



**DELFT**  
**OUTLOOK**

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**TU**Delft



THEME

# Delft Global



## Cover:

In order to demonstrate TU Delft's internationalisation, we have chosen to create a series of portraits of international students studying at the university. Keeping the pose and the lighting the same in each photo emphasises the differences between the subjects.

Viewed together, the portraits present a good picture of the diversity of our students.

Photo: Sam Rentmeester

EDITORIAL  
*Frank Nuijens*

# Internationalisation

'Dutch universities need to offer appealing career paths and outstanding research facilities in order to attract and retain domestic and international talent', says the Association of Universities in the Netherlands (VSNU) in its 2000-2020 Trend Report. TU Delft is making leaps and bounds towards both attracting international talent to Delft and giving talent from our university the opportunity to shine abroad. That certainly hasn't done it any harm.

For example, TU Delft rose six places to claim the 65th position in this year's Times Higher Education World University Ranking, partly thanks to the university scoring higher for internationalisation. In this Delft Outlook, we introduce you to a selection of the wealth of examples of internationalisation at Delft.

TU Delft launched the Delft Global Initiative late in November,

entailing not development work, but development collaboration, where researchers, lecturers and students all actively contribute to formulating concrete solutions to global issues. Did you know that TU Delft also has an office in Campinas, Brazil? We joined professors Luuk van der Wielen and Patricia Osseweijer for a week on the job. The number of international Master's students at TU Delft continues to rise. According to Marietta Spiekerman, Senior Internationalisation Policy Officer: 'If you attract talented international students, you also attract talented international staff. And that has a positive effect on the standard of education at our university. I think that this has allowed TU Delft to make massive gains in terms of quality'.

*Frank Nuijens,  
Editor-in-Chief*



Page 07

Theme: Delft Global

FOTO: SAM RENTMEESTER



**DELFT IN BRIEF**  
04

**IN PERSON**  
25

**THE PATENT**  
Helicopter  
30

**COLUMN**  
Remco de Boer  
31

**HORA EST**  
32

**THE FIRM**  
Magnet.me  
35

**#LOOKLIKEANENGINEER**  
Sexism and science  
36

**ALUMNI WORLD**  
38

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20

## Interview Marietta Spiekerman

'If you can attract good international students,  
you'll attract good international staff too'

26

## The Pearl measurement instrument

New instrument unique for The Netherlands

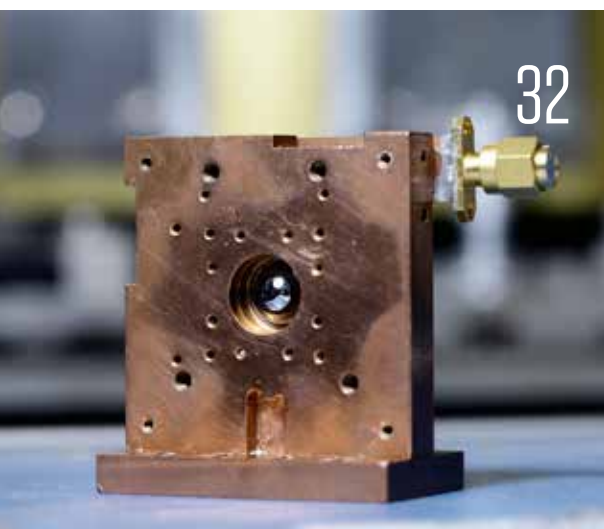
32

## Stardust

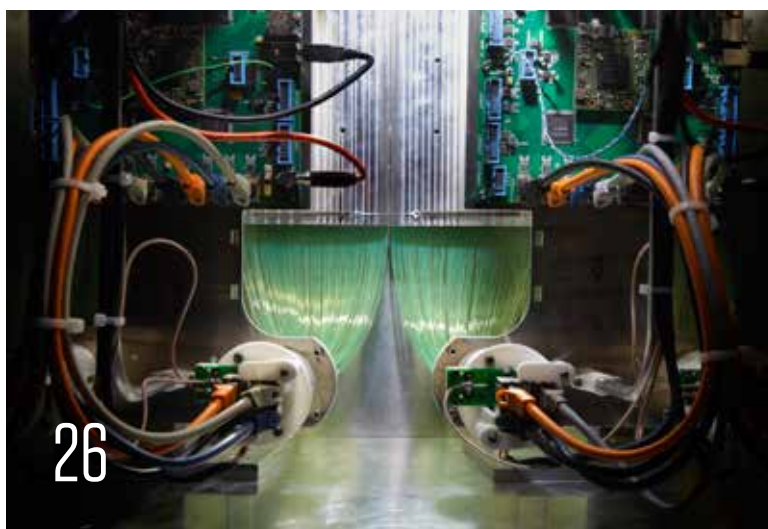
Balloons at the South Pole



20



32



26



# DELFT IN BRIEF



PHOTO: EDWARD-JANSSEN

## Altitude record

After a one-day delay spent waiting for the right wind direction, the Stratos II+ rocket finally lifted off from its launch site on the south coast of Spain on Friday 16 October and soared to an altitude of 21,457 metres. Although that was short of the hoped-for 50 kilometres, TU Delft's Dare team still smashed its own previous European and student record of 12,500 metres, setting a new European

altitude record for amateur rockets. The rocket had three experiments on board and was designed and built by the students themselves, including its important part: its hybrid motor, with a fuel core consisting of a mixture of aluminium powder, candle wax and sorbitol (artificial sweetener), through which laughing gas (nitrous oxide) is forced under high pressure.

[dare.tudelft.nl](http://dare.tudelft.nl)



PHOTO: SAM RENTMEESTER

Grasping and lifting a coffee cup without spilling a drop. That's no easy task for a machine, as first-year students of Mechanical Engineering discovered during their recent Click, Whack and Wallop final battle. Their challenge was to design and build a pneumatically-driven mechanical grabber, capable of holding a cup weighing up to 500 grams and lifting it 25 centimetres. The contents could be bronze, water or pasta, and it all had to stay in the cup. As well as a working prototype, each of the one hundred teams had to produce a website about its design.

[project.3me.tudelft.nl/2015](http://project.3me.tudelft.nl/2015)



# 57,000 hours

To the moon and back fifty times. 42 Million kilometres was the distance travelled during 57,000 hours of active service by the CF6-50 turbo-fan engine recently donated by KLM to the faculty of Aerospace Engineering (AE). The airline and the faculty hope that the 4,500-kilogram behemoth will now help bring theory to life for AE students.

[delta.tudelft.nl/30757](https://delta.tudelft.nl/30757)

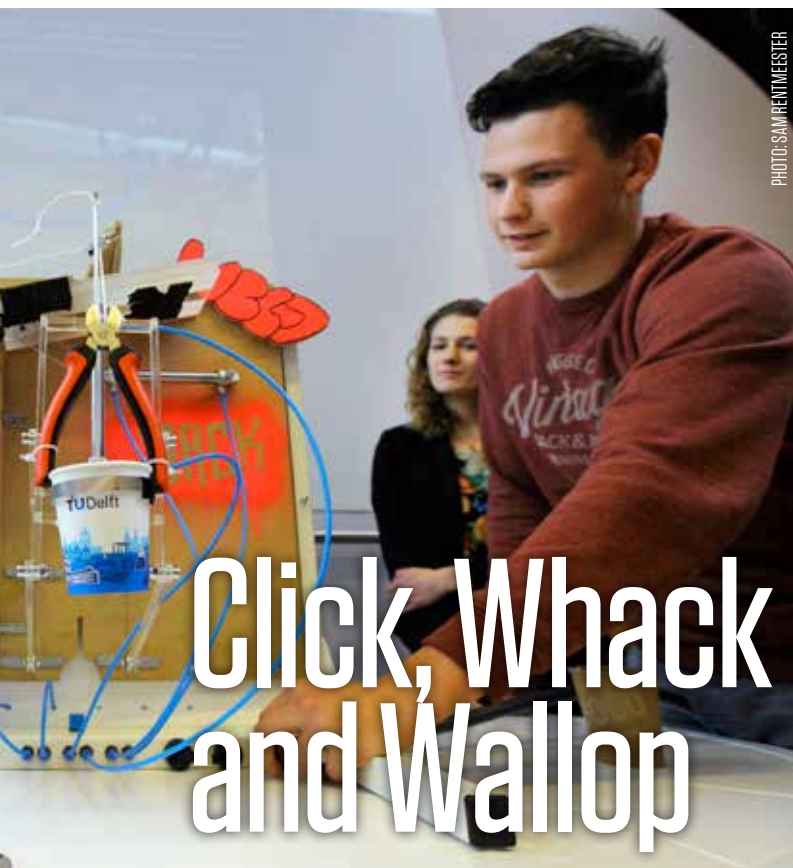


PHOTO: SAM RENTMEESTER

# Click, Whack and Wallop

## Weather stations in Africa

Good news for Nick van der Giessen, professor of Water Management in the faculty of Civil Engineering and Geosciences. The Tahmo project, which he codirects, has been awarded funding by the Global Resilience Partnership, a public-private initiative backed by various development co-operation organisations. Tahmo is one of just eight projects selected for financial support, out of 510 applications from all over the world. The project aims to set up 20,000 weather stations across Africa, creating a meteorological network capable of producing better forecasts. The stations are supplied all the energy they need by a tiny solar panel and submit comprehensive current data – rainfall, sunshine, temperature, air pressure, wind speed and direction, and much more – every five minutes over the standard mobile telephony network.

## Bachelor's Pledge

"I shall behave as expected of a good student." So begins the Bachelor's Pledge that second-year students of Mechanical Engineering, Marine Technology and Clinical Technology in the faculty of 3mE were provided by their director of studies for the first time this autumn. The ceremony has been devised to help students overcome the notorious "second-year dip". By no means confined to 3mE, this refers to a noticeable drop in academic performance in the first quarter of the second year.

## New building Pulse

A new teaching building, Pulse, is to be erected between the faculties of Industrial Design Engineering (IDE) and Mechanical, Maritime and Materials Engineering (3mE). With a total floor area of 4,500 square metres, it will connect the two existing buildings and include a new underground bicycle parking garage, a coffee bar and a "learning lab" for tutors as well as classrooms, student workstations, project rooms and an international café.



ARTIST'S IMPRESSION:  
ECTOR HOOGSTAD ARCHITECTEN



## Meat substitute

It looks just like steak, but in fact it is a totally vegetarian, soya-based dish. TU Delft researcher Georgios Krintiras is working on a machine that transforms soya proteins and gluten into a food that has the structure of meat. His method, Couette cell technology, has promise but is proving a challenge to upscale. Some €3 million is needed to build a bigger prototype. Investors have already shown an interest and Krintiras expects his 'steaks' to reach supermarket shelves within two to five years.

[delta.tudelft.nl/30812](http://delta.tudelft.nl/30812)

## Noise

Offshore wind farms should generate power in an environmentally friendly manner, but the noise produced under water during their construction poses a serious threat to marine life. To counter that, the installation of foundation piles is now subject to strict rules, which cause construction delays. Civil engineer Apostolos Tsouvalas has analysed the noise and developed a predictive computer model for the construction industry. Drawing on findings by marine biologists, he has also presented a proposal to create "curtains" of air around the piles to dampen the noise.

[delta.tudelft.nl/30799](http://delta.tudelft.nl/30799)



PHOTO: APOSTOLOS TSOUVALAS

## Renovations

Building maintenance at the faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) is now costing so much that a major renovation has become essential. Erected in 1968, the building has reached the end of its lifetime. The electrical systems, transformers and central heating are obsolete, the lifts keep breaking down and the façade is damp and leaky. Everything possible is now being done to keep the building useable for a couple more years, until we know exactly how EEMCS is to be housed in the future. The building of the faculty of Civil Engineering and Geosciences (CEG), built in 1975, is also due for an overhaul. It needs better insulation and a more open feel. Renovation plans have been in the pipeline for years, but the hope is that work on a large part of the building will begin in 2017.

[delta.tudelft.nl/30555](http://delta.tudelft.nl/30555) and [30392](http://delta.tudelft.nl/30392)



PHOTO: SAM REINTWESER

## Nuna 8 wins on last day

There was 'double Dutch' success down under in this year's World Solar Challenge. After crossing 3200 kilometres of the Australian outback, the solar vehicle built by TU Delft's Nuon Solar Team crossed the finishing line less than three minutes ahead of Solar Team Twente. Twente's red car led for much of the race, with Delft forced to wait until the final day before for an opportunity to pass it. In the remaining 180 kilometres, our team managed to extend its lead to 8'20". This is TU Delft's sixth win in the Solar Challenge, but never before have first and second places been so closely contested. Japan's Team Tokai finished third.



PHOTO: HANS-PETER VAN VEEHOVEN

# THEME

## *Delft Global*

Offices in Brazil, China and Vietnam; international co-operation between innumerable researchers and organizations throughout the world; more than 18,000 Delft alumni working abroad; over 600,000 people from all over the world registering for a Delft massive open online course (MOOC); and around 3,150 foreign students coming to Delft each year. TU Delft is truly international. Delft Global in a nutshell.

# TU Delft in Brazil

## ‘People want to see a professor’

For the past three years, TU Delft has had an office on the campus of Unicamp university in Brazil. But how do you organise joint teaching and research programmes 10,000 kilometres away?  
“That takes passion.”

**O**ne room in the white building housing the Institute for Energy Research: that is the full extent of TU Delft’s physical presence at Unicamp. The University of Campinas, to give it its full name, is situated on a former coffee and sugar plantation at an almost two-hour drive from São Paulo airport in Brazil. Anyone calling that office is re-directed to the administrative department on the ground floor, where either Fabiana Gama Viana or Lilian de Andrade Paulino picks up the phone. They are responsible for the day-to-day running of the outpost shared by TU Delft and BE-Basic. Unless someone from Delft happens to be in Campinas, all contact is by telephone or e-mail.

The office is empty much of the time, but it is not in fact the most important part of the Delft-Unicamp partnership. That centres on the shared interest that Brazil and the Netherlands have in

research and education pertaining to a sustainable biobased economy, as well as on tutors and students who complement and learn from one another. And above all, it centres on personal contacts that pave the way for new research relationships.

### Founders

The founders of the partnership, Delft professors Luuk van der Wielen and Patricia Osseweijer, personify those relationships. Osseweijer is a professor of Biotechnology and Society as well as Scientific Director of TU Delft Brazil. Van der Wielen is a professor of Bioprocess Engineering and chairs the board of BE-Basic. They liaise on new and ongoing research and educational initiatives with professors, industry and governments, in both the Netherlands and Brazil. They travel to Campinas about once a month to give lectures and to discuss the progress and registration of current and new dual-de-

gree PhD students – those enrolled at both Unicamp and Delft.

Osseweijer and Van der Wielen also meet research partners and financiers. In São Paulo on 23 November, for example, they signed agreements on behalf of BE-Basic to renew and extend Dutch-Brazilian co-operation in the field of sustainably produced biofuels for the aviation sector and the use of the manufacturing residues as chemical building blocks for new products.

Hosted by the Brazilian research and innovation organisation Fapesp, the signing ceremony was also attended by representatives from the Dutch Ministry of Education, Culture and Science (OCW) and from the local consulate, as well as commercial partners DSM, Corbion, Boeing and Embraer, Brazilian biotechnology laboratory CTBE, Unicamp, the University of São Paulo and the Dutch research institute KNAW-NIOO. Those present greeted each other like





In the last fifteen months Ramses Molijn mapped agricultural fields throughout Brazil. Read about his research on [delta.tudelft.nl/blog 94](http://delta.tudelft.nl/blog/94) (in Dutch).

old friends. After the meeting Hans Schutte, Director-General at OCW, said that he was very pleased with this ‘biggest scientific partnership between the Netherlands and Brazil’: “This is a fantastic project, an example to others. Brazil is one of OCW’s priority countries. BE-Basic delivers scientific results and human capital. What’s so impressive is that this partnership unites so many parties. That takes passion. TU Delft has two people with that kind of inspiration [Osseweijer and Van der Wielen – ed.]. What’s more, they’re capable of forging links with businesses, so that they benefit as well.”

### Eucalyptus

Like all other forms of contact – with professors, students and governments – interaction with the business community requires a considerable investment of time. Links between universities and private companies are few and far between in Brazil. So Delft’s experience in this area adds value, Unicamp

researchers say. BE-Basic has good relationships with big firms like Akzo-Nobel, KLM, Embreair and BP. One prominent topic in the contacts is bioethanol, a major industry in Brazil. It is usually derived from sugar cane, but – as he explains a

**‘What’s so impressive is that this partnership unites so many parties’**

couple of days after the São Paulo ceremony – Van der Wielen is keen to use other crops as well. So he has an appointment at the paper and pulp mill Suzano, just outside the town of Americana, half an hour from Unicamp. The plant runs huge eucalyptus plantations and is looking for ways to make new products out of cellulose and lignin, both of which are derived from the wood.

The two Dutch academics drive over to the mill in their rented car. Because, Van der Wielen says, “In >>

### Education

TU Delft, BE-Basic and Unicamp have delivered six joint Master-level courses in recent years, some in collaboration with companies like DSM, and several more are in the pipeline. The most recent of these was entitled “Business Development: Beyond Bioethanol”. The Brazilian students were challenged to compile a business plan for a profitable company producing sustainable biokerosene for aircraft. Aviation fuels are a new and important area of research for BE-Basic. As well as these conventional courses, the partners also run a joint MOOC (massive open online course) on Industrial Biotechnology.

## Research

The joint TU Delft Brazil/BE-Basic Brazil office at Unicamp officially opened on 21 November 2012. The initiative originally came from TU Delft. In the past five years the TU Delft Executive Board has invested almost €1.5 million in the project, and the faculty of Applied Sciences close to €800,000. With further contributions from BE-Basic projects and from the research and innovation organisation of the state of São Paulo, FAPESP, as its principal financiers, the total five-year investment amounts to some €13 million. Most of that money has gone into joint research projects on the biobased economy.

Six Delft PhD students and ten PDEngs (on shorter professional doctorate programmes) have already conducted research in Brazil. Five Brazilian PhD students have come to the Netherlands, and another twenty are ready to follow them. The funding for these exchanges is now available, as earlier this year the Dutch Minister of Education, Jet Bussemaker, reached an agreement with BE-Basic to facilitate a hundred dual-degree students between now and 2025.

Brazil you can't just rely on what people tell you, or on nice pictures. You have to take a look for yourself. People want to see a professor. Only then do doors open."

After some small talk – another essential in Brazil, according to Osseweijer: "The Dutch get to the point too quickly" – the conversation turns technical. During their guided tour of the plant, the professors examine three experimental setups. The first extracts oil from wood chippings. The second has a soggy white mass floating in it.

"That's cellulose", Osseweijer explains. "It's used to stiffen paper or to strengthen cosmetic products." The third experiment entails reducing the size of lignin particles. But they are still too big for use as, say, a substitute for rubber in car tyres. "They're micro, but they need to be nano", is how Osseweijer sums up the problem. Standing next to the throbbing machinery, Van der Wielen suggests having a student make a model of the production process. The first hook for a concrete line of research has been cast. <<



Patricia Osseweijer and Luuk van der Wielen visit a paper and pulp mill near Campinas.



During a meeting in Sao Paulo the Dutch professors signed agreements to renew and extend Dutch-Brazilian co-operation with research partners and commercial partners.

# Delft & DOI's

The TU Delft Library is co-founder of DataCite, the global organisation that registers research data. The organisation is now ascribing a unique number to all data sets from Dutch academic institutions.

“If a researcher publishes an article in Nature, the journal ensures that the article is given a Digital Object Identifier (DOI). This is a unique number that enables everyone, wherever they are in the world, to search for the article, locate it and quote it”, explains

Madeleine de Smaele from the Delft Research Data Services team. “But if the same researcher also wants to make their data available via the 3TU.Datacentrum, we also give them a DOI.”

In 2010, the library decided to collaborate with four other international organisations to found DataCite. The initiative was closely linked with the foundation of the research data repository 3TU.Datacentrum. “Through DataCite, we play an important role in registering DOIs for research data. Before DataCite, that wasn’t even possible in the Netherlands”, De Smaele adds. So how does the registration work? A DOI is a series of numbers, the numbers before the slash being the

prefix, while the numbers after are the suffix. “Via our DOI registration service – DataCite Netherlands – we distribute prefixes to all Dutch institutions. They add the suffixes themselves.” With 25 members, all continents are now represented in DataCite. “We’re in regular contact with each other”, says De Smaele. “In the future, we hope that each DOI of a journal article will refer to the DOI of a data set, and vice versa. That would certainly improve transparency in the academic world, alongside data usage.” 

DOI:10.1000/182

[datacite.tudelft.nl](http://datacite.tudelft.nl)

## In the picture in Brussels

Technical universities should become more visible in Europe, according to the Idea League, the alliance of TU Delft and three international partners.

The Idea League is keen to place increased emphasis on the fact that technical universities have a specific influence on society. First and foremost, technical universities educate: engineers that often go on to hold key positions. Technical universities also play a pivotal role in solving social issues. And finally, they significantly influence the economy and innovation. In light of their collaboration with industry and entrepreneurs, technical universities are different from standard universities, explains Willemijn Dicke, Secretary General of the Idea League – an organisation borne from the same body of thought. With the

introduction of the Bachelor-Master system in 1999, Imperial College, TU Delft, ETH Zurich and RWTH Aachen University (IDEA) were concerned about their five-year curriculum being shortened. They compared their curricula and examination processes, and exchanged best practices in order to improve quality. Such an exchange will now also take place at the policy level.

Over the years, Imperial College departed and since 2012, Chalmers University of Technology (Gothenburg) has been part of the Idea League. Collaboration between the universities can be seen in various initiatives, such as a joint Geophysics Master’s degree programme. Ten years ago, the universities teamed up to design a two-year programme offering students the chance to study for six months at each of the universities before choosing where they would like to graduate. ‘Since then, the programme has produced roughly 350 graduates’, Dicke adds.


The Idea League also offers research grants to students looking to conduct research at one of the partner universities. Dicke notes that the summer schools for doctoral candidates and Master’s students planning on beginning doctoral research are ‘always full’. More extended are the so-called doctoral schools, programmes that bring doctoral candidates from each of the institutions together for tuition from the leading professor in a certain field, before collaborating on a particular problem. This allows doctoral candidates to form a network, while giving professors the opportunity to discover fresh talent. Recently, ‘the challenge’ was launched, a programme inviting honours students to spend a weekend in each of the four cities focusing on policy and leadership and working on an actual project. The weekend in Delft was held at Tennet in November (see photo). 



PHOTO: SAM PENTMEESTER



## Hong Kong's saline flush

**R**esidents of Hong Kong flush their toilets using seawater. In the mid-twentieth century, the city state installed saltwater mains in order to help save the drinking water that was in short supply. The seawater was originally intended to be used to clean the streets, but the application in the city's lavatories followed soon after.

Mark van Loosdrecht, professor of Environmental Biotechnology (faculty of Applied Sciences) argues that flushing with seawater offers specific advantages with regard to water purification. He collaborated with fellow professor Guang-Hao Chen of the Hong Kong University of Science and Technology (HKUST) on a research programme exploring the benefits of utilising seawater in waste water purification.

Van Loosdrecht met Chen as a result of a response he wrote to one of Chen's articles. When Chen was appointed professor at HKUST, he asked for Van Loosdrecht's advice with regard to setting up a new research programme. Instead of elaborating on research underway at TU Delft, the Delft Environmental Biotechnologist advised Chen to conduct research into the specific situation in Hong Kong, namely sewage purification using seawater. The pair have now shown that seawater does indeed offer numerous benefits. Van Loosdrecht reels them off the top of his head: sulphates

in seawater leads to less silt production (a waste product), sulphides (created from sulphate oxidation) kill pathogenic bacteria, the chemical bond with sulphides simplifies the recovery of metals, and phosphate from sewage water is easier to recover using magnesium from seawater.


Another associated benefit is the use of seawater for cooling, which is not permitted using drinking water because of potential bacteria growth. All in all, there is sufficient cause to further highlight saltwater sewage treatment under the name SANI. Van Loosdrecht hopes to achieve his objective through a collaboration with UNESCO-IHE, the Institute for Water Education in Delft. Their first project will be at a resort in Cuba, where half of all water used is used for flushing. 



PHOTO: HONGKONG-PASU AU YEUNG

## Old meets new in Hanoi

One of the primary concerns for Vietnamese house builders is keeping heat out. This objective was traditionally aimed at using cleverly overlapping eaves, mass to retain coolness or, alternatively, light buildings that allow cool air to circulate. The blessings of the industrial revolution meant that the traditional solutions made way for high-rise concrete buildings, with an air conditioning unit adorning every façade. That same unit is used in winter for supplementary electric heating, resulting in sky-high electricity usage to ensure that buildings remain habitable.

Andy van den Dobbelsteen, professor of Climate Design & Sustainability (faculty of A+BE), collaborates with Hanoi Architectural University (HAU)

and the National University of Civil Engineering (NUCE) in the field of 'green' building, i.e. sustainability in the built environment. He points out that it's the younger generation that is most interested. Students, younger members of staff and young architects all try to combine traditional climate control solutions with new techniques in order to design buildings that not only require less energy, but also offer a healthier internal climate.

The professor will soon travel to Hanoi to present the Vietnamese translation of Integrated Sustainable Design, a book that he co-authored with architect Jón Kristinnsson. The exchange of two Master's students and one doctoral candidate from his group is also gaining traction.

The long-term collaboration plan also outlines plans for the production of a new book on smart and bioclimatic

design in tropical climates, the commencement of several joint research projects and the continuation of lectures and training sessions for the staff of both universities.

### It's the younger generation that is the most interested in 'green' building


Van den Dobbelsteen is also collaborating with the university of Quito (Ecuador) to research the influence of green developments on the internal climate of buildings in the city. And in ChongQing (China) he is involved with energy neutral design and urban energy planning: charting energy supply and demand, and outlining opportunities for sustainable energy generation with the aim of reducing fossil energy usage. 



PHOTO: TAHMO

# Development collaboration 2.0

The aim of the Delft Global Initiative is to unite researchers, lecturers and students in order to actively contribute to solving global social issues. This is not development work, but 'development collaboration 2.0'. The initiative was launched in late November.

"The objective of the Delft Global Initiative is to not only tackle global social issues, but to offer concrete solutions", explains Dr Jennifer Kockx, Programme Manager and one of the initiators of the platform. "We'll achieve this by combining expertise in the field of high-tech science within TU Delft, through intensive collaboration with local entrepreneurs and non-governmental organisations and by linking student projects to comprehensive research." Most importantly, it's not about one-sided development aid, Kockx emphasises: "We want to realise dramatic innovations together with talent from new and developing countries. To enter into partnerships that will also allow us to learn." Obligatory monthly working lunches also allow TU Delft researchers to stay up to date on each other's work, as well as learn from each other's experiences. Kockx: "A TU Delft civil engineer was working on a project in Mozambique, completely unaware that an urban planner – also from TU Delft – was working a couple of miles away. Even though their work overlaps!"

TU Delft is the first Dutch university to offer such an initiative, after Kockx and her colleagues

drew inspiration from the Aalto Global Impact project in Helsinki. The Delft Global Initiative is a ten-year programme and, for the time being, the first five years are being financed by the Executive Board. In three years' time, the network should be able to fully support itself.

The platform has already allocated seven doctoral tracks, the so-called Delft Global Fellowships. These include a project headed by Dr Jelena

## TU Delft is the first Dutch university to offer such a ten-year programme

Popovic (Electrical Sustainable Energy) that uses new technology to offer affordable solar energy to low-income families in South Africa. "You need to completely adjust your way of thinking in order to develop technology for a developing country", Popovic explains. "Now cost is all of a sudden my main priority." Together with Dr Amir Zadpoor, Gerwin Smit and Dr Dick Plettenburg (Biomechanical Engineering), professor Paul Breedveld – co-founder of the Delft Global Initiative – wants to use a smartphone app to automate the design process of prostheses, while molecular biophysicist professor Cees Dekker is using his expertise to develop a DIY test for people who suspect that they are suffering from a tropical disease.

"We have a total of 20 Fellowships to award", Kockx explains. Everyone is welcome to apply. "So long as the research tackles global challenges facing people, and has local impact. We can really make a difference." **JB**

# Design to make a difference

There are many ways that well-intentioned designs can go wrong, according to PhD candidate Annemarie Mink (Industrial Design Engineering). She is looking for ways to help designers better understand their target user when designing socially sustainable products in a context foreign to them, such as developing areas.

Mink has found that designs aiming to improve the quality of life in developing areas can be problematic. She refers to her own undergraduate design project, a silk reeling machine for women in eastern rural India. On paper it was a great success. However, later she realised that she had been so preoccupied with the technical aspects, that she had not fully taken into account the user's everyday life.

The old reeling machines were housed in a centre, with around 30 women working together, but the new portable reeling machine meant that work could be done from home, which took away one of the few opportunities for these women to socialise. The smaller and easier to use design also removed some of the prestige that is associated with working with one of the larger, complex silk reeling machines. The machines could now also be used by children; a dangerous

prospect in areas already dealing with child labour. "All these kind of aspects are


things I should have investigated more from the start." This is why as part of her PhD she has developed the Opportunity Detection Kit (ODK), which is an interview process allowing designers to learn about the daily lives of their target users in a more comprehensive way.

Mink's PhD and the ODK are based on the Capability Approach, a model that encompasses broader indicators of well-being, beyond goods or finance. It includes aspects that are important in human life such as mobility, health, family and dreams.

## 'We need to know not only what they need, but also what they want'

Perhaps when designing a cool new gadget the focus does not need to be so heavily on the user. However if designing for a context that is culturally, politically, religiously and economically different from your own, without a more comprehensive focus on all aspects of the user's lives, most of the design will be based only on secondary sources, poorly founded cultural assumptions, and the designers own experience.

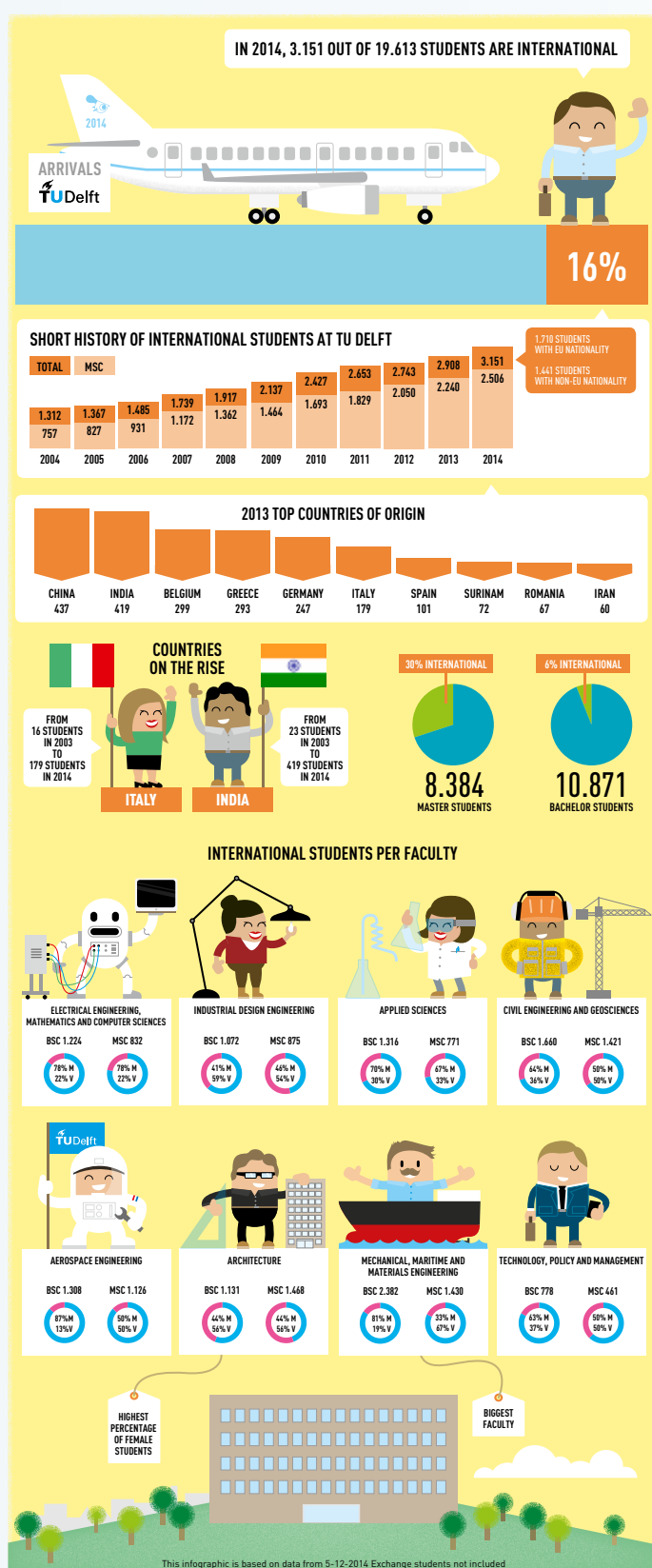
With the ODK, Mink hopes to place the emphasis on fully getting to know the user, what they need and also what they want. "From a capability approach perspective," she said, "participatory design with the involvement of potential users is very important, it is not that we know what's best for people in developing regions."

The ODK is also intended to be adaptable for different countries and contexts. Its loose format, which is primarily visual, means that sensitive topics or taboo topics can be approached in different ways, that nuance that may not be conveyed by an interpreter is still understood. When Mink completes her PhD she intends to continue her work with the ODK, further adapting it, and turning it into a web tool so it will be available for designers around the world. 





## POPULATION OF INTERNATIONAL STUDENTS AT TU DELFT IN 2014



# Students recruit students

TU Delft believes that student ambassadors and regional groups are the ideal means for attracting the most promising international students to Delft. Personal contact is of primary importance.

TU Delft has student ambassadors from countries including Taiwan, Brazil, the United States and Poland. These are Master's students at TU Delft who, via their own university profile page or Facebook, are available to answer questions from prospective students from their own countries, or from people thinking of embarking on the same degree programme. They fulfil a crucial position, as a range of research has taught the university that personal stories from other students play a major role in what future students choose to study. The university started out with five ambassadors two years ago, and now there are forty. Ina Dijstelbloem is responsible for the recruitment of international Master's students at TU Delft. Latin American and East Asian regional groups were set up first, recently followed by groups for the UK, Europe, China and India. The Middle East/Africa group is set to launch soon. The regional groups research from which universities TU Delft students originate and from which universities the university would like to attract new students. The second concern is dependent on matters such as quality, the substance of the degree programmes and whether a local study grant programme is in place. A student ambassador or a regional group can subsequently organise a meeting at their university of choice to allow students to talk one-on-one. Dijstelbloem expects that this will enable TU Delft to attract the best students, while facilitating increased diversity at the same time. In excess of 80 nationalities currently study at TU Delft, but Chinese, Indian and Greek students dominate.

For that matter, international Master's student numbers at TU Delft are increasingly rapidly. At the start of this academic year, there were 1,446 – a 40% rise compared to the previous year. Dijstelbloem “There's no need for major recruitment campaigns”, she concludes.

THE JOINT RESEARCH CENTRE IN BEIJING HAS A FOCUS ON LED'S.



# Close links with China

TU Delft has been collaborating with China for decades, but the relationship only really intensified three years ago. What's the added value of a Joint Research Centre?

“**W**e’ve been working together with Wuhan University since the year 2000 and regularly welcome visitors from China to Delft”, says professor Peter van Oosterom of the faculty of Architecture and the Built Environment (A+BE). When the Joint Research Centre (JRC) opened in Wuhan in November 2012, he gained the title of academic director. “So, to a certain extent, collaboration isn’t anything new. But the JRC has made it more obvious, structural and sustainable. We now do less on an ad hoc basis and reach better agreements regarding the exchange of students and researchers, PhDs and Master’s degree programmes. Add to this that you stand stronger when you’re united – if you prepare a research proposal, you’ve got more chance of success as

one of two high-quality partners than when you are working on your own. This brings an increasing degree of balance to the partnership.” TU Delft now has six of these strategic research centres throughout the world. The Beijing Research Centre opened in May 2011, followed by three other JRCs in November 2012, in Nanjing, Guangzhou and Wuhan respectively. That same month, collaboration with South America was intensified with the opening of an office in Campinas, Brazil. And in December 2013, the centre in Hanoi, Vietnam completed the current line-up. Every collaboration sounds both logical and recognisable, because the focus is always on one specific theme. For example, work in Beijing is primarily concerned with LEDs, in Nanjing it’s water, in Guangzhou the focus is on

urban development and Wuhan is where you find the geo-data specialists.

Vincent Nadin, professor of Spatial Planning and Strategy at the faculty of A+BE and academic director of the JRC in Guangzhou also advocates this formalised form of collaboration. “This is a much better way of establishing international relations. What we want as a university is an intensified relationship, so that we can really research things together.” As a prime example, he refers to the research being carried out by professor Jan Rots (faculty of Civil Engineering and Geosciences) into the earthquakes in Groningen. “Guangzhou is home to a special laboratory for research into earthquakes, with facilities including a floor that shakes. I think that’s a fantastic example of how our interests perfectly match.”

### Two-way traffic

There’s also absolutely no doubt that the collaboration should involve two-way traffic. “China is home to high-quality facilities with respectable satellite programmes, which makes becoming involved an extremely interesting prospect for us. Chinese talent also helps us to conduct research, and we then publish our joint findings. Things over there have developed rapidly in the past decade. It’s arrogant to assume that they are lagging behind us. Actually, the roles have even been reversed in some areas”, says Van Oosterom.

Therefore, the universities not only have access to each other’s state-of-the-art laboratories, they also secure equal amounts of funding from their respective national financing schemes. “We organise a joint annual congress and have already established a few joint research projects”, Nadin says. “As such, TU Delft has been awarded €280,000 by the Netherlands Organisation for Scientific Research (NWO), while Guangzhou has received 1,000,000 Chinese renminbi (nearly €150,000) from the National Natural Science Foundation of China (NNSFC) for Guang Ye’s project within the faculty of Civil Engineering and Geosciences (CEG). In this project, we’re collaborating to research sustainable concrete. Without the JRC, this wouldn’t have been possible.” Differences can be observed between the JRCs with regard to student and researcher numbers, which are generally much higher in China. For example, Wuhan’s Geo degree pro-

gramme produces 500 PhDs, 1,500 Master’s students and 3,000 Bachelor’s students every year, while at Delft those numbers are respectively 10, 50 and zero (for A+BE and CEG combined). There are also twice as many staff involved in the JRC in Wuhan: 40 compared to 20 in Delft. For that matter, about 40 Delft staff members work at the JRC in Guangzhou, which specialises in urbanisation. These staff members are spread over the faculties of CEG, Technology, Policy and Management (TPM) and A+BE.

### Dating service

After three years, the collaboration with the partners in Asia has thus intensified dramatically, but the alliance will need to become even closer in the years ahead. “Our platform is a bit like a dating service that matches people up”, explains Nadin. “In the past three years, we’ve matched a large number of researchers, and now it’s time to take those relationships to the next level.” As such, several JRCs are currently busy developing a double-degree PhD, which would mean that doctoral candidates would receive a diploma in both China and the Netherlands. “That would be a huge bonus to PhD candidates. After all, these are two leading universities in the field”, says Van Oosterom. The idea is that the PhD candidates’ supervisors also spend some time at the other university, among other things to give guest lectures and help draft research proposals.

## ‘It’s arrogant to assume that China is lagging behind us’

The academic directors in Delft who are responsible for the JRCs are also working together with their Chinese counterparts to consider the future course of the collaboration. “We have an advisory council here in Delft comprising people from the business world and the public sector, who make recommendations regarding as to where the research should be heading. Just like in China. That gives us an enormous boost”, adds Van Oosterom. “All things considered, a JRC – which allows you to conduct in-depth research with strategic partners – offers numerous advantages compared to an ad hoc relationship”, concludes Nadin.

&lt;&lt;



# Alumni in numbers

Total of alumni TU Delft

# 82,240

Working/  
living  
abroad

# 18,000

# in 66

countries

## Top countries:

USA 2,228

UK 1,585 (plus London 525)

Germany 1,497

Belgium 1,336 (plus Antwerp 654)

Spain 957

### TU Delft communities

London, Paris, Belgium, Athens, Switzerland, Jakarta, Singapore, Hong Kong, Taiwan, Mexico, Shanghai, Beijing

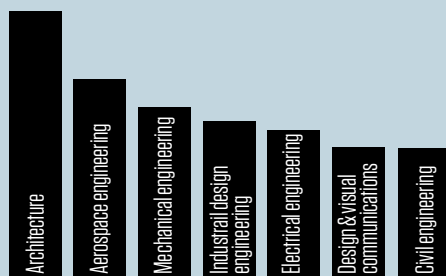
### 3TU communities

Boston, New York, Seattle, San Francisco, Houston, Copenhagen, Oslo, Stockholm, Helsinki

**Outside The Netherlands mainly employed by**  
Shell, Airbus Group, Statoil, Siemens,  
Schlumberger

### Top 7

Faculties/studies alumni abroad



\*Numbers per 1 December 2015

Source: LinkedIn

Heated-up air is blown away through the opening in the roof to the lee and attracts cool air.

Large porch is the main social space.


Gutter throughout the length of the roof for collection of rain water.

Photo: Bambu Social



# Building with bamboo

The general consensus in Nicaragua is that bamboo is a material for the poor. It's only used for scaffolding during construction because, as everyone knows, it's strong and cheap. In contrast, TU Delft architecture students view bamboo as the new gold when it comes to sustainable construction. In 2013, they started a project to build a sustainable bamboo house.

The students organised workshops with contemporaries from the BICU University in El Rama, inviting them to sketch their dream house while thoroughly questioning their choices. Why use concrete? Why place such a small living room in the middle, and have such a large veranda? This ultimately resulted in a rough design for a house. The construction of the house drew widespread media coverage and in August 2015, a foundation was set up to facilitate the construction of social housing using local materials. 

[delta.tudelft.nl/30667](http://delta.tudelft.nl/30667)  
[bambusocial.com](http://bambusocial.com)

Large roof of corrugated iron to the south east, the most common direction of wind.

Small, sheltered living room in the centre of the house.

The collection of rain water as drinking water as far away as possible from the toilet.

House built on piles to attract cool air.

Walls get their strength through bamboo strips. The stuccowork make them look sturdy and solid.





# ‘I could be a real pioneer’

From the first coachload of Indonesian students to the 1,500 international students who joined Master's degree programmes at Delft in the past year. Marietta Spiekerman explains how, in the space of three decades, TU Delft evolved from a university with a predominantly national role into a world-renowned international university of technology.





**CV**

Marietta Spiekerman (born The Hague, 1950) began her career in Student Registration at the Institute of Social Studies, which offered study programmes for students from developing countries. After some five years at the Institute, she joined the Ministry of Agriculture as a training and development manager. In 1975 she and her husband, an academic staff member of the Microelectronics department at TU Delft, went to the United States for a year. On their return, Marietta also went to work for TU Delft, initially as assistant to the international guest coordinator, then as clerk to the Board of Deans and finally as a senior policy officer for internationalisation. She retired in September this year, after working for TU Delft for 36 years.

### How internationally oriented was TU Delft when you came to work here 36 years ago?

"I have always known it as an international university. The international guest coordinator and I used to make the arrangements for guests from abroad. There were many Indonesian students, and most of them came here to study Aerospace Engineering (AE). At that time, all the teaching was still in Dutch."

### Why was AE so popular with these students?

"Because the dean was spending a lot of time in Indonesia, visiting the aircraft factory in Bandung. The Ministry of Education wanted to attract Indonesian students to the Netherlands, as a way of opening up political contact again between the two countries. In around 1985, a coachload of students suddenly arrived and we had a month to arrange things for them in Delft. There wasn't accommodation at the time, and I tried everywhere - even the school for bargees' children. We found a youth hostel where they could stay for a week. Eventually we found accommodation for them in Twente for six months, because the campus there was half empty and we were chock-a-block here."

### Even back then there was lack of accommodation?

"Yes. It was quite an undertaking to get them all to Twente. It was just before Queen's Day and I thought: they won't be able to go shopping because everything will be closed. I phoned the Albert Heijn supermarket to warn them that a coach with 75 Indonesians was on the way. The students took packs of ice with them in the coach to Twente. We'd arranged a nice meal for them, but two-thirds of the group stayed in the coach. It turned out that Ramadan had started that day. At that time, not many people in The Netherlands knew about Ramadan."

### Were there other foreign students in Delft too?

"There certainly were. We were already admitting students to research fellowships; post-docs who wanted to spend some time doing research. The College of Deans approved funding for ten fellows per year for the university as a whole. That was nowhere near enough, of course. I increased the number by telling the faculties that if they added to the budget for research fellows, they could recruit fellows themselves for six or nine months. Everything was very much in its

early stages and there was some very creative accounting. Then companies began to donate money and we were able to appoint a Fellow - subject to the same quality criteria, of course."

### Where did the fellows come from?

"From all over the world: China, Russia, India and the United States. The Rector Magnificus, Hans Dirken, had the idea to set up an International Office, and he said to me: 'You should be part of it.' I was clerk to the College of Deans at the time, and wasn't sure about working in the International Office, but when the Erasmus programme was launched in 1986 I became involved straightaway. The position of 'Policy Officer for Organisation' hadn't been created yet. That meant I could be a real pioneer. I was surfing along on the wave of internationalisation."

### What was the idea behind the Erasmus programme?

It was a project initiated by Brussels that provided grants to enable students to spend six to nine months studying abroad or working on a project at another university. One of the good things about it was that the language of instruction was English from the outset. You didn't need armies of translators and interpreters. The aim was to enable students to compete more effectively in the international job market and to give the market greater insight into the education programmes offered in the various countries. This provided the impetus to compare the content of education programmes." What is the level? "Each country had a different system. This was a reason to make changes with regard to credit points, for example."

### Was there a lot of interest in the grants?

"Yes, right from the start. The Rector Magnificus at Leuven took the initiative to set up the 'Leuven network', with TU Delft, Imperial College, RWTH Aachen and the École des Mines in Paris. This was a core group whose quality you could be sure of, and we could apply jointly for Erasmus declarations. From the outset TU Delft itself also made funding available for our own students, because it could see the benefits of spending time abroad. Compared to other Dutch universities TU Delft was very active in this. It operated on the basis of personal contacts between academics, often through project work. The university already had a strong international orientation:

around seven percent of our students came from outside the Netherlands.”

### How come?

“For one thing, because we have a sudden influx of new students from Norway. The country had one university of technology, Trondheim, and wanted to expand. The government didn’t want another one, because of the cost. Industry needed more engineers, and started making funding available to send Norwegian students to Scotland and England. The Rector Magnificus, Ben Veltman, thought that they should come to Delft too, so I was asked to go to Norway to promote our university. For several winters I spent a week there, battling through snowstorms and flying from place to place in small planes, to tell secondary-school pupils - and especially students in vocational education - why they should come to Delft.”

The next step towards internationalisation at TU Delft was the introduction of English-taught Master’s degree programmes in 1996.

“Yes, we’d been visiting Indonesia and were asked if we could offer Master’s degree programmes. At the time we still had a five-year curriculum, and the Bachelor’s-Master’s degree system hadn’t been introduced yet. I visited all the faculties to ask them what they wanted to do in terms of English-taught programmes, but no-one was interested in setting up a Master’s curriculum. The five-year curriculum was sacred, and couldn’t be divided in two. I’d advocated a Master’s degree programme before, and was asked to see if it was possible.”

### How did it go?

“At the Institute of Social Studies I’d had experience setting up selection and recruitment processes. I had to find people in the faculties who were willing to be involved. AE were willing, given their contacts with Indonesia. Electro was facing declining student numbers, and also wanted to be involved. The dean of Chemical Technology simply thought it was an interesting idea. I organised an advance welcome programme for the summer months, to bring the students up to speed. Half way through the year there was a Go/No Go stage. We said right from the beginning that the final attainment level should be the same for all students. In the first year we had 13 students.

Now we have more than 1,500 Master’s students a year.”

### So TU Delft anticipated the 1999 introduction of the Bachelor’s-Master’s degree system.

“Yes, we were the first university in the Netherlands to fully integrate the Bachelor’s-Master’s degree system. I was the project manager. Along with our best partners in Europe, I was concerned that we shouldn’t find ourselves faced with the situation they have in America, where 75% of students leave education once they have a Bachelor’s degree. We wanted to reach agreements with industry that our students wouldn’t be lured away when they graduated with their Bachelor’s degree. In the context of that discussion, the Idea League was set up: a collaboration between Imperial College, Delft, ETH Zurich and Aachen.

‘We wanted to reach agreements with industry that our students would not be lured away’

I represented TU Delft in the Operations Board from the beginning and I wanted to compare the partners in terms of content and standard, to see whether we were all actually on the same level. It turned out that we were. We accept each other’s students as our own.”

### What else does the Idea League do?

“In 2005 we introduced a joint Master’s degree programme in Geophysics for which students spend six months in Delft, six months in Aachen and six months in Zurich. They can choose which of these universities they graduate from. Recently, as project manager, I set up a new Honours programme with our Idea League partners.” (See page 11 ‘In the picture in Brussels’)

### What has internationalisation meant for TU Delft?

“I think we have enhanced our international profile. If you can attract good international students, you’ll attract good international staff too. That, in turn, enhances the quality of our education and teaching. I think that the university has benefited enormously from this, in terms of quality.”



# After Delft

Industrial design engineer Wouter Kets doesn't really have an affinity with cars. "Ask me to name all the latest Mercedes or BMW models, and I wouldn't have a clue." An appropriate answer for an interior designer who works for Audi. How a graduation project based on the design for a car seat can lead to an international career and finding the love of your life in Beijing.

He is calling from Ingolstadt in Germany, home of the headquarters of German car manufacturer Audi. "I've been back since last year", says Wouter Kets, "they wanted me to be based here again." Before this, he was based in Beijing, China, where they have completely different ideas about design and you have to learn how to survive on chicken's feet and deep-fried scorpion. "Some people struggle with those sorts of cultural differences, but it was an aspect I really enjoyed", he says. "They were the best three years of my life." Not least because this was where he met his partner - also Dutch - with whom he now has a two-year-old son.

China is the biggest market for Audi; it is bigger than Europe. The car manufacturer sent him there in 2011 with two colleagues to set up a design studio. "We had to translate the Chinese design philosophy as far as possible into concepts for Audi." He says that, looking back, this inspired the company's automotive designers all over the world. "Chinese designers have a slightly fresh perspective on the car brand; I can't quite put my finger on it." He has traces of a German accent, which is not surprising, given that he has worked for a German company since 2001. He currently manages a 200-strong team responsible for designing the interior of three models that Audi will be developing in the next few years. Yes, there is already plenty of his work to be seen, he ad-



Name: Wouter Kets  
Place of residence: Ingolstadt, Germany  
Marital status: Relationship, 2-year-old-son  
Study: Industrial Design (1994-2001)  
Association: Proteus-Eretes

mits modestly. "I designed many of the dashboard elements in the Q3, and I kicked off the design for the new A4. You can see the results of my work driving around on the streets. That's really great."

And this from someone who ended

**'You can see the results of my work driving around on the streets. That's really great'**

up in the world of car manufacturing by chance. "The TT had just been launched. For me it was a fantastic example of product design. I applied for an internship, where I worked on my graduation project, a design for a

car seat. Two weeks later the boss called me - the company's seat designer had resigned. I was given a contract straightaway."

As a Delft engineering graduate you are something of an outlander in the automotive industry, according to Kets. "Most of the designers there graduated from renowned design schools. The standard is extremely high. But Delft graduates understand design and they know about technology." The Delft approach has also stood him in good stead. "I learned to structure the design process so that it doesn't become chaotic, and so that you know precisely when it will be complete. I still benefit from that every day." **JB**

# IN PERSON

'Flying teacher' **Dr Alexander in 't Veld** of the faculty of Aerospace Engineering (AE) has been named Best Tutor at TU Delft. As well as delivering lectures on the ground, In 't Veld flies the faculty's research aircraft and in his spare time is a stunt pilot. Like his students, the judges were impressed by the way he brings difficult theories to life.

Having already obtained the best possible mark for her Master's thesis, **Hanan Al-Kutubi** of the faculty of Applied Sciences has now been awarded the title Best Graduate of TU Delft. The first student of Chemical Engineering since 2005 to earn 10/10 for their degree paper, Al-Kutubi conducts research into metal oxides and metal-organic frameworks (MOFs). She has already published articles on the results of her MSc project in three peer-reviewed journals.

**Jeroen van Erp**, creative director of the Fabrique agency, has been appointed Professor of Concept Design at the faculty of Industrial Design Engineering (IDE). Van Erp comments: "How wonderful it is to return to your own alma mater after almost thirty years, to help train the designers of the future."

Singing IDE student **Daniel Kist** has made it to the live phase of TV talent show The Voice of Holland. This is his second moment in the spotlight within a few months: earlier this year he hit the news with his deployment of drones in the fight against rhinoceros poachers in Africa. His company, Skyframes, usually uses the unmanned aircraft to inspect the blades of wind turbines.

The European Convention for Constructional Steelwork (ECCS) has presented **emeritus professor Frans Bijlaard** with its prestigious Charles Massonnet Award for his contributions to the advancement of scientific and technical support for constructional steelwork. He is the second Dutch recipient of this award.

Two of the ten new members of the Young Academy, the forum for outspoken junior talent within the Royal Netherlands Academy of Arts and Sciences (KNAW), hail from Delft. They are **Alexandru Iosup** of the faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) and **Behnam Taebi** of the faculty of Applied Sciences.

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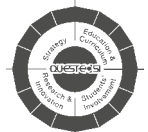


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# New usage for old reactor

The latest measurement instrument of the TU Delft measures the crystal structures of many different materials and is unique within the Netherlands. The so-called Pearl neutron powder diffractometer was opened on 24 September at the RID reactor institute. "It is difficult to overestimate the diversity of applications."

TEXT: JOS WASSINK PHOTOS: SAM RENTMEESTER



Lambert van Eijk places a sample in the centre of the diffractometer (right).



Seventy guests active in the field of international neutron research witnessed the first use of the instrument through a video link to the reactor hall. They were shown a concrete container that connects the instrument with the reactor core. They also saw Dr. Lambert van Eijck, who pointed out the semi-circle with the neutron detectors behind it to the camera man. RID director Prof. Bert Wolterbeek then opened the shutter to bombard the sample with neutrons from the reactor core. A graph immediately came up on the screen. Following a slow build-up of radiation, a series of peaks emerged. The audience applauded this convincing demonstration. To experts, the peaks indicate distances between atoms in the crystal grids of the sample. Instead of monocrystals, the sample contains several cubic centimetres of fine crystalline powder. Thanks to a smart method known as the 'Rietveld refinement' researchers can translate the peaks from the diffractometer into distances between atoms in the crystal structure linking them together.

### Wider use of the nuclear reactor

The Pearl project (not an acronym) was launched in 2009, when Prof. Katia Pappas received an invitation from Berlin to come to TU Delft to stimulate the wider use of the nuclear reactor in Delft. A neutron diffractometer seemed an ideal application for this purpose, because it enables researchers to use neutron radiation from the reactor to identify the crystal structures of many types of materials. Moreover, this type of instrument did not yet exist in the Netherlands. A year later, a budget of eight hundred thousand Euros had been secured, enabling them to recruit Van Eijck to design and build the instrument. Van Eijck worked closely with the Australian physicist Dr. Leo Cussen to create an instrument that could match others in Europe in terms of sensitivity and resolution, despite the small size of the reactor. In 2012, the final design was completed and construction got under way.

At the focal point of the device is a sample as large as a phalanx bone filled with fine crystalline powder. Neutrons are dispersed through the powder over a wide angle of nearly 180 degrees in a pattern of peaks and troughs forming a fingerprint of the crystal structure. In 1966, the eminent crystallographer Dr. Hugo Rietveld (who was present at the opening and was honoured during the ceremony) developed a method at ECN that he used to establish a link between the crystal structure and the diffraction pattern. This method, known as the 'Rietveld refinement' and used around the world, assumes a certain structure and calculates the diffraction of that structure. If that pattern eventually matches the



The sample is surrounded by a semi-circle containing 1,408 detectors.

measurement - following a number of iterations - the crystal structure will be determined. The sample is surrounded by a semi-circle (11-160 degrees) containing 1408 detectors behind a tight aluminium wall. Every detector is composed of a 2-millimetre wide strip of lithium and zinc sulphide with an optic fibre. When the lithium is struck by a neutron, it will break up into an alpha particle (two protons and

Without knowledge of crystal structures, the development of new materials for water storage, fuel cells, magnetic cooling and lithium batteries would be impossible

two neutrons) and a tritium ion (one proton with two neutrons). These particles produce a light flash in the zinc sulphide that is transmitted by the optic fibre to a photodetector, which converts it into an electric pulse. There is one problem, however: the same also happens with incident gamma radiation. Thanks to colleagues from the Rutherford Appleton Laboratory near Oxford, the detector can now differentiate between gamma and neutron flashes, only allowing the latter to pass through. >>

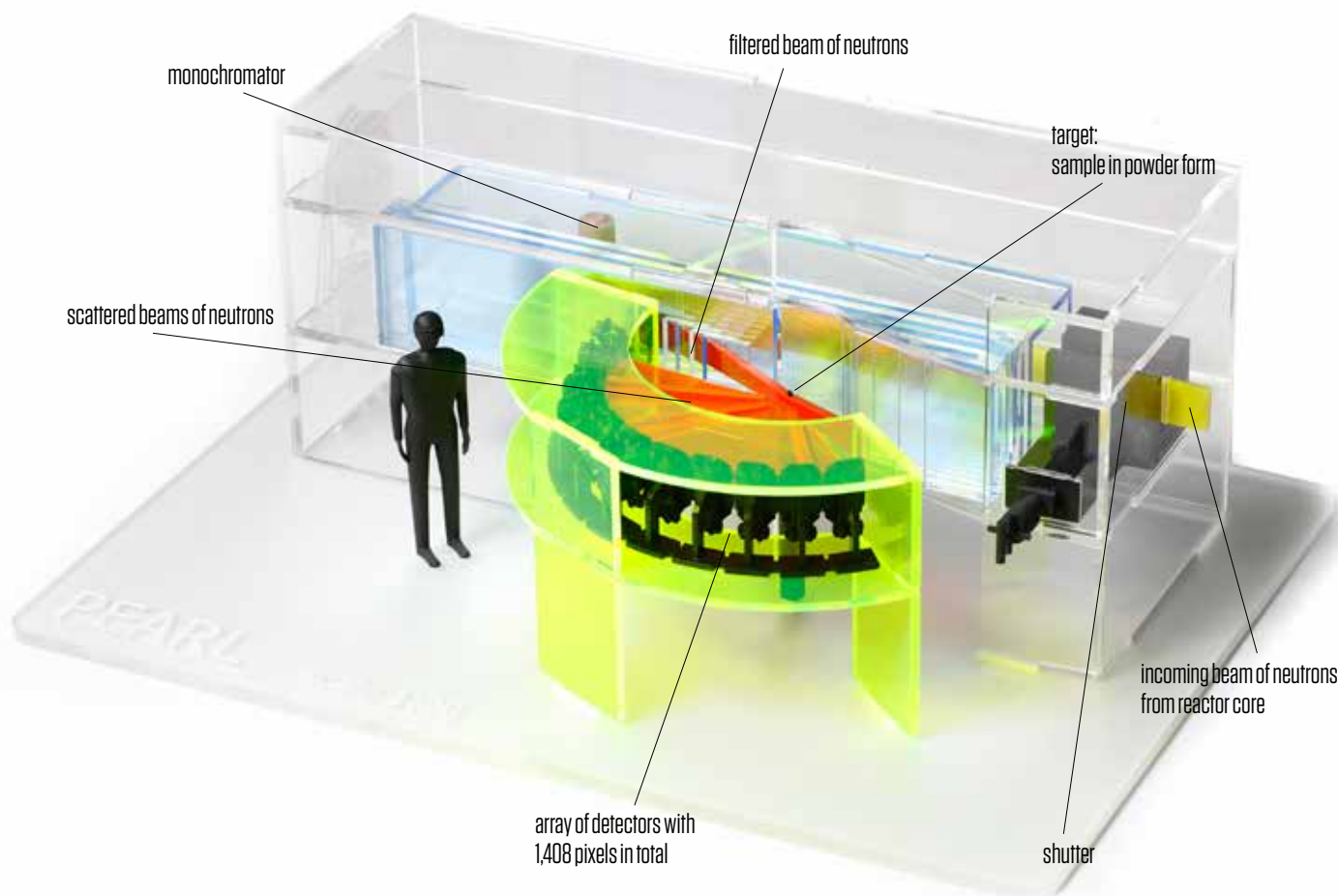
The value of crystal structure knowledge is difficult to overestimate. Without this knowledge, the development of new materials for water storage, fuel cells, magnetic cooling and lithium batteries would be impossible. And this also applies to the development of pharmaceutical materials, coatings for turbine blades and catalysts.

Various researchers at the opening symposium talked about how they improve their materials step by step using the diffractometer. They are given a profile of the material, deduce the crystal structure based on this profile and make modifications to improve performance. The modified material is placed back in the instrument to check if the chemical changes had a positive

effect. This is how they improve their materials step by step. The nearest facilities for neutron diffraction are located in Oxford, Paris and Grenoble. Now, researchers can also come to Delft for this purpose. Despite the relatively low capacity of the reactor (2 megawatts), Pearl can easily match the other centres, according to Van Eijck. He adds that he is still working on the reduction of the background radiation.

The day was concluded with a dinner in the company of the technical directors of various major companies interested in the possibilities of neutron diffraction. <<

[pearl.tudelft.nl](http://pearl.tudelft.nl)



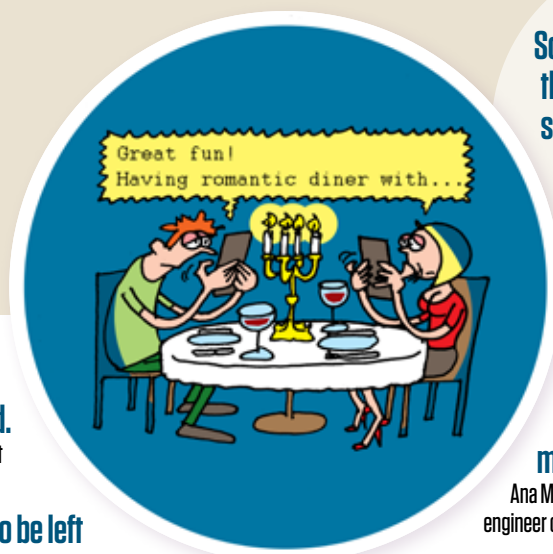
# HORA EST

## ‘Whether the human brain is described deterministically or by quantum mechanics, there is no space for free will.’

Helena Junicke, engineer quantum technology

“Matter consists of molecules and atoms. So does the human brain. In the picture of classical mechanics, each future state of the brain can in principle be predicted if only the initial system state is known, that is, the positions and velocities of all those particles in the brain. To my understanding the free will means to be in control of your own decisions. However, if the future state of the brain is already predefined by the initial conditions, there is no free will. But cognitive processes also depend on electrical currents transmitted between neurons and the electrons that make up for the electrical current obey the laws of

quantum mechanics. This means that the electrons which trigger our actions behave in some kind of random fashion. So, every foundation of our decision making would rely purely on probabilities. If probabilities determine our decision making, then still, it is probabilities that drive our actions and not free will. The problem with any scientific theory is that it aims to discover a cause. Yet, a cause is just a reason to the effect and as such can never permit the concept of free will. So maybe there’s still hope for free will? Or maybe that’s just what my brain wants me to make believe?”



**Social media give people the impression of being social, but in fact people become asocial.**

Ilhan Şen  
aerospace engineer

**Swimming stimulates creativity: in water everything is fluid.**

Egbert Henri Stolk, engineer built environment

**Democracy is too important to be left to the will of the people.**

Nick den Uijl, materials engineer

**Nowadays an experiment has no value until it is broadcasted.**

Daniela Ullien, chemical engineer

**Nothing makes a person more productive than the last minute.**

David Vladesueiro, chemical engineer

**We are ourselves through others, so we ought to choose our mirrors carefully.**

Ana Mafalda Monteiro Oliveira Cortez,  
engineer computer sciences

**Due to isolation, Chinese Phd candidates in the Netherlands should be called ‘working machines’.**

Linfeng Chen, aerospace engineer

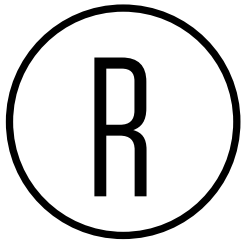
**Best is the enemy of Good.**

Emmanuelle Prest, physics engineer

**Universities pay with subscriptions for knowledge they share for free.**

Ilhan Şen, aerospace engineer





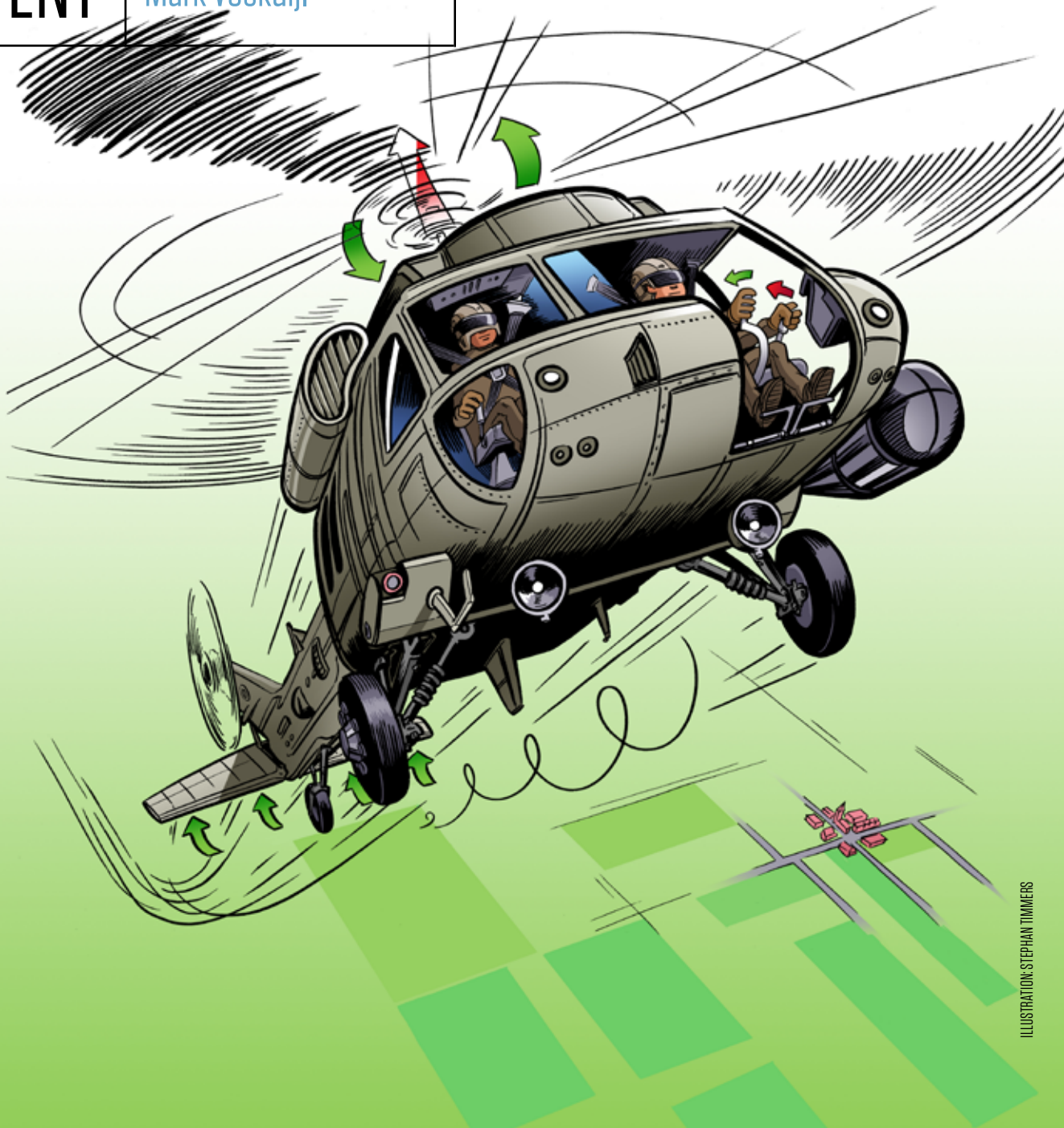
PATENT

OCT-13-037

Stabiliser with  
steering control

Inventor:

Mark Voskuijl



Even the best patents promising many benefits won't necessarily attract queues of buyers. At least, that is the experience of Mark Voskuil, Assistant Professor of Flight Performance and Propulsion (Faculty of Aerospace Engineering (AE)). Building on a project he was involved in at the University of Liverpool, where he obtained his PhD, he has developed a modification for the steering system of helicopters. Most helicopters have a horizontal stabiliser. In some cases, the stabiliser is moveable. Voskuil conceived the idea of using the movable horizontal stabiliser not only for stability but also for active steering control. This means that, at high speeds, the force to which the rotor is subjected is reduced by 25%, making the helicopter easier to steer and cutting maintenance costs. And the best thing about it is that the modification is relatively easy. Voskuil took his design to helicopter manufacturers, but their response was cautious. However easy may be to fit the new component, it needs to be certified, and that's expensive. "They also raised questions about safety aspects." The assistant professor asked graduates to work out all the failure scenarios. "We found that the horizontal stabiliser doesn't need to be extended very far to have an effect. And if it breaks, the helicopter can still fly and retain stability. Now it's a matter of convincing the helicopter industry. "The world's biggest helicopter conference is in May. It will be my last chance to sell the patent, otherwise the research won't get any further than the pages of an academic journal." **SB**

## Struggle

"After two and a half years work, my book about the opposition to shale gas in the Netherlands, *Tussen hoogmoed en hysterie* (Between Arrogance and Hysteria), was finally published. 'A revealing, and sometimes sobering glimpse behind the scenes of the modern media democracy', as it is described on the back cover. 'Where perceptions rule, framing is widespread and hardly anyone can separate fact from fiction - with all the consequences this entails.' In no time, employing the holy trinity of all successful opposition - fear, uncertainty and suspicion - environmental activists and the public have managed to get shale gas banned. There has been no debate, or anything resembling one. The voice of reason was conspicuous by its absence. Objective factual information was soon submerged in a deluge of opinions, rumour and half-truths. As I was frequently reminded in The Hague, political decision-making isn't based only on fact - emotions also play a role. That's true - but with the emphasis on 'also'. In practise, it is largely emotions that are at the root of generally held views. The fact that reason is largely lacking in today's black-and-white culture and debate is because those who represent the voice of reason are less and less inclined to take part in discussions. As in the case of shale gas. Why damage your reputation if you're not a stakeholder?

Why allow yourself to be scoffed at in a debate when even the industry itself has serious doubts about whether it can ever be developed in the Netherlands? No thanks. But the struggle over shale gas is not about gas. It's about losing sight of the facts. It's about engineers being written off as idiots, simply because they sometimes do the sums. It's about a broad view versus blinkers, optimism instead of fear, and curiosity instead of a closed mind. In short, it's about the essence of a safe, secure and prosperous society. I often heard it said in the 'reason and rationality camp', that if you just wait long enough, things have a way of working out. 'Just watch how quickly public opinion changes when the lights go out or electricity bills go through the roof.' That's right, But those who hold this resigned approach forget that every gloom-and-doom scenario relating to technology will result in even greater resistance to technological innovation next time around. 'When in doubt, don't do it' - the final nail in the coffin. Anyone who wants to let the facts speak as well as his heart will have to man the barricades in order to defend considered argument against the whirlwind of emotions that dominates many a debate on technology, and to issue the clarification call to occupy and defend, with fire and sword, the now-deserted middle position."



Ir. Remco de Boer is a technology & science communication specialist

# Stardust in terahertz

Researchers at the South Pole launch test balloons. As soon as the atmosphere is stable enough, they will launch an enormous balloon carrying a telescope with detectors built in Delft.

TEXT: JOS WASSINK ILLUSTRATION: STEPHAN TIMMERS PHOTOS: SAM RENTMEESTER

**T**en years ago, Dr Jian-Rong Gao, project leader in the department of Quantum NanoScience at the Faculty of Applied Sciences and the TU Delft Space Institute made up his mind to develop a better technology for detecting terahertz radiation: electromagnetic radiation that falls in between infrared radiation and microwave radiation. Terahertz radiation provides insight into the composition of dust clouds in our Milky Way galaxy; the ‘incubators’ of new solar systems. Since then, Gao has worked steadily and continually on the development of his terahertz detectors and, in collaboration with the Netherlands Institute for Space Research (SRON), managed to get them selected by NASA for the Stratospheric Terahertz Observatory (STO2) mission. Shortly before the launch of his life’s work (mid-December) he declares, slightly nervously: “We are hoping for God’s help in making the launch a success.” Hence the test balloons.

## Primitive

Since the beginning of November, SRON researchers Darren Hayton and Wouter Laauwen have been working at the McMurdo base station in

Antarctica, building the balloon gondola and testing all the components. This was the continuation of work that had begun last August in Palestine, Texas, where the whole gondola was lifted and tested. After the satisfactory completion of the ‘hang test’, the colossus was dismantled and shipped to the South Pole in crates. In mid-November, Laauwen wrote in his blog: “The balloon gondola is in our hangar. It’s well on the way to completion. Colleagues from APL (Applied Physics Laboratory, Johns Hopkins University, Ed.) and the CSBF (Columbia Scientific Balloon Facility, Ed.) are continuing the work. We’re going to build our instrument into a cryostat, a sort of large thermos flask filled with liquid helium that cools the whole instrument to around 270 degrees below zero, in other words 4 kelvin, 4 degrees above absolute zero. Although it’s all a bit more primitive, in the lab it’s easy to forget where you are; there aren’t any windows. As soon as you open the door, you remember: I really am in Antarctica.”

Four days later he announced: “The good news is that we’ve just got the whole signal chain from the 4.7 THz receiver to work (see ‘Delft detector’, Ed.). We’re receiving a local signal, we can see the skies and the detector is

sending out a required signal. There is still some optimising to be done, but all the steps are working. Success! The bad news is that the toilet doesn’t work.”

## Star formation

The first stars were formed around 13.5 billion years ago, from light elements such as hydrogen, helium and lithium. Nuclear fusion in the stars gave rise to heavier elements such as carbon, nitrogen and oxygen - elements that are now abundant in the dust clouds of ‘our’ Milky Way. It’s strange to think that the building blocks of our planet and life on it were once forged in the interior of stars, and were scattered as stardust billions of years later following an enormous explosion.

New stars and planets are still forming from that interstellar dust in an eternal dance of energy and matter. That is the general picture, but we still know very little about the proportions in which the elements carbon, oxygen and nitrogen occur, about how fast the gases cool, how many stars are formed, how fast that process is and how heavy the stars become.

Professor of Submillimetre Astronomy at the University of Groningen, Prof.



Floris van der Tak, hopes that measurements made during the STO2 mission will lead to a greater understanding of this. Admittedly, the balloon mission will have a limited duration - an estimated two weeks, the length of time the helium will last. That is why only a limited area of the Milky Way, 10 degrees wide by 2 degrees high, can be scanned. Within that area, the various detectors will map the distribution lines of nitrogen (N at 1.4 THz), carbon (C at 1.9 THz) and oxygen (O at 4.7 THz). Van der Tak, who works at SRON, is particularly interested in the oxygen line, because oxygen glows at 300 Kelvin (room temperature), quite a lot warmer than the environment of 100 Kelvin. In other words: the oxygen line shows the first temperature rise of a forming star. Van der Tak: "If you think of a gas cloud as a womb in which stars develop, the oxygen line is the ultrasound scan that tells you what's going on inside." Depending on the measurements, the plan is to scan larger areas in a higher resolution in later missions. In that sense, the STO2 mission itself is a sort of test balloon.

### Gao's dream

"Terahertz radiation from space was first observed twenty years ago, with >>



semiconductor detectors in a plane at an altitude of ten kilometres. There was too much noise in the measurements to do anything with them, but they showed that there was radiation in the far infrared range”, explains Dr Jian-Rong Gao (born Shanghai, 1959), describing the beginnings of submillimetre astronomy. Ten years ago, the detector specialist working for SRON and TU Delft decided to develop the best detector for terahertz radiation (see ‘Delft detector’). The detectors he developed have been used in NASA and ESA missions, and have revealed to us a hitherto obscure area of the spectrum.

His efforts were rewarded when mission leader Prof. Christopher Walker of the University of Arizona chose the Delft detectors for the STO2 balloon mission. Walker had decided that Gao’s team at the department of Quantum NanoScience built the best detectors.

Eventually, the Delft team were even the saviours of the STO2 mission, because when it became apparent last



Dr Jian-Rong Gao: “We are the eyes of the mission.”

summer that the Jet Propulsion Lab could not deliver the promised infrared detectors (for 1.4 and 1.9 THz), Gao provided some that he had made for the European Herschel mission (2009-2013). As a result, all the detectors used on STO2 are from Delft. Gao says:

“We are the eyes of the mission”.

Gao would have liked to have been the first one to measure the oxygen lines with the latest technology. Unfortunately, German researchers did that earlier this year, from a plane at an altitude of 14 kilometres. They were the first, but if everything goes according to plan, the measurements at 40 kilometres will not only be better (the atmosphere absorbs terahertz radiation from space), but also much more detailed.

A plan for the follow-up mission, GUSSTO (Galactic/Xtragalactic Ultra long duration balloon Spectroscopic Stratospheric THz Observatory), is already with NASA. GUSSTO will have 3 x 16 pixels on board (for the three different wavelengths of oxygen, carbon and nitrogen) and will be active for more than 100 days. Gao’s dream that came true has apparently led to a taste for more.

<<

## How it works

A parabolic reflector concentrates the incoming radiation onto a one-way mirror, which also receives the radiation from a terahertz laser that serves as a local oscillator. This specially developed quantum cascade laser (QCL) that generates the 4.7 THz radiation is kept at a working temperature of 50 Kelvin (minus 223 degrees Celsius) by a compact Stirling cooler. The laser itself is tiny: only one millimetre long and 20-40 micrometres wide.

The mixing of a signal with a reference radiation from a local oscillator is called heterodyne detection. The advantages of the method are that it converts the frequency of the signal from terahertz to gigahertz, and that good amplifiers, filters and meters are available for that microwave radiation.

A silicon lens concentrates the mixed radiation (signal and reference) onto a small antenna that is connected to a superconducting detector known as a hot-electron bolometer or HEB mixer. Put simply, these detectors consist of a superconducting niobium-nitride bridge between two gold contacts. The radiation absorbed heats the bridge (2 by 0.2 micrometres), which causes the bridge to lose some of its superconducting properties. The resulting increased electrical resistance can be measured.

A star camera fixes the position of the telescope in relation to the firmament. Once a reading of one pixel has been measured (on three wavelengths simultaneously), its position shifts very slightly to the next pixel. Working thus, the telescope takes around 15 days to complete a pixel-by-pixel scan of a previously-determined observation framework 2 degrees high and 10 degrees wide.

**Read the latest news in Laauwen’s blog: [srn.nl/sto2/antartica](http://srn.nl/sto2/antartica)**

# THE FIRM

They are Physics graduates, but they knew nothing about running a business. This is the realisation dawning on the owners of Magnet.me, now that they are expanding their business to the British Isles.

Lots of good ideas are born out of frustration. Four years ago, Freek Schouten, Vincent Karremans (who studied Law & Economics in Rotterdam) and Laurens van Nues were frustrated by not having a clue where their best chances lay in the job market. Sure, there were career events where multinationals and consultancy agencies profiled themselves. But that's not where you were likely to find trendy start-ups.

And that's how they hit upon the idea for Magnet.me, a company designed to provide students and those soon to graduate with a better understanding of the career opportunities open to them. A 'matchmaking' process formed the basis for their enterprise: people looking for work or an internship create a profile on the site Magnet.me, while companies can also add their profile (for which they pay a fixed monthly rate, depending on the service they offer, but it's free for start-ups). Once a match is struck between company and student, the latter receives a networking request. This means that it's always the job-seeker that keeps the initiative.

Magnet.me was launched in 2013 and two years on, 780 organisations have registered alongside 32,000 job-seekers. Their computers identify 3,500 matches each day, and send out as many network requests. A total of 800,000 matches have already been made. With the expansion of the service into Britain



as of 5 October, chances are that the number of matches will rise. Reflecting on how far they have come, the now successful entrepreneurs conclude that they were clueless when they started out. Van Nues: "We'd studied physics, but we didn't know the first thing about sales or marketing. Product development, design and programming were all new to us, unexplored territory." Along the way, they've recruited some of the required expertise: industrial design engineers and computer scientists to do the programming. The rest came down to chatting with people, searching on Google and reading books. They signed up for a sales course and witnessed sales begin to rise. It meant more to them than just more business –

in fact, it made them aware that self-improvement could help make their company more successful. They also improved their homepage and saw an increase in the number of visitors that created a profile. "That was a high-five moment", recalls Schouten.

Expanding to Britain brings a wealth of new opportunities, as the British job market is more bureaucratic and conservative. 'It's screaming out for innovation,' adds Schouten. It also presents Dutch students with fresh opportunities. But expanding into Britain naturally brings challenges – the company had to adjust to the not-so-direct ways of British culture, where everything revolves around extreme politeness and continuously saying 'thank you' and 'sorry'.



**Name:** Laurens van Nues, Freek Schouten, Vincent Karremans

**Study:** Applied physics, applied physics, Law&economics Rotterdam

**Company:** Magnet.me

**Product:** Match making

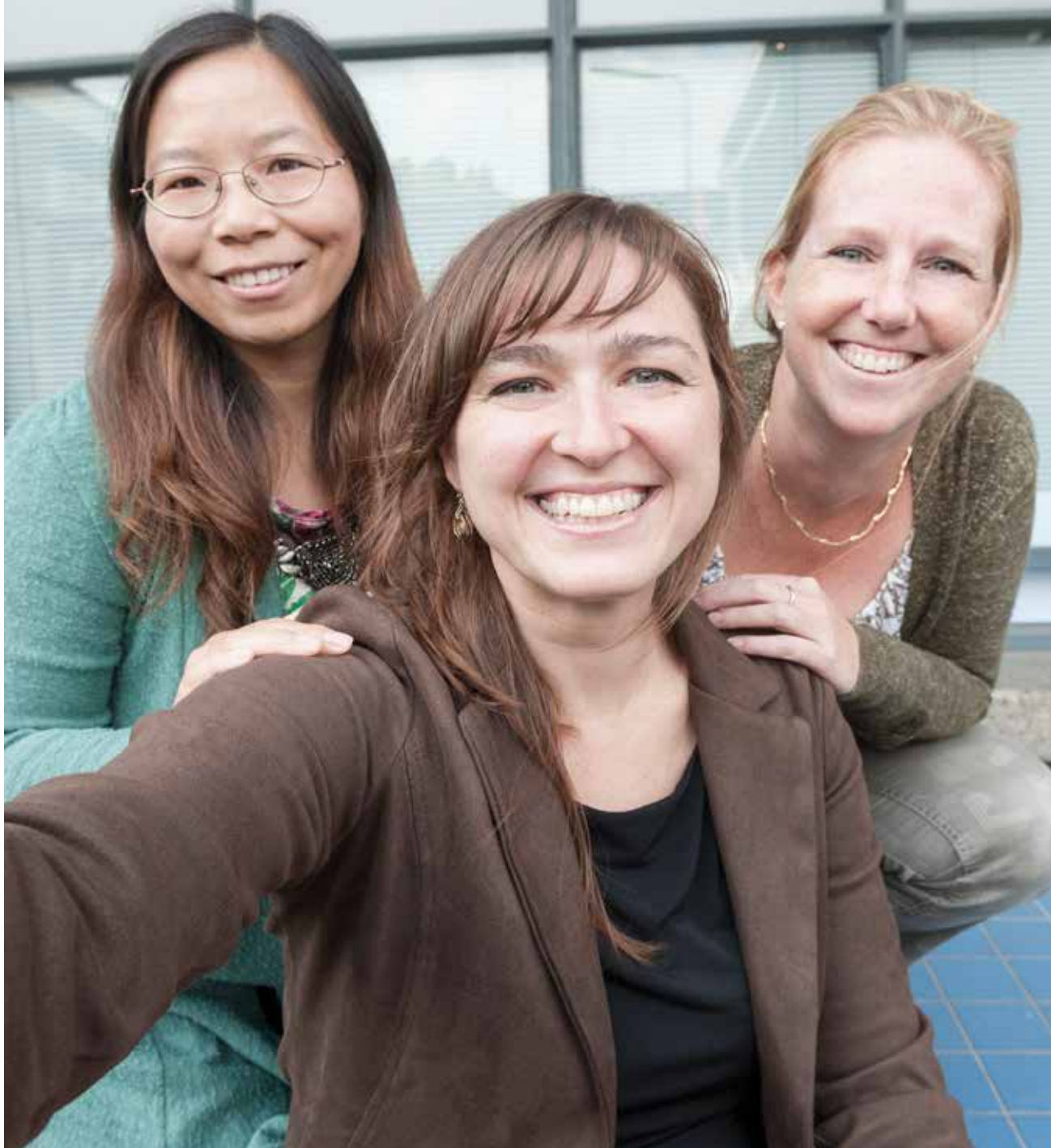
**Mission:** To let students and graduates explore their full professional potential through connecting them with every possible future employer in the world. Enable every organisation to attract the talent they need to reach their goals.

**Turnover:** Around a million euros

**In 5 years:** 'We expect to have expanded abroad and to have helped our clients even better with innovations.'



# #Looklikeanengineer



To increase the number of top female faculty members TU offers Fellowships. Jinrui Zhang, Wioletta Ruszel and Merle de Kreuk are three of these fellows.

## Science is not above sexism. At least scientists and engineers are not.

In June, Nobel Laureate Tim Hunt made sexist remarks about women being too distracting for laboratories. A social media backlash ensued. ‘#DistractinglySexy’ became a hot Twitter topic, with female engineers posting photos of themselves at work – in clean suits, hard hats or simply knee-deep in research. In July, ‘#LookLikeAnEngineer’ went viral after Isis Wenger, a software engineer in the US, was told she was ‘too pretty’ to be an engineer. A number of female scientists from Europe added their voices to both movements, highlighting the fact that women in science continue to face explicit and implicit biases every day. We spoke to organisations across Europe and researchers at TU Delft to get a picture of the situation. According to European Commission report *She Figures 2012*, the average proportion of female researchers in the EU-27 stood at 33% in 2009. Germany and the Netherlands have only 25% and 26% female researchers respectively, whereas Bulgaria, Portugal, Romania, Estonia, Slovakia and Poland have at least 40% female researchers. While the European target is 25%, the number of female professors in the Netherlands is only 15.7%. National organisation Dutch Women in Science (LNVH) found that it will take about half a century for the male and female ratio to even out in technical fields in the Netherlands.

“The pattern of male dominance is still visible. Only one out of six professors is female. We fare better than a lot of countries, but when compared to some Scandinavian countries, or even the US, we have a long way to go,” said Marike Bontenbal of UNESCO Netherlands. Together with L’Oreal, UNESCO offers an annual fellowship to women in science in several countries. Started elsewhere in 1998, it was only introduced in the Netherlands in 2012.

Today, there are number of other national initiatives. The Netherlands Organisation for Scientific Research even co-organises an annual event with LNVH called Pump up Your Career. It focuses on talent and career development for women in science.

### Unconscious bias

The European Platform of Women Scientists, which has members from across the continent, took up the issue at Ready for Dialogue, a conference in Germany which took place in November. “There is still unconscious bias against women and subtle sexism that are hard to fight. The mental image of a scientist is very much that of a serious looking bearded white man. From subtle discrimination to open harassment, there is still a lot that needs to change,” said Tatjana Parac-Vogt, president of Belgian Women in Science (BeWise) Association and professor of chemistry at KU Leuven. “Belgium has initiatives such as Ladies in Science and Green light for Girls designed to encourage young girls to opt for science,” she said. The United Kingdom began addressing the imbalance sometime back according to Hayley Hung, TU Delft Assistant Professor, who studied electrical engineering at London’s Imperial College between 1998 and 2002. She was one of the only 10% of females. “One professor would say ‘Good morning, lady and gentlemen’ in the tutorials I attended!”

### Maternal wall

“In many ways science is a much more traditional space and still associated

with male figures. This is compounded by issues of work and life balance,” explained Bontenbal. Not only does this mind set discourage female students from opting for science, it is found to have an impact on selection committees when selecting candidates as well. “A gender-mixed composition of nominating commissions, an increase in the objectivity of the applied selection criteria, tutoring of women, or even the fixing of quotas, are all policies that are generally evoked...to balance out the unequal situation that continues to prevail in the academic sector,” notes *She Figures 2012*. The report adds that “there is not just a glass ceiling, but a ‘maternal wall’ is hindering the career of female researchers.”

## The gender balance starts to skew when women are in their late 20s en 30s

Research shows that while at a BSc and MSc level the gender balance is lot more even, it starts to skew when women are in their late 20s and 30s. At TU Delft there are only 26% female PhD candidates as compared to 32% BSc students and 50% MSc students. Interestingly, in the Faculty of Architecture and the Faculty of Industrial Design women comprise 56% and 59% of BSc students respectively. Some teams now actively look for female candidates while initiatives such as the Delft Technology Fellowship continue to boost the numbers in other areas. <<

Wioletta Ruszel Assistant Professor, Applied Probability Department, Electrical Engineering, Mathematics and Computer Science

Merle de Kreuk Assistant Professor, wastewater treatment and anaerobic digestion processes, Civil Engineering and Geosciences

Jinrui Zhang Cell Systems Engineering Researcher, Faculty of Applied Sciences

Read the stories of three TU Delft researchers online: [delftoutlook.tudelft.nl](http://delftoutlook.tudelft.nl).

# Alumni World

## Course: Leadership for Engineers

They developed the new online course Leadership for Engineers, which engineers all over the world can follow free of charge from January 2016. TU alumni Pieter Ligthart (Russell Reynolds Associates) and Stefaan Rodts (McKinsey) on their passion for leadership.

### How did you hit upon the idea to develop a free online course on leadership?

S: "We felt that TU Delft is great at training technical experts, but most of your leadership skills are learnt outside the classroom. So we wanted to get fifty talented students together for a weekend to prepare them for working life. We took this idea to Dirk Jan van den Berg, former president of the Executive Board. He told us to think about how we could format this idea in a MOOC (massive open online course). This seemed like a good challenge to us, so we tackled it together with TPM professor Hans de Bruijn.

P: "Worldwide 40 billion euros a year are spent on leadership training courses, almost all of which are group sessions. This is a first step in exploring alternative ways of inspiring people to think about themselves."

### Who is the MOOC intended for?

P: "Engineers all over the world can participate. A quarter of the 100 most successful companies have an engineer as CEO. Of course this number should be higher. If you were to equip all engineers with leadership skills, you would train more complete, all-round engineers."

S: "We already have 9,000 enrolments, from 150 different nationalities, and we have the capacity for many more! The

course is suitable for all ages, because you are continually having to make choices about what you want, where you are and where you want to be in your development."

### What do people learn in this MOOC?


S: "In the first part you learn how important the context is in which leaders have to operate and how complex problems in the world and business are. The second part is about yourself, where your strengths and passions lie; it teaches a number of skills such as focusing on the positive and how you can change your own behaviour."

P: "The third part is about leadership models. We introduce sustainable leadership, because we feel this is particularly needed in this day and age. Such leaders don't only think about themselves, but all the stakeholders. They are good at building relationships and in systems

thinking - seeing the bigger picture. The MOOC closes with a model that helps you make your career choices."

### What made you as applied physics alumni keen to contribute to this?

P: "Engineers have a great deal to offer to the world. For example, leading the transition from fossil fuels to sustainable energy resources. Part of the problem is technical, but getting people on board is just as important"

S: "It's a great misunderstanding that leadership is a soft skill. We want to show people that you can work on your own leadership skills in a very level-headed, concrete and inspiring way." 

**More information: online-learning. tudelft.nl/courses/leadership-for-engineers**



STEFAN RODTS.



PIETER LIGTHART.



## Friends help talent

Meetings with the students from the D:Dream student teams; prizewinning and record-breaking vehicles, such as the Nuna8 and the DARE rocket; and bio-physics professor Cees Dekker on unravelling the secret of life and building a living cell. Excellence at TU Delft was never so tangible as during the Charity Dinner given by the University Fund Delft.

Over 150 Friends of the University Fund Delft came together in the D:DREAM hall at the end of October. With this annual charity dinner, the University Fund thanked its Friends, many of whom are TU Delft alumni, for their support. The event gives the Friends a good idea of what their support means to students and researchers. The presence of so many people who are so committed to TU Delft made the evening a great success.

### Friends

If you would like to become a Friend of the University Fund Delft and attend the annual charity dinner, please send an email to [ufonds@tudelft.nl](mailto:ufonds@tudelft.nl) or call 015-2786409.



## IDE Master Class

# Behavioural change through games

On 27 and 28 January 2016, Valentijn Visch (TU Delft) and Michael Bas (&ranj serious games) will be giving the IDE Master Class 'Persuasive Game Design, to motivate users for behavioural change.'

A game world makes it easier to achieve predefined goals in the real world (for example awareness, tolerance, behavioural change). Unlike former models, the 'Persuasive Game Design model' is focused on user experience rather than the technology: how do you develop gamification in which the player experiences a game world that goes on to facilitate desired behaviour in the real world?

This two-day master class offers an introduction to the theory of persuasive game design, the effects and potential, the design method and its immediate application in product-service systems. You learn to understand the applications and limitations, how to communicate their power within the organisation, and what strategies are needed for a successful design.

tations, how to communicate their power within the organisation, and what strategies are needed for a successful design.

### IDE Master Classes

IDE Master Classes is a series of intensive two-day master classes for design professionals. Each master class combines theory with interactive assignments and cases, so you can put what you learn into practice right away. A perfect way to increase your knowledge, to work together with other experienced designers, to expand your network and create new opportunities for your design practice.

[ide.tudelft.nl/masterclasses](http://ide.tudelft.nl/masterclasses)

### Architecture alumni event

Alumni from the years 2008 to 2015 are warmly welcome to come and add their name and signature to the faculty's Alumni Wall on 22 January 2016. The event will be followed by informal drinks. Place: Berlage Room. Time: 15.00 to 18.00.

## Alumni activities

### 8 January

174th Dies Natalis TU Delft

### 8 January

New Year's reception Mathematics and Computer Science alumni

### 22 January

Seven-year activity Architecture and the Built Environment

### 27 January

IDE Master Class Persuasive Game Design

### 8 February

Meet 'n Greet students and alumni

For a complete overview of alumni activities, see: [alumni.tudelft.nl](http://alumni.tudelft.nl)

### CONTACT

Do you have tips, ideas, questions or comments for the alumni office? Send an e-mail to: [alumnibureau@tudelft.nl](mailto:alumnibureau@tudelft.nl) or call +31 (0)15-2789111

### ALUMNI PORTAL

Do you want to change (alumni) information, communication preferences or sign up for alumni events? You can do that through the alumni portal [www.alumniportal.tudelft.nl](http://www.alumniportal.tudelft.nl)

### LINKEDIN

Do you want to contact other alumni? Join the 'Delft University of Technology - Alumni LinkedIn' group.

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