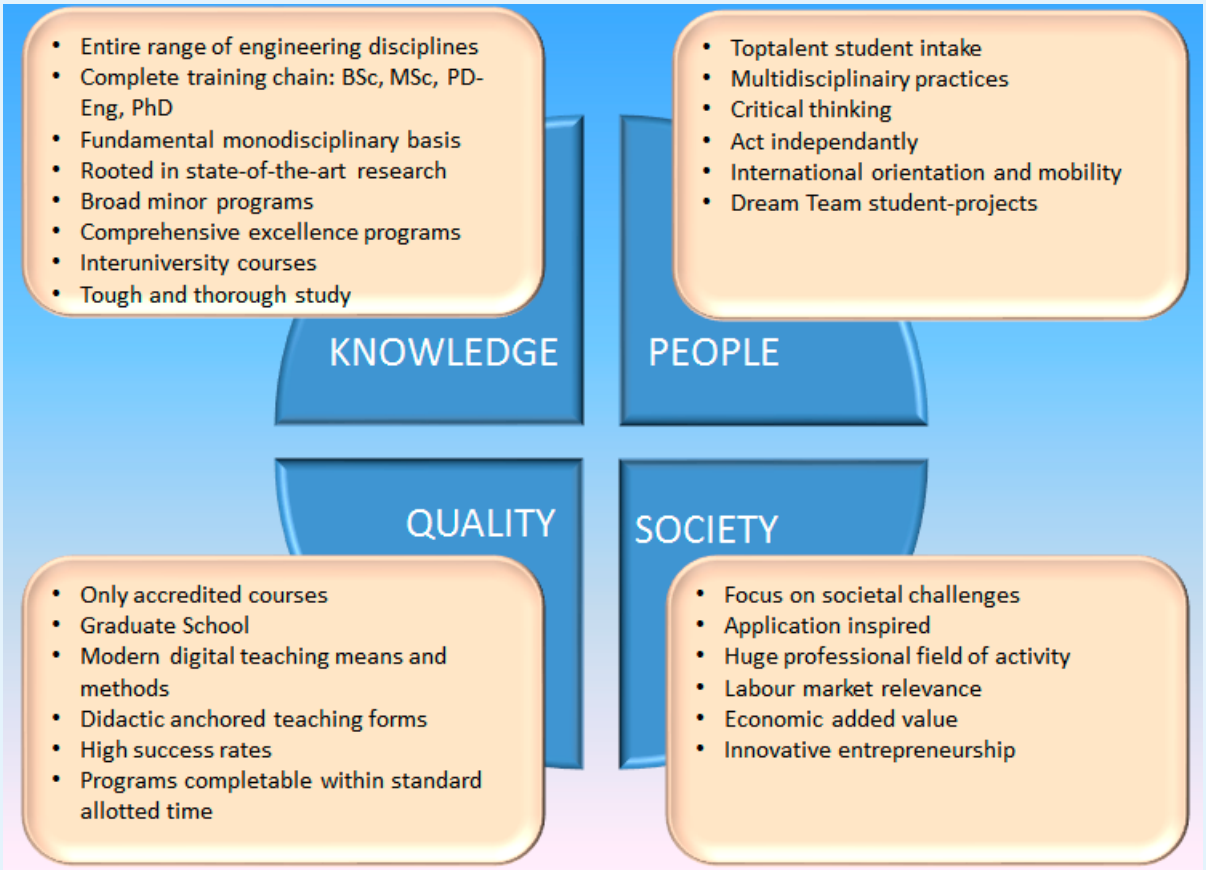
TU Delft regards the latter option as unrealistic, not least because there is little demand amongst employers in the Netherlands for BSc graduates. The Delft Engineer should possess MSc-level know-how and abilities. When developing new BSc programmes, it is vital to check that they meet demand from the professional labour market.

The BSc programmes we offer are broad in their disciplinary scope. This is because the profile of the Delft Engineer demands knowledge straddling a range of scientific and technical disciplines. The strong basis provided in the primary field of study is expanded through an extensive choice of minors to broaden the mind.

Focus for 2012-2020

- Maintain the current compact portfolio of BSc programmes. The rationale behind this choice is that all these courses should be able stand on their own in curriculum terms, that they attain sufficient critical mass in terms of enrolled students and that they lead naturally into MSc programmes.
- When expanding or modifying the BSc portfolio, the following criteria must be met.
  - The programmes are sufficiently distinctive, in terms of their content, at the regional and national levels.
  - They are properly supported by outstanding research.
  - They have sufficient critical mass in terms of enrolled student in a 'steady-state' situation.
  - They are relevant to the labour market.
  - The target annual intake for a BSc programme is approximately between 80 and 450 students. The exact number depends upon the portfolio principles mentioned above, student education demand and course capacity.
- Investigate opportunities to increase intake into the 'smaller' unique programmes at TU Delft – those with fewer than 80 new students each year, on average – or to 'embed' them into other courses. There is no intention to close programmes.

The Delft Engineer – educational profile



'You don't become a Delft Engineer just like that.' It was always thus, and so it will remain. The learning culture at TU Delft focuses upon demonstrating your ability. By Dutch standards, our students follow a relatively difficult and intensive curriculum.

Delft students also find themselves in the midst of a rich culture of clubs and societies, both academic and general. These give them the opportunity to work on a wide range of extracurricular projects. The successful Nuna initiative, to build solar-powered vehicles, is one of the best-known examples.

The high degree of organisation found in these student-led activities is an important, indeed defining, aspect of life at TU Delft. As an institution, we actively support this aspect of our culture and give it a clear role in the learning environment of the Delft Engineer of the future.

TU Delft would like to see participation in special student projects acknowledged on its degree certificates.

- Continue encouraging more female students to attend TU Delft.
- Develop new BSc programmes in Technical Medicine and Nanobiology, in partnership with Leiden University andErasmus Univerisity Rotterdam.

Profiling of MSc programmes

TU Delft draws a clear distinction between its BSc and MSc programmes. They are separate entities. The uniform admission requirement for the Master's phase is a successfully completed Bachelor's degree course. We are selective in introducing new MSc programmes. Because scientific research is intrinsically associated with all our educational activities, we do not offer separate 'research Master's' degrees. We want to select our incoming MSc students more effectively by, for example, defining specific prerequisites in terms of knowledge and competence requirements.

A period of study at a university abroad is an academic component of our MSc programmes, as it broadens the student's horizons and helps to develop their profile as a Delft Engineer. All our MSc courses are taught in English.

Focus 2012-2020

- Increase our intake of overseas MSc students, from both the European Union and elsewhere. In this respect, note that EU students fall under the national government-subsidised funding regime whereas their non-EU counterparts are charged the full cost of their education.
- Increase the number of MSc graduates to 2200 a year in 2018.
- Develop new MSc programmes, subject to the following criteria.
  - They attract a minimum annual intake of 20 students.
  - They are sufficiently distinctive, in terms of their content, at the regional and national levels.
  - They are supported by outstanding research.
  - They have sufficient critical mass.
  - They are relevant to the labour market.
  - Develop new MSc programmes in Technical Medicine and Nanobiology, in partnership with Leiden and EUR.
- Enhance the focus and mass of the teacher-training programmes through further co-operation within the 3TU Federation and with Leiden and EUR.
- Ensure that the TU Delft of 2020 is a European leader in higher education for entrepreneurship. This is to be achieved through more systematic ties with underlying scientific research, a product of the alliance with Leiden and EUR.
- Encourage greater outgoing international mobility, through such initiatives as Erasmus for All. Persuaded by experiences at Leiden, TU Delft sees great potential in knowledge alliances and the 'learning mobility' line of action.

Excellence programmes

Within their courses, outstanding students at TU Delft are offered an additional challenge in the form of a so-called 'excellence programme'. On the extracurricular front, they can take part in special activities such as the Nuna project (see above) or stand for executive positions at student clubs and societies. Or they can follow a second study programme, leading to a double degree. However, the Dutch government's proposal to 'fine' students who take too long to complete their degrees is likely to put these opportunities for outstanding scholars under pressure.

Focus 2012-2020

- Encourage greater participation in excellence programmes endorsed by the government-backed Sirius initiative. At least 8 per cent of second-year BSc

students should be joining such programmes in 2015.
- Recognise participation in special student projects by means of an acknowledgement on the degree certificate.
- Encourage double-degree students by reimbursing their tuition fees.
- Increase interest in and support for extracurricular activities and projects such as Dream Team.

PDEng programmes

- Design for Emerging Markets (in development).
- Design-Driven Innovation
- Comprehensive Design in Civil Engineering.
- Nanostructured Chemical Products.
- Designer in Bioprocess Engineering.
- Bioproduct Design.
- Process & Equipment Design.

Professional Doctorate in Engineering.

TU Delft regards its two-year Professional Doctor in Engineering (PDEng) programmes as an integral part of the learning chain. For postgraduates, a PDEng provides an application-oriented, engineering and design-based alternative to the four-year, research-led PhD programme. The PDEng programmes respond effectively to a real demand in the national and international labour markets. The PDEng student is trained as an 'integrator', capable of understanding and combining specialist knowledge from a variety of disciplines. He or she learns to be a chief designer, responsible for technical design in an industrial context. These programmes are co-ordinated by the Stan Ackermans Institute, the 3TU School for Technological Design.

Focus for 2012-2020

- Produce more PDEng graduates. To this end, the number of enrolments in 2015 should be 30 per cent higher than in 2011.
- Investigate opportunities for new design-based programmes that contribute to the objectives of the Dutch 'top sectors'.
- As part of the 3TU Federation, demonstrably increase awareness and appreciation of the PDEng programmes amongst all stakeholders.

TU Delft Graduate School – doctoral education

At the time of this plan's publication, TU Delft has approximately 2000 PhD students. In this respect, we bear a huge responsibility. It is essential that our doctoral programmes be organised in a transparent manner. In recent years, therefore, a number of initiatives have been launched to improve their organisational aspects in a systematic fashion. We have opted to cluster these programmes under the auspices of the TU Delft Graduate School, which oversees the process involved and hence the quality of our doctoral education.

The TU Delft Graduate School raises our international profile at this level, and our appeal as a training centre for new generations of researchers. It offers PhD students a broad training in generic and transferable skills, so that after graduation – and even in non-scientific functions – they can successfully occupy a variety of advanced professional roles. Development of the TU Delft Graduate School is continuing, in close co-operation with the research schools co-ordinated by or otherwise involving TU Delft. PhD programmes are a vital link in the inherent interaction between education and research. The doctoral student conducts research, follows an educational curriculum and, in many cases, also teaches part of the time.

Focus for 2012-2020

- Increase the number of TU Delft MSc graduates who go on to take a PhD here. Some 5-10 per cent of TU Delft Graduate School entrants should come from within the university in 2020. Cuts to national research budgets may put this objective under pressure.
- Ensure constant co-ordination between the TU Delft Graduate School and the research schools co-ordinated by or otherwise involving TU Delft.
- Explore the potential for a joint Graduate School of Science with Leiden University and Erasmus University Rotterdam.
- Enable rapid identification of successful and unsuccessful PhD students by implementing a university-wide tracking system in 2012.
- Reduce PhD drop-out rates by about 10 per cent by 2015, compared with the 2010 figure.
- Shorten the average completion time of a PhD by one year by 2020, compared with the 2011 figure.

TU Delft Graduate School – profile

- Smooth, high-quality PhD education.
- More PhD graduates.
- More PhDs completed within five years.
- Better support for student and supervisor.
- Overseas students integrated into the university community.
- PhD start-up training and career workshops.

Faculty of Civil Engineering and Geosciences

Educational profile

BSc programmes

- Civil Engineering
- Applied Earth Sciences

MSc programmes

- Applied Earth Sciences
- Civil Engineering
- Construction Management & Engineering
- Transport, Infrastructure & Logistics

Research profile

- Design and construction
- Geotechnology
- Hydraulic engineering
- Remote sensing
- Transport and planning
- Water management

Postacademic courses

The knowledge society is increasing the need for lifelong learning, and hence the demand for continuing education at the postacademic level. TU Delft is responding by offering a range of high-quality programmes of this kind, all with direct links to our technological knowledge base.

These courses take various forms. Some are provided under the Delft TopTech label or through our Postacademic Education Foundation (PAO), others through the Delft-Leiden Biotechnology Studies (BSDL) partnership.

Focus for 2012-2020

- Increase the range of postacademic courses where there is a clear demand from society for them, possibly in partnership with Leiden University and Erasmus University Rotterdam.
- Where possible, link postacademic courses to standard MSc programmes and/or the Delft Research-Based Initiatives.
- Improve collaboration with individual companies and business networks in developing new postacademic courses or improving existing ones.

Post-MSc courses

- Business in Energy Systems.
- Business in Rail Systems.
- Compliance Management.
- IT Management.
- Public Safety.
- Retail Design & Management.
- Safety, Health & Environment.
- Security Science & Management.
- Management of Integrated Hazard Risk.

Modern teaching methods, including digital forms

Applying the principle of 'blended learning', TU Delft intentionally incorporates modern didactic concepts into its educational provision. Active forms of teaching in small groups are an important part of this. We assume that current and future generations of students are at home in an 'e-based' learning environment, but at the same time want to be connected with the university as a physical location. This trend is making knowledge transfer and private study less and less time and place-dependent. In response, we need to be more flexible as regards the capacity and organisation of teaching space, study areas and ancillary facilities like catering.

TU Delft is already experimenting with a range of digital forms of education, both independently and as part of the 3TU Federation. Amongst other things, such digitisation helps overcome adaptation problems for prospective students. School leavers, entrants with vocational degrees and overseas students can use online modules, self-assessments and video lectures to bridge the gaps between their existing knowledge and TU Delft's entry requirements. Providing educational resources in digital form also assists independent study. Video lectures can provide an acceptable alternative in the event of unforeseen timetabling issues as well. Digitisation reinforces our international reputation. And it fits in perfectly with our image as an innovative, forward-looking, technology-led university.

As a member of the OpenCourseWare Consortium, TU Delft actively disseminates its scientific and technical know-how throughout the world. Our own free open courseware application allows distance learners to follow lectures online and so to find out more about the kind of education we provide. Since 2010 we have been streaming courses on such topics as Architecture, Civil Engineering & Water, Electrical Engineering and Aerospace Engineering on the iTunes U channel.

Focus for 2012-2020

- Create a 3TU digital learning environment for private study, to test potential students and as a means of monitoring and supervising the independent study process.
- Monitor the effects of this environment on the education we provide.
- Raise our national and international profile related to our digital learning environment.
- Increase the amount of teaching in 'digital lecture halls'.
- Shift from face-to-face learning towards digital education.
- Open a Learning Centre on campus in 2015, if necessary by refitting existing buildings.
- Create a university-wide rooms pool in 2014.
- Expand the range of courses available through open courseware and iTunes U.

3TU and Leiden-Delft-Erasmus partnerships

TU Delft regards institutional partnerships as essential if it is to continue to offer a distinctive, internationally competitive portfolio of courses. Be they sectoral (3TU Federation) or regional (the Leiden-Delft-Erasmus alliance, and partnerships with universities of applied sciences), our collaborative activities are always based upon our own strong and leading position in the academic world.

The 3TU partnership has gone from strength to strength in recent years, with the 3TU Technology Sector Plan for 2011-2015 a good example of a successful product. Our curriculum-based co-operation in technological subjects with the institutes of vocational higher education in the region – The Hague University of Applied Sciences, InHolland University of Applied Sciences and Rotterdam University – has also been a success and will continue. Their proximity to our campus offers opportunities for educational synergy.

Over the next few years we will also be further enhancing our regional co-operation in matters of education with Leiden University and Erasmus University Rotterdam, as set out in the document *Meer Waarde* (Adding Value).

Focus for 2012-2020

- Implement the 3TU Technology Sector Plan for 2011-2015, as agreed with the Ministry of Education, Culture and Science.
- Continue to collaborate with the institutes of vocational higher education in the region: The Hague University of Applied Sciences, InHolland University of Applied Sciences and Rotterdam University of Applied Sciences.
- Intensify our partnership with Leiden and EUR by, for example, developing joint centres in areas such as:
  - governance;
  - education and learning;
  - heritage; and,
  - sustainability.
- Continue to develop courses jointly with Leiden University (Life Science & Technology, Molecular Science & Technology, etc.) and Erasmus University Rotterdam.
- Develop an English-language Master's programme in Philosophy in conjunction with Leiden University and Erasmus University Rotterdam.

2. Quality and success

TU Delft is committed to further improving the effectiveness and efficiency of its entire learning chain, from BSc to PhD, by strengthening its ambitious culture of study. This culture is characterised by substance, challenges, dedication and academic breadth. We set the bar high so that, as Delft Engineers, our graduates measure up to the best of the competition in the international labour market. Meeting this standard requires us to attract enough talented new undergraduates and PhD students and to instil in all involved in our educational activities a mentality built upon study success and the attitude to go with it. To this end, we have implemented a series of study success-enhancing measures. Tutors are expected to master new ways of working, and students are required to take more responsibility for their academic progress. Our slogan in this respect is 'the standard term is the norm', which mean that everyone is expected to complete their studies within the standard allotted time if reasonably possible. Decentralised selection processes are being investigated as one possible way of preventing unnecessary withdrawals and course switches. The undergraduate cycle is being modernised with the introduction of a modular structure, and the final phase of the Master's programmes is being streamlined.

Quality of student intake

TU Delft wants to attract students who possess the talent needed to find success in the engineering sciences. At the point of admission, our basic objective is to get the right students in the right place at the right time.

A carefully considered choice of study programme is an important factor in ultimate academic success. As well as a thorough knowledge of mathematics and physics, the prerequisites for admission to any course at TU Delft include a personal attitude suited to our educational culture, with its focus upon demonstrating ability. We therefore consider it very important to actively support prospective students in their individual process of choosing the subject they want to study.

From 2018 onwards, TU Delft intends to 'deliver' 2200 newly qualified engineers each year, across all the disciplines we teach. The current figure is approximately 2000. To achieve this, we are making our curriculums more conducive to completion. Beginning in the 2014-2015 academic year, we want to introduce an intake test for prospective students, focusing upon the abilities they need to successfully pursue a degree at TU Delft, so might include aptitude in the exact sciences, spatial insight and systems thinking.

We intend to make use of the enhanced opportunities for selective admission being proposed by the Dutch government. The primary purpose of this process will be to prevent unnecessary withdrawals rather than limiting the number of students entering the university necessarily.

Focus for 2012-2020

- Further encourage more female students to enrol at TU Delft.
- Prevent unnecessary withdrawals and course switches by means of an intake test, from 2014, to support prospective TU Delft students in their choice of study programme.
- Intensify contacts with teachers of pre-university streams in secondary schools.
- Limit the first-year undergraduate drop-out rate to a maximum of 22 per cent.
- Limit the number of undergraduates switching courses at the end o the first year to a maximum of 8 per cent.
- Intensify preparatory activities for prospective students, such as technology promotion work, course information, in-university programmes for talented school students and support for school coursework projects.

- Maintain the 'transfer minor' for students from Universities of Applied Sciences and, where necessary, continue to offer a transitional programme for graduates from Universities of Applied Sciences.

Success rates and completion times: national legislation

As part of its process to implement the policy document Kwaliteit in verscheidenheid (Quality in diversity) and the resulting 'outline accord' with universities, the Dutch government is proposing measures to improve student success rates and shorten average degree completion times. These are to be enforced in law, through amendments to the prevailing legislation and ordinances, and are currently expected to take effect in the 2013-2014 academic year. They seem likely to include a legal basis for the intake (choice of study) interview, local selection of students in line with the programme's educational profile, greater freedom for universities to set their own tuition fees and a legally binding recommendation concerning the continuation of studies at end of the final years of the Bachelor's cycle. At the time of this plan's publication, exact details of new measures and how binding they will be are not yet known.

Faculty of Electrical Engineering, Mathematics and Computer Science

Educational profile

BSc programmes
- Electrical Engineering
- Computer Science
- Applied Mathematics

MSc programmes
- Applied Mathematics
- Computer Engineering
- Computer Science
- Electrical Engineering
- Embedded Systems
- Media & Knowledge Engineering

Research profile
- Applied mathematics
- Electrical sustainable energy
- Mediamatics
- Microelectronics
- Software technology
- Telecommunications

Focus for 2012-2020

- As a statutory body within the Dutch public higher education system, TU Delft is required to abide by the prevailing legislation. Within the parameters allowed by law, and in consultation with all internal and external stakeholders, we shall seek to develop specific arrangements tailored to our own educational profile in science and technology and our ambitions as an educational institution.

Success rates: 'the standard term is the norm'

Ultimate student success rates are not a problem at TU Delft; in that respect, we measure up well compared with other universities of technology around the world. What is a problem is that our students tend to take too long to complete their studies. In the future, these completion times need to be reduced. The basic principle we intend to apply is that everyone is expected to complete their studies within the standard allotted time if reasonably possible. This also means that all our programmes must be completable by this nominal deadline, otherwise we will push ourselves and our future graduates out of the international marketplace. In any case, the proposed new student financing system will enforce timely completion. Our academic staff now face a great responsibility to organise their programmes in such a way that it is genuinely feasible for all students to complete their degrees on time.

The principle on timely completion of studies affects our culture of study. Henceforth, students are expected to earn at least 45 ECTS credit points a year. In line with this new norm, in 2011 the Executive Board decided to raise the minimum threshold for a positive binding recommendation (permission to continue into the next year of study) from 30 to 45 credit points with effect from the 2012-2013 academic year.

Focus for 2012-2020

- Encourage the successful completion of BSc programmes by somewhat reducing the traditionally very high number of contact hours – on average, 25 per week – to give students the time they need for private study and extracurricular activities. The average number of contact hours will be 22 per week in 2015 and 20 per week in 2020.
- Bring the actual time taken to complete a BSc more in line with the standard time allotted for the programme. In 2015 some 55 per cent of those entering the second year of the Bachelor's cycle should complete the programme within four years; in 2020 that should be 75 per cent.
- Introduce a coherent package of measures to make the timely completion of programmes more feasible. They include further developing the use of modular and 'activating' learning during the Bachelor's cycle and streamlining the final phase of the Master's cycle.

Modern learning environments at TU Delft

Innovative forms of teaching

TU Delft is actively pursuing a didactic model that emphasises a mix of theory and practice, a blended approach to the use of digital resources and 'activating' forms of education that encourage students to work together and to learn by investigation, across disciplinary boundaries.

3. Quality assurance, accreditation educational organisation

The internationally recognised high standard of our engineering training is the absolute guiding force behind the culture of quality at TU Delft. In 2020 we still want 98 per cent of our graduates to be in work within a year of leaving. To that end, we have opted to uphold the quality of our courses through a university-wide system based upon peer review. The qualitative strength of this combined approach was acknowledged by the national accreditation body NVAO when granting our current institutional accreditation.

Teaching abilities of academic staff

TU Delft wants to be a place where new generations of engineers are taught by inspiring, motivated and enthusiastic professional tutors. People who challenge young people and encourage them to bring out the best in themselves. They are the masters who help transform students into the Delft Engineers of the future.

At TU Delft, all our educational activities are intrinsically associated with research. To become fully-fledged academics here, members of staff must combine teaching with research. As a rule, we are reluctant to appoint personnel who devote themselves exclusively to teaching or to research.

The exception to this rule is teaching in the field of mathematics, which has special role within the university as it supports the learning process across the entire range of engineering sciences. Maths is taught by a pool of tutors from the Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS). Between now and 2020 we will be paying particular attention to their work for two reasons. The first is our desire to safeguard the current high standard of maths teaching – in terms of both subject matter and didactic quality – by pursuing a focused HR policy for this group of tutors. Secondly, our aim is to tie in the subject within each faculty through a combined and co-ordinated educational approach between it and EEMCS.

Focus for 2012-2020

- A substantial increase in the number of new members of staff (charged with teaching duties and qualified to perform them) who hold a basic (BKO) or advanced (SKO) higher education teaching certificate. This objective is being pursued within the 3TU framework.
- A tenfold increase in the total percentage of BKO/SKO-certified tutors (or holders of an equivalent qualification), from 7 per cent in 2010 to 70 per cent in 2015.
- Expand didactic training opportunities for academic staff by offering more BKO/SKO certification courses.
- Expand the advisory capacity designed to enhance the didactic aspects of our educational programmes. This is being done in conjunction with Leiden University and Erasmus University Rotterdam.
- Intensify the use of digital teaching methods.

Institutional accreditation, quality assurance and student satisfaction

TU Delft regards the internationally recognized quality of its engineering degrees as one of the key pillars upon which its reputation is based. But quality is a vulnerable attribute. To safeguard it at all levels throughout the university, we have put in place a comprehensive and transparent system of quality assurance. Student and graduate evaluation of our courses is an integral component of quality assurance.

To guarantee the overall quality of the education we provide, institutional accreditation is essential. In 2011 TU Delft became one of the first universities in the Netherlands to obtain this from NVAO, the Accreditation Organisation of the Netherlands and Flanders.

For us, quality assurance in education involves intensive interaction between three groups: students, academic staff and management. They have to remain in constant communication in order to keep the teaching we provide in a state of productive balance, with a view to forming the kind of Delft Engineer described in the university's vision, ambition and mission statements and in the graduate profile. Each of these groups has its own responsibilities in this process, all of which contribute to the long-term success of our educational programmes and the Delft Engineers they produce.

Focus 2012-2020

- Issue uniform management information about our educational processes from 2015.
- Accelerated implementation of the central guidelines for examinition policy and for the role of the Boards of Examiners at the institutional level, as recommended by the NVAO Institutional Accreditation Committee.
- Shorten the time taken to mark examinations.
- Introduce regular internal audits of educational quality from 2015.
- Achieve higher student satisfaction scores in respect of tutor quality.
- Establish a programme to safeguard the current standards of mathematics teaching.
- Involve input from industry and practice in the BSc and MSc programmes in a more structured way.
- Maintain the Executive Board's focus on implementing measures to improve student success rates, as recommended by the NVAO Institutional Accreditation Committee.

University-wide student projects – D:Dream

Delft: Realisation of Extremely Advanced Machines

TU Delft is home to numerous 'Dream Team' projects. Students can take part in one of these through the 'D:DREAM' minor programme. Examples include...

- **DARE:** hands-on experience designing, building and launching rockets
- **DUT Racing:** design and construction of electric cars for Formula Student racing
- **Dutch Robotics:** development of humanoids – robots that resemble people
- **ECO-Runner:** design and construction of the most energy-efficient road vehicle possible
- **FORZE:** sustainable driving and racing of a hydrogen-powered vehicle
- **iGEM:** international competition for the best genetically engineered machine
- **Nova Bike:** innovative, sustainable design and construction of motorcycles
- **Solar Boat Team:** design and construction of solar-powered boats
- **Solar Team:** development of solar-powered road vehicles

'Being part of a Dream Team is fantastic. It's hard work, you put in long days, but you achieve wonderful results as a team. The D:DREAM minor is a superb opportunity for outstanding students.'

www.tudelft.nl/actueel/studentenprojecten

Institutional accreditation

'A very positive evaluation of the quality of education at TU Delft.'

'The Accreditation Organisation of the Netherlands and Flanders (NVAO) is very positive in its assessment of the quality of education at TU Delft and therefore declares that it has passed the 'Institutional Quality Assurance Test'.' TU Delft is one of the first institutions to achieve this status, along with Radboud University Nijmegen.

According the NVAO report, TU Delft has a clear vision with regard to the quality of its education and what it wants to achieve in the future. Moreover, these plans are discussed widely within the organisation. This approach, with the Executive Board as the main driving force behind it, is characterised by a culture of consultation from the bottom up as well as the top down – a feature that does the university credit, according to the audit committee: 'This working method has resulted in the development of a true culture of quality that is widely supported throughout the whole organisation.'

Over the past few years, the management model at TU Delft has evolved towards a more centralised guidance of the faculties. As a result the university enjoys an effective organisational and decision-making culture, with the consultative model at its heart.

The NVAO report further states that TU Delft 'has systematically rooted a culture of improvement in every part of the organisation'. It has an effective system of quality assurance, thanks to which it is able to guarantee the high standard of the courses it offers.

'The findings of the audit committee have resulted in the NVAO accepting TU Delft's application for approval under the Institutional Quality Assurance Test.'

www.nvao.nl/instellingstoets

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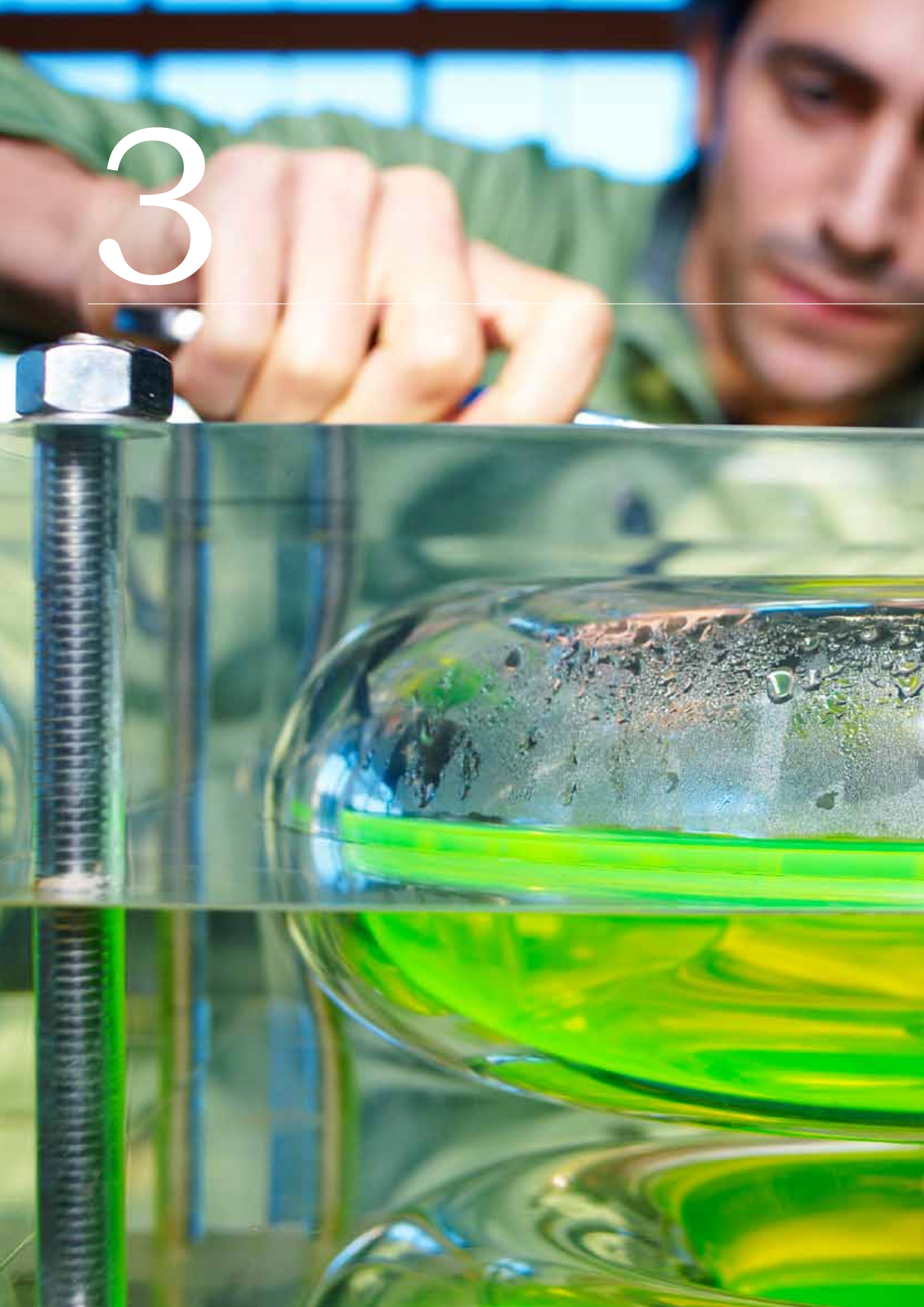


Research

Research at TU Delft encompasses virtually the entire spectrum of engineering sciences. This breadth is the basis of our robust scientific profile. The research questions we tackle are strongly inspired by important future challenges facing society. The technical and scientific knowledge acquired through our research activities feeds naturally into the education we provide. And vice versa: interaction with inquisitive, critical students generates new and unexpected research questions. In other words, at TU Delft research and education inspire one another.

Strategic research priorities at TU Delft for 2020

- Scientific profile: science, design, engineering.
- TU Delft research priority areas.
- Focus and mass in research programming.
- Interfaculty alliances – TU Delft institutes.
- 'Grand challenges for society' – four priority areas.
- Strategic research co-operation.
- International peer reviews and rankings.
- Individual and group quality.
- Top sectors and Horizon 2020
- Fundraising.
- Need for state-of-the-art research infrastructure.

TU Delft's research position

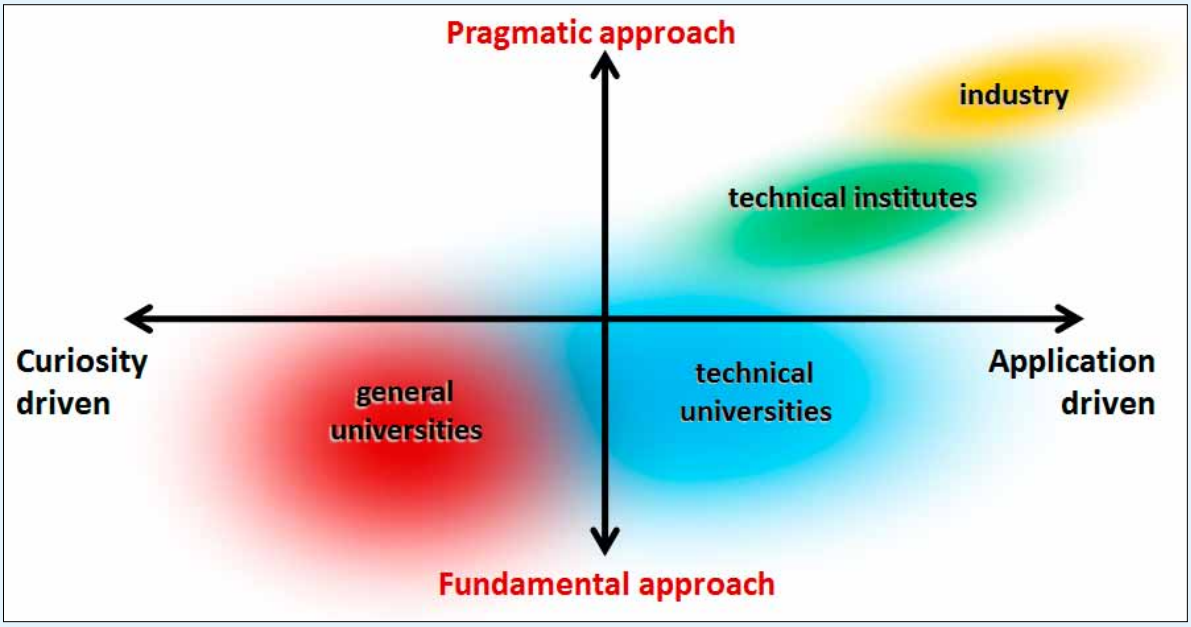
The first dimension or variable defining a university's research position is: where does the request for research come from? It is motivated by curiosity or potential utility? Professional researchers are likely to be driven by curiosity, whereas businesses and society at large are more interested in utility. The second dimension is: how best can the research question be answered, by taking a fundamental approach or a pragmatic one?

Most research at TU Delft is positioned in the lower right-hand quadrant of the diagram above. In other words, it seeks to answer utility-driven questions in a fundamental way. And most of it has a long time horizon, greater than eight years.

The complexities of the research questions we are posed means that many of them have to be tackled in a multidisciplinary or interdisciplinary fashion.

Internationally, more and more universities are adopting the research position which already characterises TU Delft: investigating utility-driven questions in a fundamental manner.

The diagram used here was inspired by Donald Stokes' *Pasteur's Quadrant: Basic Science and Technological Innovation* (2011), but is not intended as a direct reproduction of his work.



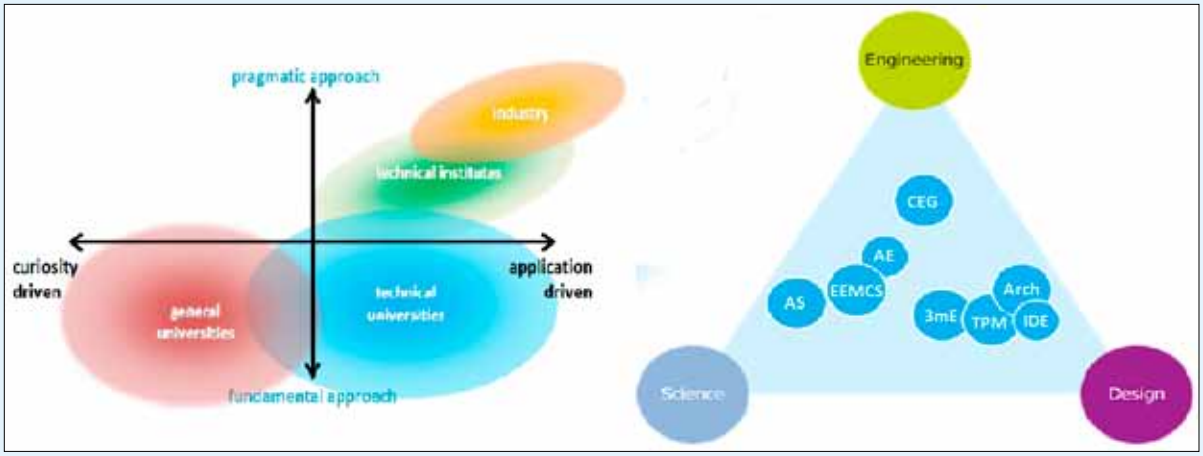
TU Delft – science, engineering and design profile

Faculties

Research at TU Delft encompasses virtually the entire spectrum of engineering sciences. This disciplinary breadth and pluriformity is vital to our scientific reputation.

We approach our research activities from three directions: science, engineering and design. But the degree of emphasis placed upon each of these dimensions varies from discipline to discipline.

The positioning of the faculties in the above diagram is a 'snapshot'. The internal dynamism in the engineering sciences means that their precise focus is shifting all the time. As a university we intend to enter into a discussion with our faculties about the positioning and development of each of their departments within the science-design-engineering triangle, as depicted above.



1. Research priority areas

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. TU Delft is aligned with both the Dutch agenda on science and innovation policy, the 'top sectors' initiative, and the European research agenda Horizon 2020. Building upon our firm academic research base, we are forging close alliances with other leading institutions, such as Leiden University and Erasmus University Rotterdam, as well as our partners in the 3TU Federation in the Netherlands, the IDEA League in Europe and others internationally.

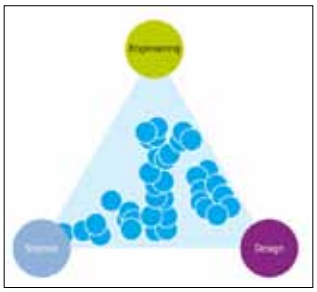
Scientific profile: science, design, engineering

TU Delft wishes to be a university at which science, design and engineering are the dominant factors in its educational and research activities. Now and in the future, these three dimensions will be present in combinations with varying ratios.

Throughout the world, the engineering disciplines are becoming more and more tied up with fundamental science. This development has certainly not passed TU Delft by. In fact, given our own institutional ambitions, it is something we have chosen to encourage. As a broad-based university of technology, it is important that we strike the right balance between the three factors making up our scientific profile. This also means it is not realistic to expect that activities currently associated very strongly with one position will shift into a completely different one. For the strategic positioning of TU Delft as a whole, however, it is important to know the direction in which the faculties intend to develop themselves in the light of our vision, ambition and mission as an institution, and to conduct a critical dialogue about that choice.

Focus for 2012-2020

- Consult with the faculties about the current positioning of their research and the direction it will take in the next few years.



TU Delft research priority areas

The entire research portfolio at TU Delft was restructured in 2001-2003. This exercise resulted in the departure of approximately 200 academic personnel (FTE), and the internal redeployment of another 700 or so (also FTE). The operation released about €8 million per annum, which has been reinvested in new research initiatives.

Compared with 'classic' research universities, TU Delft stands out because of its distinctive technical-scientific profile. In this respect, science, design, engineering are the profile determining factors.
This profile is firmly rooted within the remits of the academic departments at TU Delft, and in the teaching and research mandates of its professors. As such, they and their staff are the front-line representatives of our scientific position: the driving force behind the ground-breaking scientific and technical research for which we are responsible.

From time to time, it is vital that we systematically review our scientific profile at a university-wide level. The tool we use to do this is the comprehensive planning and evaluation cycle (see Chapter 7, 'Implementation').

Under the TU Delft Review Agenda, a long-term programme has been initiated to clarify the scientific profile of each faculty. As part of this, the faculties have drawn up internal reprofiling and restructuring proposals to generate total savings of €45 million. These funds are to be reserved for reinvestment and renewal. This university-wide operation has also led to some difficult decisions, including the merger, downsizing and even closure of certain departments and courses.

The following criteria have been used to assess the faculty reprofiling and restructuring proposals.

- TU Delft's profile as a university of technology at which science, engineering and design are represented in a balanced fashion in all scientific activities.
- TU Delft's public visibility in the following social policy priority areas: energy, infrastructure and mobility and the living environment.
- TU Delft's scientific basis, with particular attention to the further strengthening of our academic focus and critical mass.
- The intrinsic, interactive relationship between education and research, and striking the right balance between these two activities.

Focus 2012-2020

- Complete the fundamental restructuring and reprofiling of the faculties and their academic departments by 2014, in accordance with TU Delft Review Agenda and including the following main points:
  - o Group the research activities of the current Faculty of Architecture into four departments.
  - o Integrate the OTB Research Institute for the Built Environment into Faculty of Architecture as a fifth department.
  - o Combine the Department of Structural Engineering in the Faculty of Civil Engineering and Geosciences (CEG) with the Department of Architectural Engineering & Technology in the Faculty of Architecture.
  - o Cluster research related to transport.
  - o Move the Department of Remote Sensing in the Faculty of Aerospace Engineering to the Department of Geotechnology in CEG.
  - o Close the Department of Multiscale Physics in the Faculty of Applied Sciences and merge parts of it into the Department of Process & Energy in the Faculty of Mechanical, Maritime and Materials Engineering (3mE).
  - o Restructure the Department of Materials Science & Engineering in 3mE.
  - o Reposition the Faculty of Electrical Engineering, Mathematics and Computer Science as a Faculty of Information and Communications Technology.
  - o Reduce direct funding of the DIMES Research School (Delft Institute of Microsystems and Nanoelectronics).
  - o Restructure the Faculty of Technology, Policy and Management (TPM).
  - o Reposition TPM as a School for Public Management and Technology.

Focus and mass in research programming

At the time of this plan's publication, TU Delft is operating approximately 120 research programmes (see Appendix). But this number is not set in stone. Both internal scientific dynamics and external factors – quality assessments and financial considerations – can cause existing

programmes to be realigned or discontinued and new ones to be initiated.

TU Delft works on the principle that each of its research programmes should have a sharp scientific focus and should cluster the research capacity that is available in such a way that it achieves international visibility and global scientific leadership. Organisationally, the programmes are rooted in the university's academic departments. The results of recent research assessments indicate that a considerable number of TU Delft's research programmes are seen as trend-setting on the global level.

Focus for 2012-2020

- Strategic positioning of leading international flagship programmes.
- Strengthen selected research domains and programmes which are either world leaders already or have the potential to reach that level.
- Encourage full use of the opportunities made available by open access.

Interfaculty alliances – TU Delft institutes

In certain specific fields, both established and emerging, TU Delft wishes to further enhance the international visibility of its research. This is to be achieved by 'clustering' high-quality research capacity – either physically or virtually – into a number of university-wide institutes. This will put us in a better position to join national and international consortia and networks, as well as making us more attractive to top scientific talent. Each TU Delft institute is headed by one of our leading scientists. It is important to note that, in order to maintain the clarity of our scientific profile, the number of TU Delft institutes will always be limited.

Focus for 2012-2020

- Develop at least four institutes during the period 2012-2017:
  - o TU Delft Process Technology Institute;
  - o TU Delft Robotics Institute;
  - o TU Delft Transport Institute;
  - o TU Delft Climate Institute.
- Also during the period 2012-2017, develop additional institutes in a limited number of selected research domains, either established or emerging. These might possibly, but by no means necessarily or exclusively, include the following areas:
  - o materials;
  - o health;
  - o information and communications technology;
  - o building and construction technology.

Faculty	Research priority areas	
Architecture	• Architecture • Architectural Engineering & Technology	• Real Estate & Housing • Urbanism • OTB for the Build Environment
Civil Engineering & Geosciences	• Structural Engineering • Geoscience & Engineering • Hydraulic Engineering	• Water Management • Geoscience & Remote Sensing • Transport & Planning
Electrical Engineering, Mathematics & Computer Science	• Applied Mathematics • Electrical Sustainable Energy • Intelligent Systems	• Microelectronics • Software & Computer Technology
Industrial Design Engineering	• Design Engineering • Industrial Design	• Product Innovative management
Aerospace Engineering	• Aerodynamics, Flight Performance and Propulsion & Wind Energy	• Aerospace Structures & Materials • Control & Operations • Space Engineering
Technology, Policy & Management	• Engineering Systems & Services • Multi Actor Systems	• Values, Technology & Innovation
Applied Sciences	• Bionanoscience • Biotechnology • Chemical Engineering	• Imaging Science & Technology • Quantum Nano science • Radiation, Radio-nuclides & Reactors
Mechanical, Maritime & Materials Engineering	• Biomechanical Engineering • Systems & Control • Maritime & Transport Technology	• Precision & Micro-systems Engineering • Process & Energy • Materials Science & Engineering

'Grand challenges for society' – four priority areas

The 'grand challenges for society' formulated by the European Union have inspired much of the research currently being undertaken at TU Delft. Within the very wide spectrum of such challenges identified, we have selected four major university-wide priority areas: energy, health, the environment and infrastructures and mobility. Research in all these fields is firmly rooted in disciplines in which TU Delft is strongly represented.
Moreover, these four themes tie in with the broader national, European and global public agendas. They embrace the research questions that are key to developing a sustainable society in the future. Many other universities and academic institutions are choosing to focus on these or similar priority areas, but what makes TU Delft distinctive in this respect is the practicality of the engineering sciences in which we specialise. In 2008-2009 we developed the Delft Research-Based Initiatives as a tool to put this positioning into practice. These are not so much organisational units as thematic, interfaculty and interdisciplinary classifications of research activities by various academic departments, with their own management teams and offices.

Focus for 2012-2020

- Review the Delft Research-Based Initiatives in 2014-2015.
- Ensure that, through the academic departments that form part of them, the Delft Research-Based Initiatives play a substantial part in seven of the nine 'top sectors' defined by the Dutch government: chemicals, the creative industry, energy, high-tech systems and materials, life sciences and health, logistics and water.

Strategic research co-operation

All the research activities at TU Delft are embedded in national and international partnerships, ranging from peer-to-peer contacts on a small scale to complete large-scale programmes. The development of strategic research partnerships is part of our ambition to be recognised as a leading university on the world stage. In forging them, we apply the criterion that they should enhance our profile and reputation. TU Delft is pursuing such partnerships on a global, European, national, regional and sectoral scale, and they are developed at three levels of contact: between individual academics on a peer-to-peer basis, by departments and/or faculties and at the level of the university administration.

Focus for 2012-2020

- In the spring of 2012 TU Delft, Leiden University and Erasmus University Rotterdam present a joint report on their proposed alliance. This foresees intensified research co-operation in the following domains.
    - o Law.
    - o Humanities.
    - o Science, engineering and design.
    - o Medicine and life sciences.
    - o Social and behavioural sciences.
    - o Economics and management.
- Strengthen co-operation with Leiden University and Erasmus University Rotterdam in the fields of health, mathematics, physics, chemistry, computer science and electrical engineering.
- Explore opportunities for collaboration, jointly with Leiden University and Erasmus University Rotterdam, within the context of the European Horizon 2020 programme, on such themes as 'inclusive, innovative and secure societies'.
- Strengthen Medical Delta, the regional strategic research partnership in the health sciences.
- Further develop research collaboration and co-ordination within the 3TU Federation, focusing particularly upon the following joint centres of excellence.
    - o Intelligent Mechatronic Systems

  - o Dependable ICT Systems
  - o Sustainable Energy Technologies
  - o Multiscale Phenomena
  - o Bio-Nano Applications
  - o Ethics & Technology
  - o Applied Mathematics
  - o Construction
- Maintain, and where necessary strengthen, our presence in and contribution to national programme-based research partnerships and alliances in the form of research schools, technological top institutes and research consortia.
- Maintain our involvement in the IDEA League, as an important European network of leading technological universities.
- Explore opportunities to establish a prominent and permanent presence in emerging knowledge economies like Brazil, China, Singapore and Malaysia, possibly in the form of local branches.

Since 2010, TU Delft has been a member of two of the three Knowledge and Innovation Communities (KICs) led by the European Institute of Innovation & Technology (EIT).

In the Climate KIC, our partners include the universities of Utrecht and Wageningen, ETH Zürich, Paris Tech and Imperial College London, as well as TNO, Shell, DSM and Amsterdam Schiphol Airport.

Through 3TU, in the ICT KIC we work with universities in Berlin, Stockholm (KTH), Helsinki and Paris, amongst others, and with industrial partners including Ericsson, Nokia and Alcatel-Lucent.

Faculty of Technology, Policy and Management

Educational profile

Bachelor
- Technology, Policy and Management

Master
- Engineering and Policy Analysis
- Management of Technology
- Systems Engineering, Policy Analysis & Management

Research
- Infrastructure Systems & Services
- Innovation Systems
- Multi Actor Systems
- Values & Technology

Faculty of Mechanical, Maritime and Materials Engineering

Educational profile

BSc programmes
- Maritime Engineering
- Mechanical Engineering

MSc programmes
- Biomedical Engineering
- Marine Technology
- Materials Science & Engineering
- Mechanical Engineering
- Offshore & Dredging Engineering
- Systems & Control

Research profile
- Biomechanical engineering
- Systems and control
- Maritime and transport technology
- Materials science and engineering
- Precision and microsystems engineering
- Process and energy

Delft Research-based Initiatives

Through its public mission and core values, TU Delft is an academic institution at the heart of society. Its scientists and researchers are working to resolve some of the great and pressing issues of our time, in four main areas: energy, health, the living environment and infrastructure and mobility.

Some examples of the questions we are trying to answer...

- How do we stop wasting heat?
- How can we use biomass in a sustainable way?
- What will the seaport of the future look like?
- How do icecaps, airstreams and land masses affect our climate and living environment?

Helping to solve these and similar questions requires a lot of innovative research. And so represents an enormous challenge for our staff and students.

Delft Research-based Initiatives	Energy	Environment	Infrastructures & Mobility	Health
				
Staff(fte)	700	250	425	200
Research themes	• Policy innovation and market design • Clean fossil and Nuclear energy • Sustainable energy technologies • Enabling technologies and infrastructure	• Sensing our environment • Modelling our environment • Shaping our environment	• Safe & livable Delta areas • Sustainable Mainports & Hubs • Safe, Efficient, Clean & Intelligent Transport • Available & Sustainable Infrastructures	• Medical Imaging & Image Guided Medicine • Interventions & Care • Targeted Molecular Technology • Home care technology
Top sectors	Energy, Water, High Tech Systems & Materials, Chemistry	Energy, Water	Logistics, Water, High Tech Systems & Materials	Life Sciences & Health, High Tech Systems & Materials, ICT

2. Quality assurance in research

TU Delft's scientific reputation is largely determined by the quality of its research performance and, secondarily but intricately bound up with that performance, its educational programmes. Our efforts in this respect are driven by the desire that our teaching and research be judged 'very good' or 'excellent' by our international peers, using the Standard Evaluation Protocol. International rankings are also an indicator of what others think about the quality of TU Delft research, either as a whole or in relation to specific disciplines. They are important to our international standing. As a talent-driven organisation, it is essential that we invest in our scientific potential. Our priority here is to strengthen the quality of our academic personnel in a sustainable fashion.

International peer reviews & rankings

International peers frequently assess our research quality, often as part of a regular external audit exercise. The current national system of peer review in the Netherlands is a tried and tested means of determining quality, with input from authoritative international experts. Our ambition is to be rated at least 'very good' on all assessment criteria. When a rating is significantly lower than that, we will seriously consider reorganising or even closing the programme in question.

Moreover, TU Delft now wishes to go a step further by introducing more systematic and direct comparisons with its international peers at the discipline level. This will provide us with a clearer understanding of the quality of specific programmes at fellow academic institutions abroad, rather than only those in the Netherlands. To this end, we have taken the initiative to develop – in conjunction with our European sister universities – an international benchmark for the positioning and quality of specific scientific disciplines. This will cover education and research in equal measure.

Focus for 2012-2020

- Continue to apply the national frameworks and protocols for the external assessment of research. These are guided by the criteria set out in the Standard Evaluation Protocol.
- Initiate development of an international peer-review system for one or more disciplines in 2014-2015, possibly within the framework of the IDEA League.

TU Delft in global rankings

- **QS** Engineering & Technology ranking 2011-2012: 18
- **THE** Top 50 Engineering & Technology 2011-2012: 22
- **THE** World Reputation Ranking 2011-2012: 51-60
- **QS** Natural Sciences ranking 2011-2012: 79
- **Shanghai** Engineering 2011 – Technology: 76-100
- **THES** World University Ranking 2011-2012: 104
- **QS** World University Ranking 2011-2012: 104
- **Leiden** Ranking 2011-2012: 115
- **Shanghai** Ranking 2011: 151-200

Individual and group quality

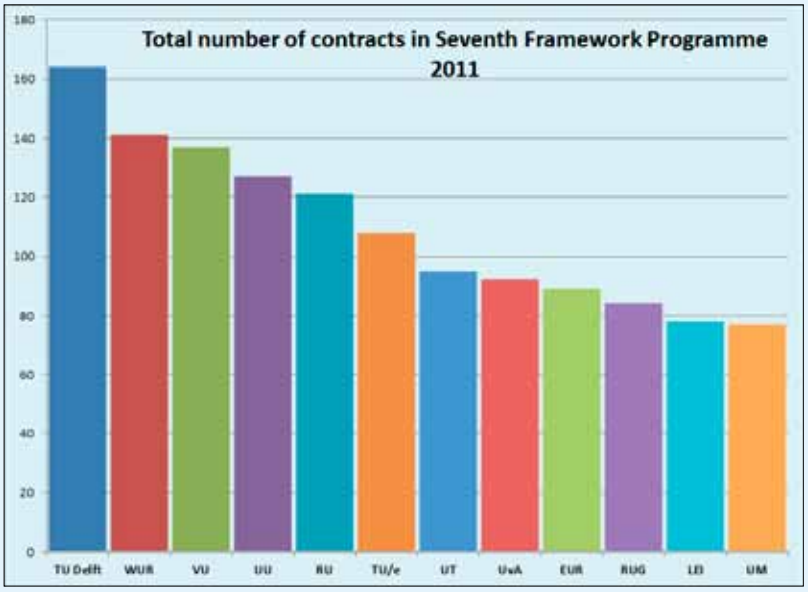
In all its academic disciplines, TU Delft wants to play in the global 'premier league'. And in selected fields our aim is to top that league. To help achieve this, we have opted to systematically promote the quality of entire research groups as well as the excellence of individual scientists. Research groups need to incorporate a balanced spread of skills and competencies. As part of the university-wide Result and Development Cycle, all our academics are appraised annually on their performance in teaching, research, knowledge valorisation, organisation and leadership.

Professorial appointments are strategic decisions which affect TU Delft's core profile. Whenever a chair falls vacant, its remit is reviewed in the light of developments in the subject area, the faculty and university profile and so on.

Focus for 2012-2020

- Implement a focused strategy for academic recruitment ('scouting'), talent management and personal career development.
- Encourage more publication of the results of constructive and productive research in ISI-registered journals or publications of equivalent standing. This is one of the indicators of quality.
- Develop the academic departments as professional scientific communities, modelled after the concept of the faculty, as used to refer to the communities of assistant professors, associate professors and full professors in Anglo-Saxon universities.

TU Delft and Framework Programme 7



TU Delft is constantly developing collaborative activities at the national and European levels through participation in consortia with major companies and academic institutions.

Within the last two European framework programmes, FP6 and FP7, we have taken part in more than 200 research projects with partners throughout the EU.

In FP7, we have been involved in more projects than any other Dutch university. This puts us in an excellent starting position for substantial and active participation in FP8.

3. Top sectors, horizon 2020 & fundraising

Indirect government funding of research through the Netherlands Organisation for Scientific Research (NWO) and Technology Foundation STW is being limited. And the Economic Structure Enhancement Fund (FES) is being gradually wound up. In response, to safeguard its revenues TU Delft has opted to align itself with the Dutch government's 'top sectors' policy and with the Eighth Framework Programme of the European Union, Horizon 2020. It is also seeking to raise more funds through private donations and other sources.

Top sectors and Horizon 2020

TU Delft is keen to play a prominent role in the 'top sectors' defined by the Dutch government. Our activities to this end over the next few years – knowledge development, internationalisation and implementation of the human capital agenda – are tailored to our focus as a university: in each top sector, the programmed research spans the entire range, from curiosity-inspired to application-driven. Our scientific contributions to these sectors are specified in innovation contracts with government and the business community, which include commitments undertaken by TU Delft for the coming years.

We are also intensifying our presence in European alliances. Together with strategic partners at home and abroad, we intend to be an active participant in Horizon 2020, the Eighth Framework Programme of the European Union. The focus here is not just a response to the 'grand societal challenges' formulated by the EU, but also securing additional funding for research into industrial leadership and programmes under the auspices of the Knowledge and Innovation Communities led by the European Institute of Innovation & Technology (EIT), as well as individual European Research Council (ERC) grants.

Focus 2012-2020

- Faculty and departmental participation in the 'top sectors'. Our commitments in this respect are entered into by the university as a whole, in consultation with the faculties.
- Intensive and substantial co-operation with our strategic partners at the regional, national and international levels, in respect of both the 'top sectors' and Horizon 2020.
- More intensive and effective organisation of facilities at the Valorisation Centre in order to foster the early identification, creation and exploitation of opportunities to secure additional research funding from Dutch, European and international public agencies.

Fundraising

TU Delft is actively endeavouring to raise funds from private donors, companies and charitable foundations. Our alumni network has an important part to play in this activity. All the money raised will be channelled into scientific research and scholarships for talented students.

Focus for 2012-2020

- Develop and implement a fundraising campaign with a focus upon projects in areas of particular public interest, such as health, climate and energy.
- Dedicated investment in alumni relations.

4. Research infrastructuur

To attract outstanding scientific talent, to conduct groundbreaking research and to train new generations of engineers TU Delft is heavily dependent upon excellent but expensive infrastructure. This is what makes it possible for us to test the real-life practicality of models simulated on computers, for example – something no other Dutch university is able to do on such a large scale and a defining factor of TU Delft's profile in the international research landscape.[17]

Necessity of state-of-the-art research infrastructure

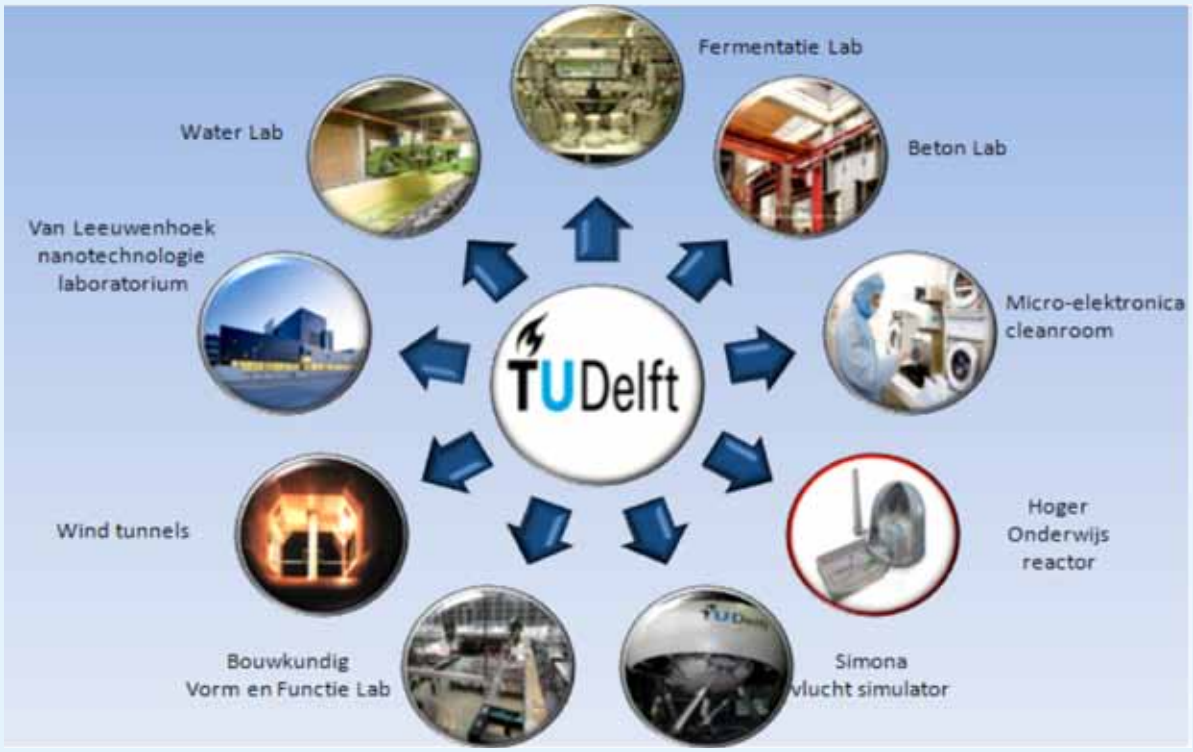
Excellent facilities are a necessary precondition for the research programmes undertaken at TU Delft, and as such help to determine our choice of profiles. We possess a research infrastructure of national and European importance, providing society with significant value. To continue to fulfil its public remit, it is essential that the university modernise its existing infrastructure or develop new facilities as and when necessary. This requires extensive investments, which regularly exceed our own financial capacity as an institution.

Since 2009 we have been working on a long-term investment programme to keep our research and educational infrastructure up to date. This includes both the construction of new buildings and the upgrading of existing facilities, as well as the acquisition of new equipment. As the plans currently stand, this programme is to be implemented over the next eight years. It requires substantial financial input but is absolutely essential at a time of active investment in comparable infrastructure in other parts of the world – particularly Asia, but also elsewhere in Europe. Many of our current buildings and other facilities date from the 1950s, 1960s and 1970s and are in urgent need of renovation or, where that is no longer possible, replacement. Hitherto, such work has often been conducted on an ad-hoc basis, resulting in only partial solutions. This is why we have now decided on a coherent, long-term approach to the issue, based upon a clear vision played by the campus in the life of the university and as an integral part of the city of Delft.

Focus for 2012-2020

- Implement a substantial, coherent and long-term programme to modernise or replace the existing educational and research infrastructure. Take part in Dutch and European programmes related to large-scale infrastructure of this kind.
- Implement a web-based overview of all the research infrastructure at TU Delft in 2014.

Vital research infrastructure TU Delft



TU Delft Higher Education Research Reactor

The Reactor Institute at TU Delft operates the only nuclear reactor in a university environment in the Netherlands. Instead of being designed to generate electricity, the reactor is used for research purposes. The Reactor Institute is a world leader in the development and production of neutron research instruments.

'The Reactor Institute is receiving a financial injection of €38 million from the Dutch government to implement its OYSTER (Optimised Yield for Science, Technology and Education of Radiation) programme, with which the institute intends to maintain and reinforce its international position as a centre of expertise and education in the field of nuclear technology and radiation. The investment was approved by the Cabinet on 20 January 2012.'

'The extra funds mean that the Delft reactor can be fitted with a so-called 'cold source'. New, innovative research instruments will also be developed. These are essential for research into the detection and treatment of cancer and for the development of materials for sustainable energy technology, amongst other things.'

rid.tudelft.nl

Nanotechnology TU Delft

KAVLI INSTITUTE of Nanoscience Delft

TNO innovation for life

TU Delft

The Kavli Institute of Nanoscience Delft (KIND) was founded in 2004, partially financed by the prestigious Kavli Foundation.

The Kavli Foundation is dedicated to advancing science around the world with the aim of helping to resolve some of the important issues facing society today and tomorrow. At the time of its establishment, KIND was only Kavli Institute outside the United States.

It now employs more than 250 nanoscience and nanotechnology specialists, who are developing new concepts and making fundamental breakthroughs. KIND encompasses two departments in the Faculty of Applied Sciences: Quantum Nanoscience and Bionanoscience.

The Van Leeuwenhoek Laboratory is one of the largest nanotechnology research facilities in Europe. This state-of-the-art lab is the successful product of years of collaboration in R&D between TU Delft and national applied research organisation TNO, combining the former's dedication to groundbreaking research with the latter's practical approach.

The successful application of nanotechnology will be of decisive importance to the future of virtually every sector of society. At the Van Leeuwenhoek Laboratory, students, scientists and commercial partners are working to shape that future from a variety of angles.

kavli.tudelft.nl

Faculty of Applied Sciences

Educational profile

BSc programmes
- Molecular Science & Technology
- Applied Physics
- Life Science & Technology

MSc programmes
- Applied Physics
- Chemical Engineering
- Industrial Ecology
- Life Science & Technology
- Science Education & Communication
- Sustainable Energy Technology

Research profile
- Bionanoscience
- Biotechnology
- Chemical engineering
- Imaging science and technology
- Multi-scale physics
- Nanoscience
- Radiation, radionuclides and reactors

4

Knowledge valorisation

TU Delft defines knowledge valorisation as the process of creating value out of knowledge, by making it suitable or available for economic or social exploitation and translatable into competitive products, services, processes or activities. As such, it is our third core task alongside education and research. Moreover, it reflects our public remit and our mission to contribute towards a competitive economy. Multinational companies, large technology firms, SMEs and government agencies are all essential stakeholders in TU Delft, as parties demanding know-how and solutions to take to the market. It is vital that we align ourselves more closely with the agendas of these strategic partners. There is a long tradition of intense interaction between the results of research and valorisation, especially in a technical and scientific environment.

Strategic priorities in knowledge valorisation at TU Delft for 2020

- TU Delft valorisation profile, 2012-2020
- Structural co-operation with business and government
- Co-operation with SMEs
- Delft Technological Innovation Campus
- Support organisation –TU Delft Valorisation Centre
- Entrepreneurship training and development of new commercial activity
- Intellectual property
- Debate on ethical aspects of public-private partnerships

Biobased Economy

Triple Helix: : university, business, government

The term 'biobased economy' (BBE) refers to one fuelled primarily by biomass rather than being dependent on fossil fuels for its energy, as is the case at present.

The complexity of the international market and of the scientific and technological advances being made in this field far outstrip the capacity of any single company or institution.

For this reason, a public-private environment in which universities, businesses and governments work together is essential if we are to move successfully towards a BBE.

B-Basic

B-Basic is an international biobased experiment aimed at encouraging innovation. Co-ordinated by TU Delft and funded by the Dutch government, it brings together the best scientists and experts in this field from universities in the Netherlands and elsewhere, as well as companies like AkzoNobel, DSM and Essent.

1. Partnerships: business, government, university

TU Delft is a university with a strong focus on the social and economic utilisation of knowledge. To enable us to undertake these activities in a more systematic way, in 2004 we initiated the TU Delft Valorisation Programme. This forms the basis of our current valorisation profile, which is to be further developed in the coming years.
At the European, national and regional levels, TU Delft positions itself as a constructive knowledge partner for 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 have therefore decided to further enhance our position in the innovation clusters.

TU Delft valorisation profile, 2012-2020

Knowledge valorisation is a fully-fledged core task for TU Delft, alongside education and research. It is not an autonomous activity, but very much linked to the results of research. Our success in valorisation is therefore dependent in the first instance upon our academic staff and their performance. For this reason, it forms part of the annual staff Result and Development Cycle.

It is important that we systematically co-ordinate our activities in this area with all the links in the valorisation chain. They include national applied research organisation TNO, the Dutch 'large technological institutes' (GTIs) and various government bodies. To involve other social and economic stakeholders in the same systematic manner, we organise regular meetings for representatives from the public and private sectors.

Faculty of Industrial Design Engineering

Educational profile

BSc programmes
- Industrial Design Engineering.

MSc programmes
- Design for Interaction.
- Integrated Product Design.
- Strategic Product Design.

Research profile
- Design engineering.
- Industrial design.
- Product innovation management.

Focus for 2012-2020

- Further develop the TU Delft valorisation profile for 2012-2020, building upon the basis first established with the opening of the Valorisation Centre in 2004.
- Select valorisation indicators relevant to TU Delft, in order to provide a better insight into our efforts and performance in this area and to make them easier to compare with other national and international players.
- Develop a form of annual valorisation reporting in 2013, supplementing the information already provided on the subject in the university's annual reports.

Structural co-operation with business and government

TU Delft continues to pursue a policy of reinforcing its structural alliances with multinational companies, large technology firms and relevant government agencies. This is done by means of strategic long-term agreements with these partners on such topics as research, training, continuous education (lifelong learning), knowledge management and facility sharing. The actual cost and quality of the services provided are an important basic criterion in these agreements.

Focus for 2012-2020

- Further reinforce regional networks devoted to public-private partnerships, such as Medical Delta, Cleantech Delta, Greenport and ICT.
- Further develop stakeholder and account management activities with current and potential partners, especially at the international level.
- Foster links at the personal level through, for example, dual appointments.
- Draw up an innovation strategy for each faculty, as an integral part of its strategic planning process.
- Actively develop postacademic and in-company educational programmes.

Co-operation with SMEs

TU Delft wants to build a strong bridge between the development of knowledge and its practical application by small and medium-sized enterprises. In particular, this means supporting product, process and service innovation by SMEs. In pursuit of this aim we have decided only to expand and connect existing SME forums and networks, not to develop new ones of our own – that is a task for the SMEs themselves. In strengthening our partnerships with these enterprises, the emphasis will be on customer relationship management and making the university more accessible. As a result, we will be able to continue to play an active part in facilitating innovation on the part of SMEs.

Focus for 2012-2020

- Improve access for SMEs to the know-how and the research infrastructure at TU Delft by inventorising their potential for this sector at the academic department level as part of the faculty innovation planning process.
- Join existing SME forums to stimulate cooperation.
- Place a greater emphasis upon customer relationship management to ensure that agreed activities unfold successfully.

Science Port Holland – Delft Technological Innovation Campus

As part of its core task of valorising knowledge, TU Delft wishes to be an attractive physical location for companies with a strong R&D component. We are a shareholder in the company Science Port Holland NV, which is developing a 'Delft Technological Innovation Campus' – a project also supported by the Province of Zuid-Holland and the cities of Delft and Rotterdam. The intention is for this campus to be closely integrated with the university campus, and this should be central to the plans.

However, this initiative is certain to trigger a debate about the extent to which TU Delft can and should act as a codeveloper of a project of this kind.

Focus for 2012-2020

- Develop the Delft Technological Innovation Campus during the period 2012-2017, in close collaboration with Science Port Holland NV.

The TU Delft Valorisation Centre provides scientists with professional support in the following areas.

- Early identification of opportunities to secure external research funding from national and European public agencies and from the private sector
- Taking advantage of new opportunities by pointing out where and how to submit high-quality research proposals
- Involving strategic third parties in activities related to TU Delft's societal, technical and scientific priority areas
- Managing and co-ordinating projects, especially large-scale ones, including their contractual aspects
- Managing TU Delft's portfolio of patents and guiding our inventions onto the marketplace
- Developing and co-ordinating structural stakeholder management activities focusing upon large knowledge-intensive companies
- Developing fundraising opportunities targeting private donors, companies and charitable foundations

Support organisation – TU Delft Valorisation Centre

It is very important to TU Delft that it fulfil its role in the innovation chain effectively. This requires maintaining a professional and well-organised network encompassing stakeholders such as private businesses, national governments and, to an increasing extent, the European Union. Which in turn demands that our valorisation activities be robust and of the highest professional standard, so that their 'clients' throughout the organisation are assured of the best possible support in this respect. Proactive and high-quality organisational assistance to academic personnel in developing and submitting applications for additional external funding of their research projects and programmes is an absolute precondition for successful knowledge valorisation. TU Delft therefore focuses its supporting activities in this domain in three areas: strategic guidance, project guidance and relationship and stakeholder management.

Focus for 2012-2020

- Permanently embed the activities conducted under the title 'TU Delft Valorisation Centre' in the supporting line organisation of the University Corporate Office, anchoring them in Legal Services, Strategic Development and Marketing & Communications.
- Develop a TU Delft valorisation agenda for 2012-2015 to guide supporting activities in this domain.
- Organise effective TU Delft representation in the Dutch government and EU processes of choosing themes and programmes, in consultation with the faculties.
- Improve interaction between the academic shop floor and the Valorisation Centre.

2. Encouraging entrepreneurship

TU Delft wants to see high-quality research translated into innovative commercial activity around the university campus. We therefore actively encourage our students to familiarise themselves with entrepreneurship. The Delft Centre for Entrepreneurship and YES!Delft respectively facilitate education on this subject and support the development of promising new technology-driven businesses. Building a strong portfolio of patents is a precondition for the success of these activities.

Delft Centre for Entrepreneurship

Underlying our entrepreneurship education activities is a clear vision for the future. TU Delft is currently introducing enterprise-related modules throughout the educational chain. All students can take these courses, which imprint the idea of starting their own business in their mind. Whether they actually go on to do so requires careful further consideration, of course, but those who do can also take more advanced courses so that they leave the university with all the right skills.

Entrepreneurship training and development of new commercial activity

TU Delft has brought together all its entrepreneurship-related teaching activities under the auspices of the Delft Centre for Entrepreneurship. Here, students and researchers can learn how translate their know-how into commercial activity. This also corresponds to one of the characteristics of the Delft Engineer.

YES!Delft facilitates the development of new technology companies, and TU Delft wants it to become one of the leading business incubators in Europe. Its new building opened in 2010 and very quickly began to reach the limits of its capacity. We are now planning an 'expansion' building, with laboratory facilities as well as office space. This will be open to firms that outgrow or have to leave YES!Delft, but it can also be used as temporary accommodation by companies eventually intending to base themselves at Science Park Holland.

YES!Delft is the university's enterprise centre, encouraging technological entrepreneurship and supporting it in all its phases.

YES!Delft inspires students, professionals and scientists to become entrepreneurs, and provides them with practical assistance in establishing and developing their own companies.

A total of 100 new businesses were launched with YES!Delft backing between 2004 and 2012.

Focus for 2012-2020

- Initiate the development of a second YES!Delft building.
- Increase participation in entrepreneurship-related modules. In partnership with Leiden and Erasmus University Rotterdam (EUR), ensure that at least 450 Delft MSc students are introduced to this subject in 2015.
- Encourage technological start-ups. In 2015 YES!Delft should be aiding about 15 new companies a year. Three firms should be moving out of the building each year due to expansion, with two of them having the

potential to employ twenty or more people.
- Develop an LDE Centre for Entrepreneurship in partnership with Leiden University and Erasmus University Rotterdam.

Intellectual property

TU Delft wishes to increase its production of technologies suitable for commercial exploitation, and to see them brought to market as quickly as possible. Patent protection makes an invention attractive to businesses or investors as a commercial proposition. TU Delft therefore intends to improve the quality of its intellectual property, with scouting for and screening of ideas taking place close to the academic 'shop floor'.

Focus for 2012-2020

- Ensure that the commercially exploitable TU Delft patent portfolio is at least self-financing by 2015.
- Professionalise the scouting and screening process, with a focus on the development of thematic market-technology combinations such as energy, transport and logistics, the living environment, ICT and health.
- Develop a training programme on intellectual property for academic personnel.

Debate on ethical aspects of public-private partnerships

The development of public-private partnerships is a central aspect of knowledge valorisation. But working on the dividing line between the public and the private can raise ethical and evaluative dilemmas. TU Delft wants all its staff and students to be able to openly exchange their thoughts on such issues, with our Code of Ethics as their framework of reference.

Taking that code as our starting point, we organise internal debates for academic personnel, support staff and students at all levels on the normative aspects of professional conduct, in the context of both work and study. These reinforce the realisation that everybody at the university should act in accordance with the Code of Ethics.

Faculty of Architecture

BSc programmes
- Architecture

MSc programmes
- Architecture, Urbanism & Building Sciences
- Geomatics

Research profile
- Architecture
- Building technology
- Real Estate and housing
- Urbanism
- OTB Research Institute

Focus for 2012-2020

- In 2012-2013, within the context of the university's academic integrity policy, organise discussions on secondary employment and on what third-party research assignments TU Delft should and should not accept.
- In accordance with the Code of Ethics, implement a coherent ethics infrastructure complete with control mechanisms, supervision and reporting tools. For example, the appointment of a Conflict of Interest Committee and a confidential adviser on matters of academic integrity.

Science Port Holland - Technopolis

Technopolis

Science Port Holland – Technopolis is an advanced new science park adjacent to TU Delft. Over the next few years it will become home to scientific institutes, technology start-ups and international companies. The park-like campus is to be a meeting place for researchers and entrepreneurs, where they share their knowledge and work together on innovations in medical technology and industrial biotechnology.

www.scienceportholland.nl/technopolis

TU Delft and top sectors

Faculty / Topsector	Chemistry	Creative Industry	Energy	High Tech Systems & Materials	Life Science & Health	Logistics	Water
Architecture		●	●				
Civil Engineering & Geosciences			●	●		●	●
Electrical Engineering, Mathematics & Computer Science	●	●	●	●	●	●	●
Industrial Design Engineering		●	●		●	●	
Aerospace Engineering	●		●	●			
Technology, Policy & Management		●	●		●	●	●
Applied Sciences	●		●	●	●		●
Mechanical, Maritime & Materials Engineering	●		●	●	●	●	●

TU Delft is making a substantial contribution to seven of the nine economic 'top sectors' defined by the Dutch government: water, energy, high-tech systems and materials, life sciences, chemicals, the creative industry and logistics. The diagram above shows which of our faculties are involved with each.

www.top-sectoren.nl

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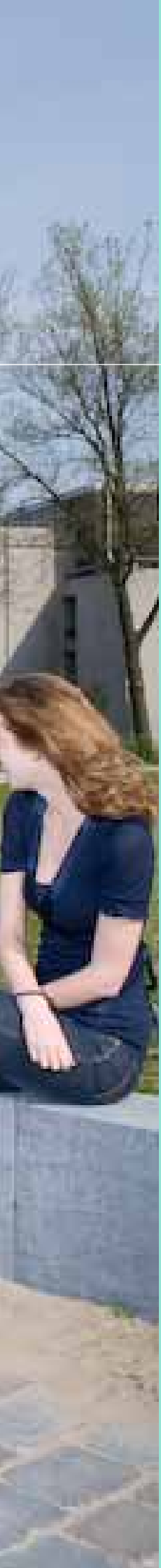


Campus & Facilities

TU Delft provides an inspiring campus with modern educational and student facilities that matches its profile. The university's built environment closely reflects the dynamism found in our teaching and research. Study, science and ancillary activities each require their own specific kind of working environment. New perspectives on the workplace allow less room for personal 'territory', making the demand for space at TU Delft less easy to predict. But the need for adequate accommodation on the part of students still remains as great as it ever was. Despite relatively limited means, therefore, we have deliberately chosen to keep on modernising our campus, our buildings and our facilities.[21]

Strategic priorities in campus and facilities at TU Delft for 2020

- Investment agenda: new buildings and essential maintenance.
- Expansion of student accommodation.
- More 'e-based' educational facilities.
- TU Library – open access and national role.

The TU Delft campus
From car park to public park

Friday 5 June 2009 saw the opening of Mekelpark, the new heart of the TU Delft campus. Its completion marked an important step in the creation of a campus appropriate to a leading international university. Until recently the so-called 'TU District' in Delft was divided in two by a major road and surrounded by car parks. In the new park, pedestrians and cyclists come first.

1. An inspiring campus

Our campus provides an attractive environment for everyone working, studying or staying at TU Delft. It is organised in a manner designed to appeal to the lifestyle of today's students and university staff, and flexible enough to accommodate education, research, new and established businesses, guest housing and sporting, cultural and other leisure activities. The planned Delft Technological Innovation Campus will be closely integrated with the university campus.

Investment agenda: new building and essential maintenance

Since many of our existing buildings are ageing and inefficient, they – and the teaching and research facilities they accommodate – are in urgent need of either thorough renovation or complete replacement. At the new premises, sustainability will be a priority. Our investment agenda incorporates a coherent and substantial programme to modernise or renew the entire educational and research infrastructure at TU Delft between 2012 and 2020.
As part of this vision, we have opted to provide students and staff with contemporary workplaces with an increased focus upon 'short-stay' facilities. We also need to enhance opportunities for economic activity within the university, which in turn will help to improve the quality of the campus experience. Where relevant and possible, and as part of a wider programme of social innovation, we wish to apply the concept of 'The New Way of Working' – a move which should not only reduce costs but also improve the quality of professional interaction. The development and possible introduction of new ways of working is the subject of ongoing debate and decision-making within the university.

Focus for 2012-2020

- Strategic planning to promote the multi-functional use of university land and buildings.
- Construction of new buildings in the TU-Zuid area of the campus, to house parts of the Faculty of Applied Sciences.
- Renovation of existing buildings as provided for in the university's Long-Term Real Estate Plan.
- Improve energy efficiency, encourage lower energy consumption and investigation opportunities for thermal storage, combined heat and power generation and geothermal heating.

2. Modern educational and student facilities

TU Delft wants its students, staff and guests to enjoy modern facilities. The increase in the number of students, PhD researchers and guest tutors from the Netherlands and abroad, together with the increasing sophistication of our research, make it essential that we maintain high standards of quality in the living, working and study accommodation we provide.

Expansion of student accommodation

TU Delft expects all its students and PhD researchers to have access to adequate and affordable housing. Overseas MSc students are guaranteed accommodation. With demand for student housing rising, pressure on this segment of the market is increasing in Delft. In response, we hope to work with the local authority and student housing provider DUWO to find permanent solutions to the problem.

Focus for 2012-2020

- Create new accommodation for 3600 students between 2012 and 2016.

Faculty of Aerospace Engineering

Educational profile

BSc programmes

- Aerorspace Engineering

MSc programmes

- Aerospace Engineering

Research profile

- Aerodynamics, Wind Energy & Flight
- Aerospace Structures & Design Methodologies
- Control & Operations
- Space Engineering

Modern educational facilities

TU Delft intentionally incorporates modern didactic concepts into its educational provision. Active forms of teaching in small groups are an important part of this. We assume that current and future generations of students are at home in an 'e-based' learning environment, but at the same time want to be associated with the university as a physical location. This trend is making knowledge transfer and independent study less and less time and place-dependent. In response, we need to be more flexible as regards the capacity and organisation of teaching space, study areas and ancillary facilities like catering.

Focus for 2012-2020

- Create a Learning Centre on the campus in 2015, if necessary by refitting existing buildings.
- Use teaching accommodation more effectively and innovatively by, for example, creating a university-wide rooms pool in 2014.

3. Innovative university library

TU Delft Library is the central hub of knowledge for the technical sciences in the Netherlands, and as such it has a defined national remit. Providing access to that knowledge in a wide variety of ways, its ambition is to be the country's most innovative university library.

TU Library – Open access and a national role

At TU Delft, allowing all users access to our scientific output is a core institutional principle – not least because it raises the visibility of our educational and research results. The composition of the TU Library collection will increasingly be determined by students and academics themselves. Whilst maintaining a physical collection will be always be an important responsibility of the library, facilitating electronic access to all relevant technological and scientific information has now become a central task. It is expected that practically all the material needed by users will have been digitised by 2020.
As one important part of its national remit in respect of technological and scientific collections, TU Delft Library is working with the National Library of the Netherlands to build the latter's 'e-repository'.

Through the Library Learning Centre, the university library is a place of social interaction as well as one of study. And hence a testing ground for initiatives in social innovation on our campus.
The library also plays a leading role in training students in information skills – from finding, using and correctly citing references to such topics as data management, copyright, intellectual property and publication. This makes it an intrinsic factor in the academic formation of the engineers of tomorrow.

Focus for 2012-2020

- Introduce innovative new services in the fields of personalisation, social media, the semantic web and linked data.

- Develop virtual research environments together with other universities.
- Develop integrated research-support services, from fundraising to publication.
- Supply all relevant research, educational and organisational information in digital form.
- Through such concepts as open access, improve the findability and availability of sources.
- Continue co-operating with the other 3TU libraries.
- Explore opportunities for collaboration with the libraries at Leiden University and Erasmus University Rotterdam.

TU Delft Library

3TU.Datacentrum possesses the knowledge, experience and tools needed to archive research data in a standardised, secure and well-documented manner. It provides the research community with:

- an enduring archive for the storage of scientific research data;
- permanent access to research data and tools for its reuse; and,
- advice and support on data management.

3TU.Datacentrum currently hosts about 5000 datasets.

Open access is based upon the principle that research results financed using public funds should be publicly available. TU Delft has been part of the international open access movement since 2004.

TU Delft Library is putting open access into practice by setting up repositories containing the university's output. As well as academic articles, this includes more and more background material, such as maps, visuals, videos – for example, the iTunes U web lectures released by the university since 2010 – and datasets. Our library has also helped organisations like Philips Research, UNESCO-IHE Institute for Water Education, national public works agency Rijkswaterstaat, the National Institute for Public Health and the Environment (RIVM), the Ministry of Justice and research institute Deltares to establish their own repositories. **www.library.tudelft.nl**

6

People (&) Work

The vulnerable and complex academic procedures at a modern university require smooth, transparent supporting processes. Only with solid foundations with regard to management control, human talent, IT infrastructure, information management and the organisation of ancillary services can an effective and innovative working environment be created. The worlds of work and study are changing constantly. Both are becoming less and less time and place-dependent. TU Delft is responding to the questions this raises, even though many of the answers are still unclear.

Strategic priorities in people and work at TU Delft for 2020

- From financial control to management control
- Excellent academic and support staff
- State-of-the-art ICT infrastructure – wireless campus
- Transparent information management and management information
- Corporate Office 2020 – quality services in one place
- Social innovation

TU Delft HR Strategy - Freedom to Excel

TU Delft intends to develop into a dynamic, flexible and resilient organisation which can count upon the commitment of its employees and is able to defend its leading position under all circumstances and in any situation. The human resources policy we have developed closely reflects this ambition, and guides our employment practices accordingly.

Our vision of HR embraces quality, autonomy and coaching leadership. Now more than ever, it is essential that employees who are facing changes actively participate in shaping their own futures, and that their managers openly provide them with the support and guidance they need in these changing times. This is the only way to ensure that everyone is employed in a position where they can achieve genuine personal and professional development whilst also making a real contribution to the organisational goals of the university.

To put the human resources policy into effect, activities are being undertaken throughout TU Delft at faculty and department level. They include the rollout of a coaching leadership programme, the introduction of a university-wide 'tenure track' scheme and the improved communication of career, training and personal development opportunities for both academic and support staff.

1. Management control

Universities are characterised by a huge number of very complex processes, both at the core of the organisation – in education and research – and in the ancillary services which support it. Here we are referring not just to the internal process management associated with financial matters, but also to such domains as planning and evaluation, human resources, IT, information management and accommodation. Organising the complex interactions between all these areas in combination with the core educational and research processes is something TU Delft wishes to approach holistically, using the all-embracing concept of 'management control' or 'internal process management'. In so doing, we are building upon the transparency derived from combining many of our support services under the auspices of a single University Corporate Office.

From financial control to management control

TU Delft is a publicly funded institution, and as such is required by law to be transparent and accountable. To achieve this, it is essential that the many internal processes which keep the university in operation be adequately controlled. But for such management control to be effective, it must also fit in with the character of the university. Internal process management is not an end in itself, but rather a means to support TU Delft in reaching its strategic objectives.

Focus for 2012-2020

- Fully integrate the 'four levers of control' model into the TU Delft planning and control cycle in 2012. This includes more systematic transfer of know-how by means of internal courses on the subjects of governance, decision-making and the rules concerning legal mandates.
- Rollout and improvement of the web portal on university rules, guidelines and procedures (working title: www.b3.tudelft.nl) in 2012.
- Regular update of university rules
- Implementation of a new system of internal budget allocation to faculties in 2013.
- Systematic strengthening of legal control with regard to real estate, in the light of proposed investments.
- Harmonisation of project administration for contract and indirect funding.
- Further professionalisation of the procurement function, including the establishment and correct application of university-wide rules for buyers.

2. Implementation HR strategy

To carry out its mission TU Delft needs professional and highly competent people, plus an organisational culture that gives both them the freedom to develop themselves and encourages them to take that responsibility. A culture in which people encourage one another, are open to change, continue to learn and work closely together. We offer our staff a climate in which they are free to flourish, and are given every opportunity to do so. But in return we expect them to meet the highest quality standards.

Excellent academic and support staff

TU Delft's academic standing demands scientists who excel in their field, who can collaborate across national and disciplinary borders and who are capable of undertaking fundamental research. People with didactic skills, intercultural competencies and talents in areas such as entrepreneurship, management, networking, co-operation and communication.
Equally, the university requires committed and competent ancillary staff to provide bespoke support services. Personnel who can empathise with the needs and motivations of both academics and the outside world, and tailor their work accordingly.
To attract and retain the best people, it is important that TU Delft foster its national and international reputation as an excellent employer. This calls for good career prospects and personal development opportunities, a flexible organisation, an eye for cultural differences and a coaching leadership style designed to allow as much scope as possible for individual responsibility.
We have had our own internal HRM training programme for more than 25 years now. Building upon the experience this has given us, we have implemented a variety of further initiatives in recent years. They include the PhD Start-up Programme, the Postdoc Career Development Initiative, the Delft Technology Fellowship and the training programmes University Management & Policy in Context and Coaching Leadership.
Ultimately, achieving abstract strategic objectives is the result of day-to-day efforts by real people.

To give them a collective sense of direction, it is essential that TU Delft's core values, its mission and – insofar as they are relevant to personal job performance – the strategic objectives themselves form an integral part of the staff Result and Development Cycle.

Focus for 2012-2020

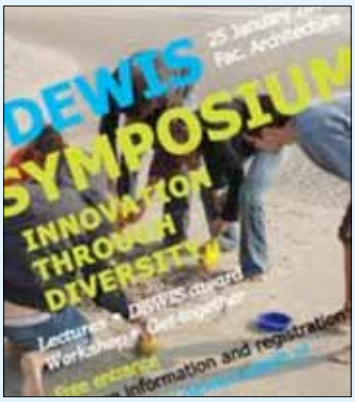
- Anchor TU Delft's core values and – insofar as they are relevant to the job in hand – strategic objectives in the Result and Development Cycle.
- Introduce the concept of flexible working, in a manner adapted specifically to each faculty or department.
- Extend the Tenure Track Scheme to cover all new academics appointed from outside the university, so that they join the Tenure Track Personal Development Programme.
- Increase the proportion of senior academic positions held by women to 20 per cent in 2020, and the proportion of senior support positions they hold to 40 per cent.
- Introduce concrete objectives and measures to improve diversity in terms of age, ethnicity and nationality.
- Encourage all staff in management positions or those with management potential, especially new employees, to join the Coaching Leadership training programme.
- Introduce 360° feedback into the Result and Development Cycle for all positions at Grade 10 and above.
- Regularly evaluate and update the integrity rules.

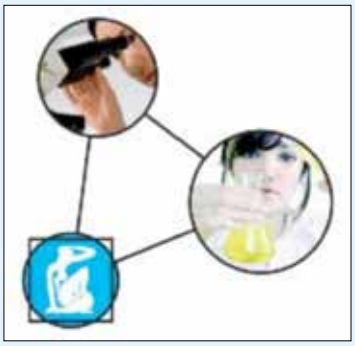
More outstanding female talent

TU wants to improve the gender balance of its academic workforce, which means recruiting more women. They are particularly underrepresented in senior positions. Attracting more outstanding female talent will help:

- to make the university a better reflection of society as a whole;
- to make better use of the full range of available scientific skills; and,
- to inspire the female students of today and tomorrow.

*DEWIS - **DE**lft **W**omen **I**n **S**cience*





DEWIS is the network for female scientists at TU Delft. Its primary goal is to encourage women here in pursuing their personal, professional and scientific ambitions.

- DEWIS has no formal membership structure. All women in scientific positions at TU Delft are members by default. At present, there are more than 650 of them.
- The network offers members the opportunity to get to know each other and to share their knowledge and experience. In particular, it encourages, motivates and supports young women building a career in science.
- DEWIS acts a sounding board for the Executive Board and can provide it with advice, either on its own initiative or by request.

DEWIS
DELFT WOMEN IN SCIENCE

dewis.tudelft.nl

3. The E-based-university and information management

The modern university is 'e-based'. At this 21st-century institution, the work processes are heavily dependent on up-to-date ICT. At the same time, work and study become less tied to time and place, and collaboration is increasingly supported through digital means. This makes new forms of research and knowledge transfer possible. ICT and the associated information systems are vital to internal management and transparent decision-making. The combination of ICT infrastructure, basic information systems and management information provision is 'mission critical', so TU Delft is doing all it can to intensify and modernise these components.

State-of-the-art IT-infrastructuur – wireless campus

TU Delft has opted for a flexible ICT infrastructure which offers constant high quality and is responsive to the latest developments. Achieving a 'wireless campus' is the central aim. The infrastructure reflects the notion that staff, students and guests prefer to use equipment of their own choosing (consumerisation). In configuring it, we have therefore applied two principles: 'bring your own device' and 'self-service'. This implies an environment that supports a wide range of computer equipment, whilst such an infrastructure also facilitates the introduction of new concepts like flexible working, digital collaboration and integration, both within the organisation and beyond it.

Focus for 2012-2020

- Create an ICT infrastructure which supports any device (plug and play), anywhere and at any time.
- Improve opportunities for digital collaboration.
- Create an ICT infrastructure which gives the user control over the products and services they use (self-service).

University Corporate Office

Operating domains

- Education & Student Affairs
- Information Technology
- Human Resources
- Finance
- Marketing & Communication
- TU Library
- Legal Services
- Strategic Development
- Real Estate & Facility Management
- Electronic & Mechanical Support

Transparent information management and management information

Transparent information management is essential at our university, both to support the primary processes and for internal management control. At TU Delft we use four basic systems, for administering personnel, financial, student and research information respectively. Each is at the top of its specific segment and is essential for the supply, in various forms, of accountability data to external stakeholders, administrative information for internal process management and domain-specific management information. Moreover, smart links between the four systems allow them to exchange data and so manage it more effectively (enterprise service bus). We are planning to replace or upgrade several of these basic systems, and also to modernise the range of tools available for generating management information. Another focus of this exercise will be the enhancement of self-service functionality.

Focus for 2012-2020

- Develop a 'data warehouse light' to enable consistent overall provision of management information.
- Introduce self-service functionality to keep information in the basic systems up to date.
- Modernise and upgrade the basic information systems, and implement smart links between them (enterprise service bus).

4. Good and innovative services

Motivated, customer-oriented and expert support staff are essential to TU Delft in achieving its ambitions in education, research and knowledge valorisation. In organisational terms, most of these staff members fall under the auspices of the University Corporate Office. Some, however, are employed within the faculties. One of TU Delft's main aims is to encourage social innovation.

Corporate Office 2020 – clustered quality services

The demand for services in support of education, research and knowledge valorisation is changing all the time, as are the environment and people at TU Delft. This requires adaptability on the part of Corporate Office personnel, as well as close contact with all their colleagues so that together they can achieve the university's strategic objectives.
Our support staff have to respond to developments throughout the university, ranging from the increasing internationalisation of the student population and academic personnel and growing competition in the market for talent to cuts in government funding, digitisation, the dominance of the 'Brussels agenda' and more intensive strategic co-operation. Using their know-how to anticipate developments and to respond rapidly to them is a key skill for this section of the workforce. Empathy when dealing with students, academics and colleagues should go without saying. And an affinity with our primary institutional processes is essential.

Focus for 2012-2020

- Increase cross-domain and cross-departmental working
- Improve the mobility of support staff
- Systematically improve the English-language skills of the entire support staff
- Further improve the completion time of services provided by the Shared Service Centres (SSCs)
- Achieve an average customer satisfaction rating of at least 7.5 out of 10
- Keep internal costs transparent and under control

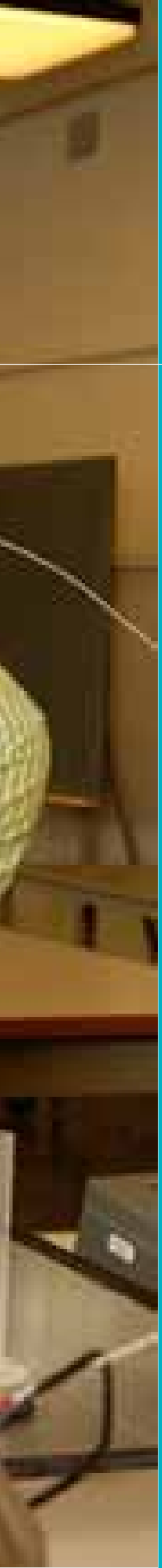
Social innovation

Various recent initiatives to change how people at TU Delft work and study, to make these activities more modern and more 'smartly' organised, are often grouped under the broad heading 'social innovation'. One definition of this term reads, 'Social innovation is a modernisation of the employing organisation and its working relationships that results in improved organisational performance and the development of talent.' That is a description which closely matches our HR strategy and echoes the title of this institutional plan, Freedom to Excel. There is still much we do not know about how the world of work and study will evolve over the next few years, or what that will mean for everyone at TU Delft. But initiatives to shape that future are appearing in a number of domains. 'The New Way of Working' is one example. As a modern technological university, we have chosen to monitor these developments closely, to combine emerging initiatives into a coherent programme of 'social innovation' and, where appropriate, to guide and encourage them.

Focus for 2012-2020

- Develop and implement a 'social innovation' programme by clustering existing activities and incorporating future initiatives

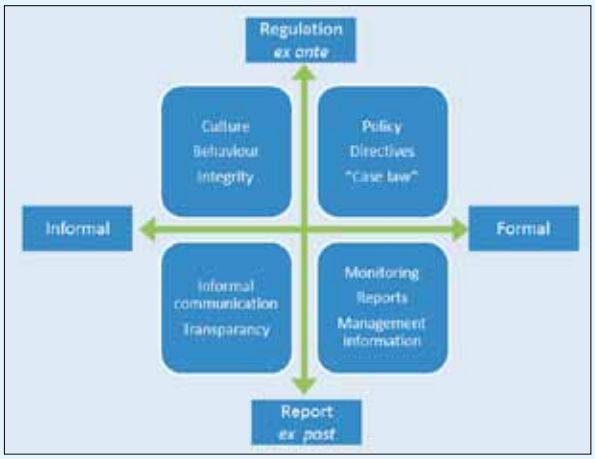
7



Implementation

Dutch universities are required by law to draw up an institutional plan at least once every six years, so that their medium-term strategy is clear. The prevailing plan is updated every three years, and the universities report annually on their strategic progress and current financial position. This annual report is externally audited and submitted to the Supervisory Board for approval, then presented to the Minister of Education, Culture and Science.

TU Delft as an organisation



The 'ownership' of TU Delft lies with us all. Every member of the university community has his or her own task and role, and the responsibility to help keep the organisation's self-corrective capability up to a high standard. This implies that all at TU Delft – staff and students – must share a common vision of the organisation. To create that single perspective, however, it is vital that we learn to speak each other's languages better.

We live in an age with a great craving to enshrine everything, including the work of a university, in rules and regulations. But we at TU Delft believe that to go too far down that road could be fatal. A university is an organisation harbouring a high percentage of independently-minded individuals who are perfectly capable of coming up with solutions of their own. For a university to flourish, trust in those people is essential. Nonetheless, a clear and generally accepted regulatory framework is also needed to define the 'playing field'. The diagram below shows a structure in which rules are needed, but not everything revolves around formal regulation. On the right-hand side we see that some things do not need to be regulated in advance; accountability after the fact is sufficient. And on the left we see that themes which are not easy to encapsulate in rules are also important to the proper functioning of an organisation. We are currently using the structure presented here to overhaul our regulatory framework.

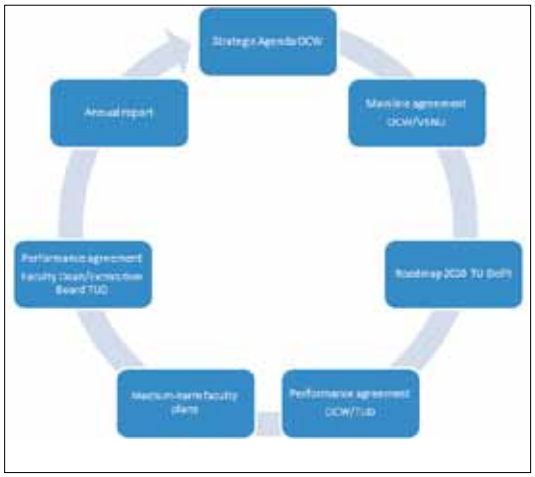
TU Delft is a learning organisation, at which everyone is expected to work together in a critical and solution-driven manner. Naturally, things do not run perfectly all the time – that is not the case anywhere. Universities are human communities, after all. However, learning from what went or was done wrong is a core value at TU Delft. It guides us in our intention to act with integrity. And it also drives us in our mission to achieve the highest possible standards of quality, in both our primary and ancillary processes.

TU Delft planning and evaluation cycle

TU Delft has operated a university-wide planning and evaluation cycle since 2005, linking strategic goals to resources. This is done for the following reasons.

- To reinforce the coherence of strategy and policy at the institutional, faculty, departmental and support levels.
- To encourage management dialogue, as well as co-ordination and interaction between the abovementioned levels.
- To monitor and evaluate the implementation of proposed actions.

Our adage here is: 'Do we, as TU Delft and our faculties, do the right things and do we execute them properly?' As well as internal objectives to be met, there are also long-term and perfor-



mance agreements with the Ministry of Education, Culture and Science to be fulfilled.

Medium-term faculty plans

Each faculty compiles its own medium-term plan. This sets out its strategy for the years ahead, within the parameters allowed by – and in the same format as – the institutional plan. Also like the institutional plan, the faculty plans cover a six-year period and are updated after three years.

Management consultations

Twice a year, in the spring and the autumn, there is a round of bilateral consultations between the Executive Board and the dean and management team of each faculty. Comparable meetings are also held with the director of the University Corporate Office and the heads of its service departments.

Critical dialogue

The compilation and implementation of the faculty and Corporate Office medium-term plans are the subject of a critical dialogue within the university. They are reviewed for their ambition and feasibility, their reflection of the institutional strategic objectives and their practicality. The dialogue is guided by four questions.

- How have the TU Delft core values been carried over into the faculty and Corporate Office plans?
- What strategic risks and uncertainties are discussed regularly in various forums, both formal and informal?
- What measures are in place – or should be – to assess activities and to avoid internal and external risks?
- What management information and systems – both quantitative and qualitative – are used to monitor implementation and to identify unusual situations so that, where necessary, these can be addressed at an early stage?

All of these items are the subject of specific agreements, which include concrete educational, research, knowledge valorisation and management targets. Obviously, such agreements must be realistic given the immediate and longer-term financial resources available to the faculty.

Quarterly financial reports

Once every three months, the member of the Executive Board with responsibility for management matters meets the dean of each faculty and representatives of its management team to discuss the monthly financial reports, the quality controller's report and progress towards the predefined targets.

Management Agenda and 'pyramid of objectives'

The Executive Board compiles an annual plan – the TU Delft Management Agenda – setting out the specific interim and final results being pursued by the institution for the year ahead. The framework of reference for this exercise is the institutional plan. The annual plan defines priorities, and also forms the basis for the development of a so-called 'pyramid of objectives'. This reveals how each management unit is expected to contribute towards achieving the mission and vision formulated for the university as a whole. Each faculty is also asked to draw up a comparable management agenda, presenting its priorities for the forthcoming year in the form of a 'pyramid of objectives'.

From pyramid to person

Abstract strategic objectives need to be translated into practical goals for each individual member of staff. What exactly these are naturally depends very much upon the nature of that person's function and their position in the organisation. Defining specific activities that make a tangible contribution towards achieving the overall mission and objectives of the university is a proactive process, in which each employee is expected both to assume responsibility and to accept accountability. For this reason, the Result and Development cycle is a key factor in converting the abstract 'what' into a concrete 'how'.

Staff representation

The legal rights of the staff representative body at TU Delft are enshrined in the Higher Education and Research Act (WHW, Article 9.30a, clause 2, subclause a). They include a right of approval in respect of the institutional plan. As part of the decision-making process, therefore, once the plan has been provisionally adopted by the Executive Board it is submitted to the General Assembly of Councils – that is, the Staff Council and the Student Council sitting in joint session. Naturally, any substantial later amendments likely to affect the course of the university are also referred to the General Assembly.

8

Key Figures & Targets 2010 - 2020

TU Delft has set itself a series of specific targets for 2015. These reflect the strategy and policy described in the previous chapter. Progress towards them is to be outlined in the university's annual reports. Due in part to the nature of the long-term and performance agreements reached with the Ministry of Education, Culture and Science (OCW), there are thus two sets of targets: those for the period 2010-2015 and those for 2020.

Targets agreed with the Ministry of OCW

The State Secretary of OCW has asked all the Dutch universities to provide objectives for 2015 with regard to seven indicators. These are formulated in terms of performance in 2010, as a benchmark year. Most of the indicators relate to the quality of education and student success rates. The table below compares the benchmark figures as of 31 December 2010 with the targets for 2015 and 2020.

	2010 (benchmark)	2015	2020
Excellence programme	2,2%	8%	10%
Withdrawal (drop-out rate)	19%	22%	19%
Course switches	8%	8%	6%
BSc completion rate	27%	55%	70%
Teaching quality (BKO-qualified)	7%	70%	75%
Educational intensity (contact hours)	25 hr/week	22 hr/week	20 hr/week
Indirect costs	19,3%	19,3%	19,3%

Excellence programme
This refers to the percentage of second-year undergraduates enrolled on the Sirius-endorsed programme Challent. Participation in this is by invitation, issued at the beginning of the student's second year. The benchmark date for the 2010 figure is 1 December 2010 and the cohort consists of students who first enrolled at the university in the 2009-2010 academic year. Similarly, the target for 2015 refers to those programme participants as of 1 December 2015 for whom the 2015-2016 academic year is their second at TU Delft.

The excellence programme provides outstanding students with an additional challenge within their core course. But there are also other alternatives, such as participation in special extracurricular projects or taking a second programme of study leading to a double degree. TU Delft wishes to see the proportion of these students joining an excellence programme increase substantially by 2015, compared with 2010.

Withdrawal
This refers to the proportion of undergraduates dropping out of the university during their first year of study. The cohort for the 2010 figure is initial enrolments at the beginning of the 2009-2010 academic year and that for the 2015 figure will be initial enrolments at the beginning of the 2014-2015 academic year.

The first year of undergraduate study at TU Delft has a selective as well as an explorative and referential function. The aim is to refer the right students to the right places in which to pursue their subsequent academic career. It is assumed that the first-year drop-out rate will remain more or less constant, compared with the 2010 figure. To ensure that it does not increase, a number of measures are being taken (see Chapter 2, 'Students and education').

Course switches
This refers to the proportion of undergraduates who enrol on a different course in their second year of study than they did in their first. The percentage is calculated based upon the total number of enrolments in the relevant first-year cohort, with that for the 2010 figure being undergraduate enrolments at the beginning of the 2009-2010 academic year and that for 2015 enrolments at the beginning of the 2014-2015 academic year.

TU Delft expects the number of students switching course at the end of their first year to remain more or less constant. This is because of the selective, explorative and referential nature of that year, and because we do want to refer the right students to the right places in which to pursue their subsequent academic career. In any case, within TU Delft students remain in the domain of engineering and technology.

BSc completion rate
This refers to the number of second-year undergraduate enrollees who have been awarded their Bachelor's degree after four years. The cohort for the 2010 figure is second-year enrolments at the beginning of the 2007-2008 academic year (initial enrolment in 2006-2007) and that for 2015 will be second-year enrolments at the beginning of the 2012-2013 academic year (initial enrolment in 2011-2012).

TU Delft draws a clear distinction between its BSc and MSc programmes. They are separate entities. The uniform admission requirement for the Master's phase is a successfully completed Bachelor's degree course. That throughput is a key driving force behind our efforts to double the BSc completion rate by 2015, compared with 2010.

Teaching quality
This refers to the proportion of paid academic staff with teaching duties who hold at least a basic higher education teaching certificate (BKO). Specifically, the cohort includes those with a permanent appointment on the reference date, or with one in prospect, and excludes academics with research duties only. The target for 2015 also includes members of this group with a qualification equivalent to the BKO or the advanced SKO certification. The reference date for both the 2010 benchmark and the 2015 target is 31 December of the year in question. TU Delft wishes to see a substantial increase in the number of new members of staff holding either a BKO or an SKO. This objective is being pursued within the 3TU framework. For current personnel without these qualifications, a didactic quality mechanism is being developed, which will be refined and implemented at the faculty level. This should result in a considerable rise in the percentage of (teaching) staff holding a BKO or SKO or having an equivalent qualification level in 2015 compared to 2010 (from 7 per cent in 2010 to 70 per cent in 2015), which will constitute a tenfold rise in the proportion of academic teaching staff holding a BKO, SKO or equivalent.

Educational intensity
This refers to the average number of timetabled contact hours (and other structured learning periods) in the first year of all undergraduate programmes. The 2010 benchmark figure is derived from these programmes' study guides for the 2010-2011 academic year, and the figure for 2015 will be determined using the guides for the 2015-2016 academic year.

TU Delft wishes to improve BSc completion rates by achieving a better equilibrium between contact hours and the time students need for private study and extracurricular activities. At present, the number of timetabled contact hours per week is relatively high due to the combination of classroom and practical sessions with lectures and seminars. Whilst retaining the differentiation characteristic of modern teaching methods, we wish to reduce the intensity of the educational experience where possible.

Indirect costs
TU Delft uses the methodology 'overhead formation as a share of the total formation' by Berenschot. The university aims to maintain the current ratio of indirect costs at a stable level.

Key internal figures and targets

As well as indicators agreed with the Ministry of OCW, TU Delft also uses key figures defined internally to monitor progress towards its strategic objectives. The table below shows our in-house targets for 2015 and 2020, which are based in part upon those set by individual faculties. They have been compiled taking into account the national legislative and financial situation as known in April 2012. Significant changes to that may result in revision of the targets.

Students and education: TU Delft targets for 2015 and 2020

	2010 (benchmark)	2015	2020
Total BSc/MSc student intake	3.580	3.600	3.700
BSc/MSc degrees awarded	3.261	3.300	3.500
Positive binding recommendations (permission to continue into the second BSc year)	67%	70%	73%
Average study credits (ECTS) obtained by student with PBR in first year of BSc	44,9	50	50
PhD completion rate	41%	45%	65%
PhDs awarded	333	380	450
P-in-1 (first-year diploma in one year)	17,6%	25%	40%
BSc/MSc student population	17.039	17.000	17.000
PhD student population	2.208	2.300	2.400
PDEngs awarded	17	25	40
Students per permanent academic staff member	20,9	20	20
Students per teaching staff member	16	17	18
Overseas BSc students	7,6%	10%	10%
Overseas MSc students	30,8%	35%	40%

Research and knowledge valorisation: TU Delft targets for 2015 and 2020

	2010 (benchmark)	2015	2020
Proportion of female academic staff	8,7%	15%	20%
ISI publications	2.125	2.250	2.500
Postdocs	-	100	200
Permanent academic staff	816,1	820	840
PhD students/ Permanent academic staff	1,34	2	3
PhD five-year completion rate	41%	45%	65%

Finance: TU Delft targets for 2015 and 2020

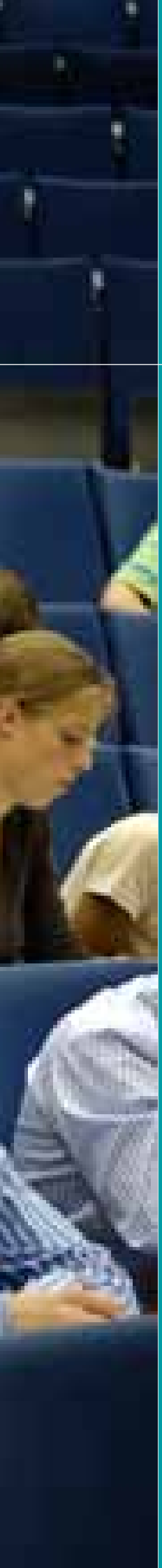
	2010 (benchmark)	2015	2020
Government funding	350,1	-	-
Indirect funding	30,1	-	-
Contract funding	117,1	-	-
Operating result	-15,0	-	-
Cashflow	+29,6	-	-
Net capital	267,5	-	-
Government funding / fixed costs	-	-	-
Indirect funding / government funding	7,16%	-	-
Contract funding / government funding	33,4%	-	-

Personnel: TU Delft targets for 2015 and 2020

	2010 (benchmark)	2015	2020
Permanent academic staff	816,1	820	840
Postdoctoral researchers	-	100	200
Other academic staff	693,2	550	450
Share of senior female academic staff	8,7%	15%	20%

		(REFERENCE DATE 31 DECEMBER 2010)
Excellence	%	Student participation in Honour's programmes, Dream Teams or another indicator in which student participation in excellence programmes is portrayed.
Withdrawal (drop-out rate)	%	The proportion of students of the total number of full-time Bachelor students (first-year Higher Education) that is no longer enrolled in the institute after one year of study. Optional: withdrawal from the programme in the second or third undergraduate year.
Switch	%	The proportion of students of the total number of full-time Bachelor students (first-year Higher Education) that enrols in a different programme at the same institution after one year of study.
BSc completion rate	%	The proportion of re-enrolment students of full-time Bachelor students (first-year Higher Education) that is awarded a degree at that institution after four years.
Teaching quality	%	The proportion of academic staff with a BKO qualification. This includes the whole of the academic teaching staff.
Educational intensity	hours / week	The number of scheduled contact hours (and other structured periods of learning) in the first undergraduate year as included in the study guide.
Indirect costs	%	According to the 'Berenschot' methodology: overhead formation as a share of the total formation.
Operating result	K€	Annual operating results based on the annual financial statements.
Cashflow	K€	Transactions of incoming and outgoing liquid assets at TU Delft between year start and year end (1-1-2010 / 31-12-2010).
Government funding	K€	Awarding of government funding based on internal distribution model (BTS budget allocation system). Allocation is in accordance with requirements, supplemented by declarable amounts for strategic projects.
Indirect funding	K€	Revenue from education and/or research contracts commissioned by the Netherlands Organisation for Scientific Research (NWO) and its foundations, such as FOM, STW SRON, SON.
Contract funding	K€	Revenue from education and/or research contracts not provided from government or indirect funding sources. This includes M2i funding.
BSc/MSc student population	Number	Students who followed a Bachelor or Master's main degree at TU Delft, paid tuition fees (by the reference date) and intend to complete their study with a degree.
BSc/MSc student intake	Number	Students who have enrolled in a Bachelor or Master's programme for the first time and have paid tuition fees with the aim of completing their study with a degree.
BSc/MSc degrees awarded	Number	Bachelor's and Master's degrees awarded by the Board of Examiners of the programmes and registered with the Central Student Administration.
Positive binding recommendations	%	A student must attain a minimum amount of study credits in the first year of study.
P-in-1 (first-year diploma in 1 year)	%	The proportion of students – of the total number of first-year programmes – that succeeds in gaining the first-year diploma in one year.

Average study credits (ECTS) per student per year	ECTS / student	Average amount of ECTS credits achieved in a Bachelor's programme by first-year students at TU Delft, enrolled as a student or external student with a VWO pre-university education (so-called joiners) diploma attained in the same calendar year.
PhD student population	Number	Number of PhDs and PDEngs as registered by P&O in Peoplesoft.
PhDs awarded	Number	Number of PhDs registered at the University Registrar's Office.
PDEngs awarded	Number	Number of design diplomas as registered by KIVI NIRIA.
PhD completion rate	%	Number of PhDs registered with the University Registrar's Office.
Postdocs	FTE	(conditional definition) Postdoc holds a PhD and has an appointment of a minimum of two years, aimed at preparing for an academic career.
Tenured academic staff (asst./assoc./full prof.)	FTE	Size of salaried, tenured academic staff (including Tenure Trackers)
Other academic staff (tenured and temporary)	FTE	Researchers and lecturers (excluding the category of other academic staff)
Share of females at the top	%	Academic staff: proportion of females employed at TU Delft in UFO scale 15 and above. Administrative and support staff: proportion of females employed at TU Delft in UFO scale 14 and above.
ISI publications (SBI new, definition determined)	Number	Number of publications in ISI journals.
Government funding / fixed costs	%	(conditional definition) Government funding costs and additional costs.
Students / Academic staff	Number / FTE	Student / staff ratio in accordance with the national definition of the Association of Universities in the Netherlands.



Educational portfolio TU Delft

TU Delft degree courses

BSc programmes
- Architecture
- Civil Engineering
- Electrical Engineering
- Industrial Design Engineering
- Life Science & Technology
- Aerospace Engineering
- Marine Technology
- Molecular Science & Technology (with two variants: Chemistry and Technology)
- Applied Earth Sciences
- Systems Engineering, Policy Analysis & Management
- Computer Science
- Applied Sciences
- Applied Mathematics
- Mechanical Engineering

Master programmes
- Aerospace Engineering
- Applied Earth Sciences
- Applied Mathematics
- Applied Physics
- Architecture, Urbanism and Building Sciences
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Computer Science
- Construction Management & Engineering
- Design for Interaction
- Electrical Engineering
- Embedded Systems
- Engineering & Policy Analysis
- Geomatics
- Industrial Ecology
- Integrated Product Design
- Life Science & Technology
- Management of Technology
- Marine Technology
- Materials Science & Engineering
- Mechanical Engineering
- Media & Knowledge Engineering
- Offshore Engineering & Dredging
- Science Education & Communication
- Strategic Product Design
- Sustainable Energy Technology
- Sustainable Process & Energy Technology
- Systems & Control
- Systems Engineering, Policy Analysis & Management
- Transport, Infrastructure & Logistics

Joint programmes

All or part of several BSc and MSc programmes at TU Delft are offered jointly with other renowned institutions. This collaboration is recorded on the TU Delft degree certificate.

Joint programmes with Leiden University
- BSc Molecular Science & Technology
- BSc Life Science & Technology
- BSc Applied Mathematics
- MSc Industrial Ecology

National 3TU programmes
- MSc Construction Management & Engineering
- MSc Embedded Systems
- MSc Science Education & Communication
- MSc Sustainable Energy Technology
- MSc Systems & Control

Erasmus Mundus programmes

TU Delft participates in the following Erasmus Mundus programmes.

- Economics and Management of Network Industries (EMIN) within MSc Engineering and Policy Analysis, in partnership with Universidad Pontificia Comillas (Madrid) and Université Paris-Sud 11.
- Coastal & Marine Engineering & Management (CoMEM) within MSc Civil Engineering, in partnership with NTNU Trondheim, UPC Barcelona, the University of Southampton and City University London.
- Erasmus Mundus Minerals and Environmental Programme (EMMEP) within MSc Applied Earth Sciences, in partnership with RTWH Aachen, the University of Exeter, Helsinki University of Technology, the University of Miskolc and Wroc□aw University of Technology.

- Optics in Science and Technology (OpSciTech) within MSc Applied Physics, in partnership with Imperial College London, Université Paris-Sud 11, HS Universität Jena and Warsaw University of Technology.
- Computer Simulation for Science & Engineering within MSc Applied Mathematics, in partnership with TU Berlin, KTH Sweden and FAU Erlangen-Nuremberg.
- Industrial Ecology within MSc Industrial Ecology, in partnership with the University of Graz, the Asian Institute of Technology (Bangkok), Chalmers University of Technology (Gothenburg), Rochester Institute of Technology, Leiden University and Waseda University.
- European Wind Energy Master (from September 2012) within MSc Aerospace Engineering, within the Technical University of Denmark, the Norwegian University of Science and Technology and Carl von Ossietzky Universität Oldenburg.

Double-degree programmes with external partners

- Applied Geophysics variant of MSc Applied Earth Sciences, in partnership with RWTH Aachen and ETH Zürich
- MSc Engineering & Policy Analysis, in partnership with Harbin Institute of Technology, China
- Flight Dynamics & Control and Avionics variant of MSc Aerospace Engineering, in partnership with the Instituto Superior Técnico (IST), Lisbon, Portugal
- Hydraulic Engineering & Water Resources Management specialisations within the Hydraulic Engineering and Water Management variants of MSc Civil Engineering, in partnership with NUS Singapore

International educational alliances

- Microelectronics variant of MSc Electrical Engineering, in partnership with Fudan University, Shanghai
- Microelectronics variant of MSc Electrical Engineering, in partnership with Tsinghua University, Beijing
- Computational Design & Fabrication Technologies variant of MSc Architecture, Urbanism and Building Sciences and Industrial Design/Design for Interaction variant of MSc Design for Interaction, in partnership with Middle East Technical University (METU), Ankara

Postgraduate degree programmes

The postgraduate degree programmes listed below are formally approved by the national Certification Committee for Technological Design Programmes (CCTO) or by TU Delft's internal Committee for Design and Professional Training

- PDEng in Process and Equipment Design
- PDEng Designer in Bioprocess Engineering
- PDEng in BioProduct Design
- PDEng in Civil Engineering & Geosciences
- Master of IT Management
- Master of Petroleum Business Engineering
- Master of Space Systems Engineering
- Master of Business in Energy Systems
- Master of Business in Rail Systems
- Master of Safety, Health & Environment
- Master of Public Safety
- Master of Security Science & Management
- Master of Public Management & Compliance
- European Master in Urbanism (NVAO-accredited, CROHO-registered)

Externally assessed research programmes

TU Delft complies with the national standard evaluation system for publicly-funded research, under which all such programmes are externally assessed once every six years. Every three years the research group produces a self-assessment to be used in preparing for both the external assessment and the internal midterm review.

Aerospace Engineering
(Source: Midterm Review Report, 2007-2010)
- Aerodynamics
- Wind energy
- Control and simulation
- Air transport and operations
- Aerospace structures and computational mechanics
- Structural integrity
- Composites
- Novel aerospace materials
- Astrodynamics & space missions
- Space systems engineering

Applied Mathematics
(Source: Research Assessment Report, 2003-2008)
- Analysis
- Computational Science and engineering
- Probability, risk and statistics

Applied Physics
(Source: Research Assessment Report, 2001-2009)
- Bionanoscience
- Imaging science & technology
- Multi-scale physics
- Quantum nanoscience
- Radiation physics for energy and health

Architecture and the Built Environment
(Source: Research Assessment Report, 2004-2010; Research Assessment Report, 2000-2006)
- Architecture
- Computation and Performance
- Design and History
- Green building innovation
- Housing quality
- Innovations in the management of the built environment
- Urbanism
- GIS technology
- Governance and geo-information and land development
- Housing systems
- Mobility studies
- Sustainable housing transformations
- Urban and regional development
- Urban renewal and housing

Chemical Engineering
(Source: Research Assessment Report, 2001-2007)
- Analytical biotechnology
- Biocatalysis and organic chemistry
- Bioprocess engineering
- Catalysis engineering
- Environmental biotechnology
- Enzymology
- Industrial microbiology
- Multi-scale physics
- Nano-organic chemistry
- Nano-structured materials
- Opto-electronic materials
- Products & process engineering
- Self-assembling systems

Civil Engineering
(Source: self-assessment for research assessment, 2005-2010)
- Structural mechanics
- Materials & environment
- Structural and building engineering – steel, wood & composite structures
- Structural and building engineering – concrete structures
- Road and railway engineering
- Transport & planning
- Hydraulic engineering
- Environmental fluid mechanics
- Water resources engineering
- Sanitary engineering

Computer science
(Source: Research Assessment Report, 2002-2008)
- Intelligent information-processing
- Man-machine interaction
- Modelling and visualization
- Parallel and distributed systems
- Software engineering

Electrical engineering
(Source: self-assessment for research

assessment, 2005-2010)
- Network architectures and services
- Radar and remote sensing
- Telecommunications
- Circuits and systems
- Computer engineering
- Electronic components, technology and materials
- Electronic instrumentation
- Electronics
- Energy conversion
- Power grids

Geotechnology
(Source: Research Assessment Report, 2002-2007)
- Applied geology
- Applied geophysics & petrophysics
- Geo-engineering
- Petroleum engineering

Industrial Design Engineering
(Source: Midterm Review Report, 2007-2009)
- Strategic design
- User experience
- Technology transformation
- Healthcare
- Personal mobility
- Sustainable living/working

Maritime and Transport Technology
(Source: self-assessment for midterm review, 2007-2009)
- Transport engineering and logistics
- Ship design, production & operations
- Ship hydromechanics and structures
- Offshore and dredging engineering

Materials Science and Engineering
(Source: self-assessment for midterm review, 2007-2009)
- Microstructural control in metals
- Metals production, refining and recycling
- Joining and mechanical behaviour
- Surfaces & interfaces
- Structure & change
- Materials in art and archaeology

Mechanical Engineering
(Source: self-assessment for midterm review, 2007-2009)
- Biomechatronics & biorobotics
- Medical instruments
- Vision based robotics
- Biomaterials technology
- Systems and control
- Fluid mechanics
- Energy technology
- Intensified reaction and separation systems
- Engineering thermodynamics
- Process equipment
- Applied mechanics
- Mechatronic system design
- Micro and nano engineering

Technology, Policy and Management
(Source: Research Assessment Report, 2003-2009)
- Innovation systems
- Multi-actor systems
- Next-generation infrastructures
- Philosophy of technology, design and values
- Risk & design

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[3] Cf. Duderstadt, J. J. (2008), Engineering for a Changing World: 'The skill set required for contemporary engineering practice is ch anging rapidly and will continue to do so even more in the years ahead. Beyond a strong foundation in fundamentals such as science, mathematics, and engineering sciences, engineers require broader skills such as those suggested by Bordogna (2003):

- Engineering science (analysis)
- Systems integration (synthesis)
- Problem formulation as well as problem solving
- Engineering design
- The ability to realize products
- Facility with intelligent technology to enhance creative opportunity
- Ability to manage complexity and uncertainty
- Teamwork (sensitivity in interpersonal relationships)
- Language and multicultural understanding
- Ability to advocate and influence
- Entrepreneurship and decision making
- Knowledge integration, education, and mentoring.'

[4] Cf. NAE (2008), Grand Challenges for Engineering; Duderstadt, J. J. (2008), Engineering for a Changing World.

[5] Cf. Duderstadt, J. J. (2008), Engineering for a Changing World; Duderstadt J. J. (2009), New University Paradigms for Technological Innovation; MIT (2011), The Third Revolution: The convergence of life sciences, physical sciences and engineering; European Science Foundation (2012), Responses to Environmental and Societal Challenges for our Unstable Earth.

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[8] Cf. European Commission (2010), Europe 2020 Flagship Initiative: Innovation Union; Ritzen, J. (2010), A Chance for European Universities.

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[11] Cf. DEMOS (2012), Future Universities: Towards a genuinely sustainable system.

[12] Cf. European Universities Assocation, www.eua.be; CESEAR Conference of European Schools for Advanced Engineering Education and Research, http://www.cesaer.org/en/home/.

[13] http://www.3tu.nl/.

[14] TU Delft (2010), Herijkingsagenda [Review agenda].

[15] http://tudelft.nl/onderzoek/kwaliteitszorg/.

[16] Cf. Ministerie van EL&I (2011), Naar de top: het bedrijvenbeleleid in actie(s) [To the top:

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