DELFT OUTLOOK
NO. 4 DEC 2017 YEAR 34
TU Delft

Two departing board members

ANKA MULDER:
'Offering our professional education to alumni'

KAREL LUYBEN:
'Bringing in talent early on'

THEME
Disasters

MRI for Africa
Working on an affordable version

Cover: The Zebro robots have been around for some time. Now they can also work together in a swarm and search buildings after a disaster. Their cameras look like eyes, which give them a friendly look. (Photo: Sam Rentmeester)

EDITORIAL
Saskia Bonger

Natural disasters

'Eternal life is on the horizon.' This was quite a statement for departing Rector Magnificus Karel Luyben to make in his final interview with this magazine. Whether you agree with it or not, it reflects a great confidence in the ability of mankind – and especially engineers – to solve problems and to push boundaries. You can find out what this confidence is founded on four times a year in this very magazine. Because, although natural disasters sometimes seem to be the order of the day, behind the scenes the researchers and students of TU Delft are working on solutions.

For example, they develop robots that can function under extreme conditions and in rough terrain to assist disaster relief teams. Or they may try to soften the effects of future disasters by learning from the past and collecting and analysing information about events like Hurricane Harvey.

Or they might build floating homes for the people of the Philippines, whose houses are currently inundated by floods on a regular basis.

It is very likely that you, a TU Delft alumnus, have also contributed to solving social challenges in some way. Anka Mulder, the other departing member of the Executive Board, explains why there is good news for all of you in her final interview: alumni can now follow refresher courses for a reduced price. So, though you may not have eternal life, you can still be the eternal student!

Saskia Bonger,
editor-in-chief

PHOTO: SAM RENTMEESTER

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Theme disasters

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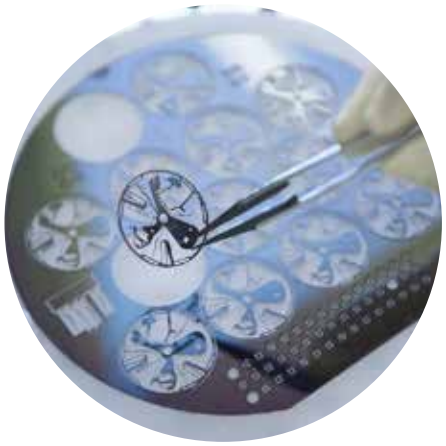
Delft Outlook is the magazine of TU Delft

DELFT IN BRIEF

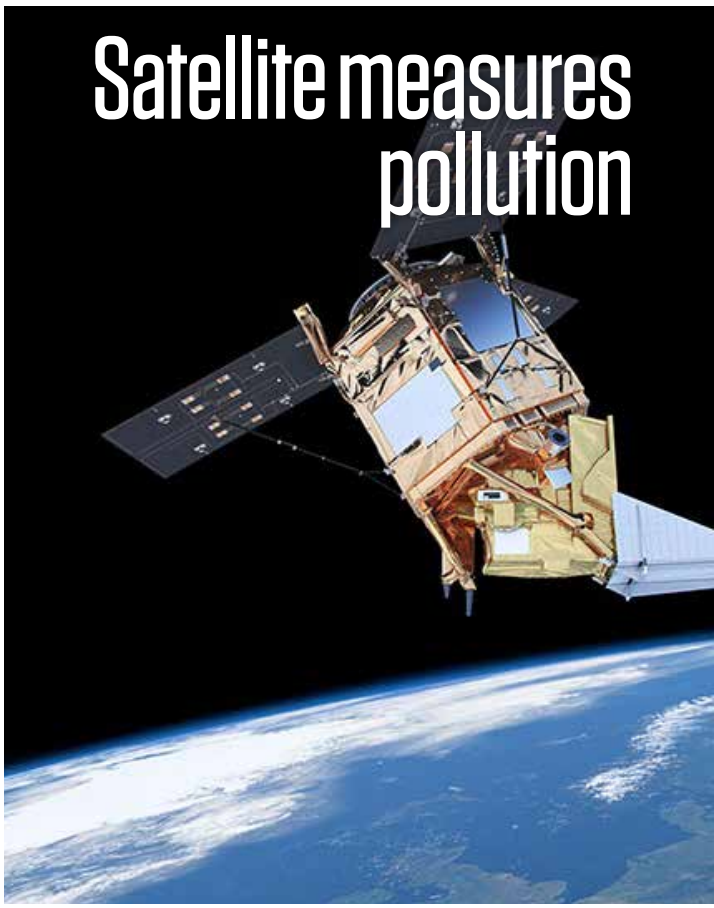


Precision watch

Dr Nima Tolou of the Precision and Microsystem Engineering department (3mE) believes he has created the most accurate mechanical movement in the world. Tolou has re-invented the mechanics of the watch together with the Swiss watch brand Zenith. The original design using a yoke spring, devised by Christiaan Huygens in the 17th century, has been replaced by a single-piece oscillator made of silicon. The watch is accurate to one second every 24 hours. The first watches sold for €26,000 in Switzerland, but an electronic watch that only costs thirty odd euros on a website is still more accurate. “But then you miss out on the romance of the mechanical movement,” says Tolou. “For some people, handmade mechanical watches are iconic.”

delta.tudelft.nl: Made in Delft, the most accurate mechanical watch ever

Satellite measures pollution



Hyperlobby

The TU Delft start-up HARDT, born out of the winning TU Delft Hyperloop team, has successfully lobbied for the construction of a five-kilometre-long test track in the Flevopolder. Departing minister Schultz van Haegen was present at the opening of a thirty-metre-long test tunnel last summer. She declared the Netherlands a centre of smart mobility and commissioned TNO to study the possibilities for a complete test track. By the end of the summer, TNO had chosen Lelystad, and estimated the costs at €120 million. This study was discussed in the House of Representatives during the MIRT debate on the Multiannual Programme for Infrastructure, Space and Transport.

delta.tudelft.nl: Succesvolle lobby voor testbaan hyperloop

The European satellite Sentinel-5P was launched from Russia last October. It was carrying the Dutch space instrument Tropomi. Tropomi will map air quality and greenhouse gases around the world with an unprecedented resolution of 3.5 x 7 kilometres. The instrument is circumnavigating the globe at a height of over 800 kilometres and measures nitrogen dioxide, ozone, sulphur dioxide, methane and carbon monoxide. The leader of the Tropomi project is Dr Pieternel Levelt of the Atmospheric Remote Sensing research group (CEG). 'Tropomi allows us to accurately identify the sources of certain types of pollution from high up in space,' says Levelt, who also works for the KNMI. 'For example, we can distinguish between pollution that originates from the Port of Rotterdam and pollution produced in the nearby city centre.'

delta.tudelft.nl: Mapping polution with unprecedented precision

PHOTO: TROPOMI

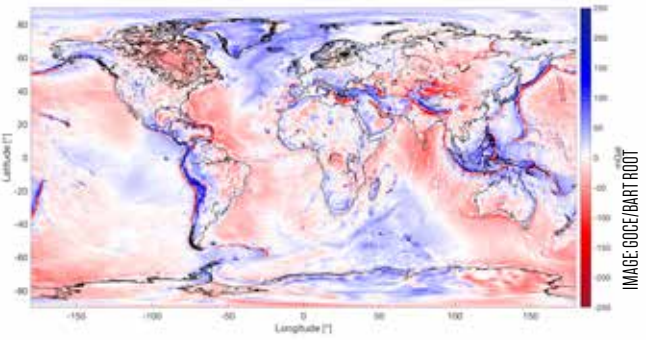


IMAGE: GOCE/BART ROOT

Seeing with gravity

The gravity satellites GRACE, and later GOCE, provided a unique insight into the global variation of the gravitational 'constant'. Dr Bart Root of the AE faculty analysed the data from these satellites for his doctoral research. The data has revealed how fast land ice is melting on Greenland and West Antarctica, and how Scandinavia is still recovering from the last ice age. Gravity analysis is one of the few ways to find out what is happening deep beneath the surface of the earth. Among others, it has revealed two hidden continents, 2,900 kilometres deep.

delta.tudelft.nl: Gravity measurements offer a glimpse of inner earth

Simulated airline disaster

Twenty-five years after El Al flight 1862 crashed in the Amsterdam Bijlmermeer, researchers are still learning from this disaster. TU Delft researchers Dr Bob Mulder and Dr Qiping Chu of the Control and Operations department (AE) and their colleagues from the National Aerospace Laboratory (NLR) have developed software that simulates the disastrous flight of 1992, when two engines broke loose. For a long time, it was thought that the aircraft, damaged as it was, was doomed to crash. But the TU Delft researchers' simulations have revealed that it could theoretically have still landed if it had been equipped with a control system that constantly adjusted to the condition of the aircraft and compensated for the defects.

delta.tudelft.nl: Safely landing a crashed plane

Container batteries

It is not easy to make container ships cleaner and more sustainable. The engines are gigantic and there is no time to recharge batteries. But TU Delft students Peter Paul van Voorst tot Voorst and Daan Geldermans still think their start-up Skoon has a solution. Skoon plans to install exchangeable batteries the size of shipping containers in European ports so that hybrid ships can quickly load new power sources for their electric engines. But sailing hundreds of nautical miles on electric power is still a dream for the future, thinks Skoon.

delta.tudelft.nl: All batteries on deck

Wave forecasting

Dr Peter Naaijen has received the prize for Best Innovation in Offshore Energy for his doctoral research into wave height forecasting using a ship's radar. Thanks to start-up Next Ocean's wave radar, offshore work can now be continued in conditions in which it would normally be cancelled. The wave radar detects high waves approaching minutes in advance so that the work can be temporarily interrupted. The jury called the innovation a useful and logical tool. Next Ocean, a company started by Peter Naaijen and Karel Rozen, uses the existing radar equipment on a ship to forecast wave heights.

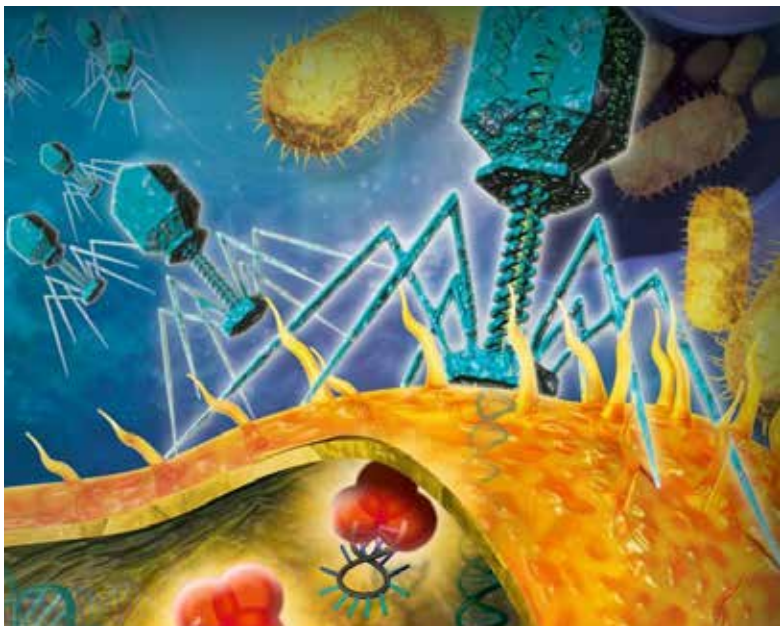
delta.tudelft.nl: The benefits of wave watching rewarded

Education award

TU Delft scientist and lecturer of software engineering Felienne Hermans has won a Surf Education Award for her innovative teaching. The award is given to people who use ICT innovations in education. Hermans teaches children programming through a combination of online and campus teaching. She is conducting research into programming education, supervises graduate and doctoral candidates and is involved in many projects that focus on coding for children.
Her MOOCs have attracted some 250 thousand participants, which means Hermans' work has influence beyond the bounds of TU Delft, said the Surf judges.

delta.tudelft.nl: Felienne Hermans wint Surf Onderwijsaward 2017

Photo: Sam Rentmeester



Phages therapy

More and more bacteria are becoming resistant to antibiotics. According to microbiologist Dr Stan Brouns of the Bionanoscience department (Applied Sciences), viruses can help us to fight bacteria. He has started a crowdfunding campaign to develop a therapy.
The viruses that Brouns has such high expectations of are bacteriophages, the natural enemies of bacteria. Bacteria evolve, which is the problem with using antibiotics. But phages evolve together with their prey. There are still no clinical studies on the effectiveness of phages, but there is increasing evidence that the therapy works, says Brouns. Bacteriophages may currently only be given to patients in extremely rare cases: if they are dying and antibiotics no longer help. This has to change, says Brouns.

delta.tudelft.nl: Delftse onderzoeker start onderzoek naar fagentherapie

THEME
Natural disasters

When a region is hit by a natural disaster, you need to provide help as quickly as possible. You might help disaster relief teams to safely navigate through the disaster area using adaptive GPS devices (page 16). You could send a swarm of robots to search for survivors in the devastated region (page 14). Or you could deploy tiny, dragonfly-sized autonomous drones that can avoid colliding with each other and injuring people (this photo and page 12). Of course, you will also want to learn from previous disasters to be able to offer more efficient help in the future. This is easy to do at TU Delft: organise a hackathon and ask students to search for data on the internet and social media that you can analyse (page 8).

PHOTO: SAM RENTMEESTER

PHOTO: AFP PHOTO: MARK RALSTON

Learning from Harvey

An interdisciplinary team of researchers and over 80 students from various programmes met on Campus to share and analyse information about Hurricane Harvey during the Hurricane Harvey Hackathon.

The aim of the hackathon was to improve the response to future hurricanes. Groups of students worked in two-hour blocks, with a new design in each block. For example: what information did people in the disaster area receive before and during the disaster, and how did the authorities communicate? Researcher Dr Baukje Kothuis of Civil Engineering and Geosciences (CEG) and students searched for this information on websites, social media and in news articles. "A good follow-up question is: which tips did people ignore or take to heart and why," says Kothuis.

"There is a wealth of data to be found. As scientists we can learn a lot from Harvey," says PhD candidate Kenny Meesters of TPM. But why is the focus on Harvey rather than the more recent storm Irma? "For researchers Harvey is very current," says Meesters.

During Harvey, Meesters worked as a volunteer for the US Coastguard with the Standby Task Force, a large group of volunteers who search on social media to find information about the disaster and people in need of help.

Information affects decisions

As a researcher, Meesters is interested in how aid organisations and the local population responded to Harvey: which decisions were made, by whom and when? With his promotor Prof. Bartel van de Walle, Professor of Policy Analysis (TPM) and spiritual father of the Hackathon, Meesters wants to find out how the information available affects decisions by aid organisations on the scene.

Civil engineering student Pieter Verhey identified the places offered as shelters and the available facilities. "What I found remarkable was

Which decisions were made, by whom and when?

that Airbnb put a crisis plan into action during Harvey, calling on room owners to make accommodation available free of charge. This drew a great response."

Under the supervision of researcher Tony Sebastian, the current flood damage was surveyed. Aerial images were used to pinpoint flooded buildings, and then linked to Google Streetview information - such as type of building and the number of storeys.

Imaging expert Dr Stef Lhermitte (CEG) worked with students to analyse satellite images of the affected areas. "It is hard to interpret satellite images in urban areas because tall buildings cast shadows," says Lhermitte. "You can't always see clearly which areas are under water."

Seventy-eight people lost their lives when Hurricane Harvey hit Texas on 25 August. It is estimated that 120,000 homes were damaged, 500,000 cars were submerged, and 300,000 people lost power. The area's petrochemical industry was also affected, with 24 oil storage reservoirs damaged. The total damage is estimated at 150 billion dollars, putting Harvey among the five most expensive natural disasters in United States history.

Little attention for flood risks

The fact that the hurricane was so disastrous in Houston is partly due to the city's design. The sprawling suburbs have replaced wetlands, which were able to absorb vast quantities of rainwater. The construction of canals, dams and storage reservoirs have not kept pace with the rapidly expanding city. With an area of over 1,500 square kilometres, Houston is almost ten times bigger than Amsterdam. The city's surface area has grown by 23 percent since 2001. The Delft researchers found that there has been little attention for flood risks during the construction process, especially in poorer areas.

The Hackathon results and researchers' recommendations were combined in the 'Hurricane Harvey Report, A fact-finding effort in the direct aftermath of Hurricane Harvey in the Greater Houston Region'. "We certainly intend to tackle other cases in this way," says Kothuis.

Delta Plan for Houston

The results were also presented to researchers from Texas A&M University and Rice University in Houston. TU Delft has had close ties to these universities for years. Two years ago, a TU Delft delegation travelled to Texas to present a type of Delta Plan, which would protect the population of Houston and the Gal-

Aerial photos were linked to Google Streetview to determine the extent of the damage

veston Bay area from flooding as a result of hurricanes. The plan includes a combination of flexible storm surge barriers, double dikes and multifunctional coastal defences. Galveston Bay is a rich, densely populated and vulnerable area. On average, a hurricane hits the area once every nine years, with Hurricane Ike causing major damage in 2008. When Harvey hit, it seemed logical to the TU Delft researchers to also study this natural disaster, caused by rainfall rather than high sea water levels. The Harvey team has been made possible by DIMI (Deltas, Infrastructures & Mobility Initiative) and the Delft Safety & Security Institute (DSyS).

PHOTO AND ILLUSTRATIONS: FINCH FLOATING HOMES

Floating homes in old fish ponds

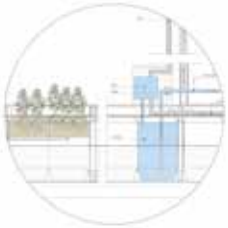
"Your home under water twice a day. Hard to imagine, but this is a daily occurrence in coastal areas of the Philippines," explains PhD candidate Pieter Ham. For his PhD he is studying whether floating homes could provide a solution in these areas. He and some colleagues also set up the Finch Floating Homes foundation with the aim of actually building such homes.

The floating homes could be situated as above.

The houses provide shelter to an average Filipino family of five and are built on a floating foundation.

Well ventilated

Typhoon resilient



Water system

Modular floating foundation

Comfortable interior

"In Macabebe, north of the capital Manilla, numerous rice fields were flooded with seawater," explains Ham by phone from the Philippines. "Those fields were used as fish ponds for a while. But that didn't last long as the fish escaped during floods. As a result, there is more than enough space in the municipality to build floating homes. I'm currently searching for the ideal spot for the first home. And I'm talking to local labourers who will build the homes."
The floating homes should form a solution to the housing shortage in the Philippines, because they can be built in areas where standard construction is impossible. Housing shortages in coastal areas mainly affect the lower and middle incomes.

The floating homes should form a solution to the housing shortage in the Philippines

The floating home was designed in cooperation with the local population and provides shelter to an average Filipino family of five. Built using local wood, the homes provide protection against typhoons. They can be built as a single home but also as a cluster of 4 connected floating houses, with one or two floors. The floating foundation consists of a wooden frame with barrels, which is easy to expand.
Ham and his colleagues recently completed a successful crowdfunding campaign to fund the homes.

finchfloatinghomes.com

PHOTO: SAM RENTMEESTER

Bees as an example for drones

In the event of natural disasters, you want an overview of the affected area in order to provide aid to victims. Drones can help. Guido de Croon is studying this with natural artificial intelligence.

Do you remember? The fire in the building of the faculty Architecture and the Built Environment in 2008? Nobody dared to send people inside to see if the chair collection was still intact. Guido de Croon suggested using drones. And so it happened: the dragonfly-like DelFly plane and a quadrotor – a drone with four propellers – whizzed along various storeys of the smouldering building.

They didn't go inside for two reasons. First, there was a lot of turbulence, from the wind blowing through broken windows. Second, the DelFly pilot needed images in order to guide it, but the video signals could be lost if the DelFly went too far inside the building. "At that time, it would have flown straight into a wall, creating another problem," says De Croon.

This prompted the development of a research programme to design drones that can fly and return by themselves. De Croon's idea is to send a group of small drones inside to explore a building together. In a group, because they can search faster together. Small drones, so that they can fly in collapsed, narrow spaces without injuring people.

It is important that the drones avoid objects and each other, know that they can fly through a window or door opening, recognise where they have been already, can find their way back, and record downloadable images. "The biggest challenge is to do smart things with little computing power and few sensors," says De Croon. "Because the heavier the drone, the less time it can fly."

NWO provided funding under the natural artificial intelligence programme. De Croon is working with biologists to learn how bees fly. "They keep track of how they're moving by observing how the world moves past them. We call this optical flow. We are trying to incorporate this type of intelligence into small robots. For landing drones we are looking at how bees land."

'The biggest challenge is to do smart things with little computing power and few sensors'

De Croon's lab is working on drones with a wing as well as multiple propellers, which can:

- fly into hard-to-reach areas and record images to enable rescue workers to make real-time decisions via a communication network
- deliver things like medicines and thus take off and land vertically without a pilot
- fly inside

According to De Croon, those drones will be very useful for searches and rescue work. The first DelFly, weighing 20 grams and able to maintain its height and avoid obstacles, was completed in 2013. Two years later, a pocket drone slightly smaller than a hand was able to estimate its own speed. A recent development is drones that can avoid collisions by measuring the distance to each other wirelessly.
These are all steps on the road to De Croon's swarm. Within a year and a half, he hopes to carry out a mini-mission in which drones are sent into the hall to explore rooms. He expects to have some solutions within five to ten years, in case of another fire. CVD

Lego houses

Unused office buildings, a row of vacant ground-floor shops: architect and structural engineer Pieter Stoutjesdijk transforms them into temporary housing.

Stoutjesdijk does this using a computer-controlled milling machine. It produces MDF components, which he and his company The New Makers click together like Lego bricks. Last year, this technology helped the TU Delft employee win the 'A Home Away from Home' competition of the Dutch Central Agency for the Reception of Asylum Seekers (COA) during Dutch Design Week in Eindhoven. He

'This makes every technical challenge in a disaster area even more complicated'

presented his design, the Comfort Cabin, as a solution for housing residence permit holders in vacant properties.
You can also use the computer to make construction packs for entire houses, such as houses for emergency accommodation. With that in mind, Stoutjesdijk started developing this construction method in 2013 for his graduation project. He designed a house that could be manufactured in series - but in various configurations - for Haiti, which was hit by a major earthquake in 2010.

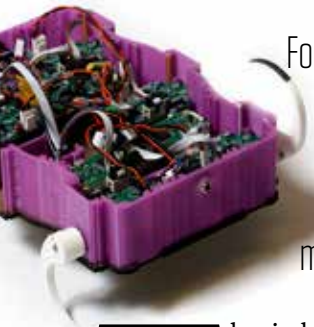
Not open to innovation

It seemed like a good idea. Nevertheless, it did not catch on with major international aid organisations. "Those organisations are not open to innovation," says the architect, somewhat disillusioned. "They receive money from sponsors, with which they have to achieve something tangible in the short term, to satisfy the financiers."
The temporary housing also proved more difficult to achieve technically than Stoutjesdijk had anticipated. "In a disaster area, everything's in ruins. This makes every technical challenge even more complicated. For example: the milling machine requires a constant electricity supply. In an area where nothing's working, you have to rely on generators. That makes milling difficult."
Stoutjesdijk now has a commercial company. "The idea is to further perfect the technology, earn money, and provide the technology in disaster areas in the form of charity when the time is ripe." TVD

comfortcabin.nl

PHOTO: MARCEL BILOW

Strength in numbers



Following an earthquake, hundreds of robots scour the devastated area in search of survivors. That is the Zebro Project's vision for the future. Industrial designer Mattijs Otten created a design that brings the mass production of the Zebro a step closer.

The six-legged robots, called Zebros, look like brightly coloured shoe boxes with six rotating legs on the outside, full of electronics and all kinds of sensors. The sensors enable the Zebros to detect everything from gas leaks to humans and mines. The round legs, developed some ten years ago by Boston Dynamics in the US, can walk across any terrain. Whether it's the woods, a mine field, a flooded area (replace the legs with oars) or the moon: you'll soon find the Zebros everywhere.
What makes the Zebros so special is that they operate in groups, known as swarm robotics. "This imitates how animals, such as starlings or ants, behave in groups," explains Mattijs Otten. He graduated this year with a design to produce the Zebro on a large scale, which is needed in order to make a swarm. "There are major advantages to small robots that work in a group. They can make multiple measurements, resulting in more reliable data. And if one breaks, it's not such a disaster as when a part of a large robot fails."

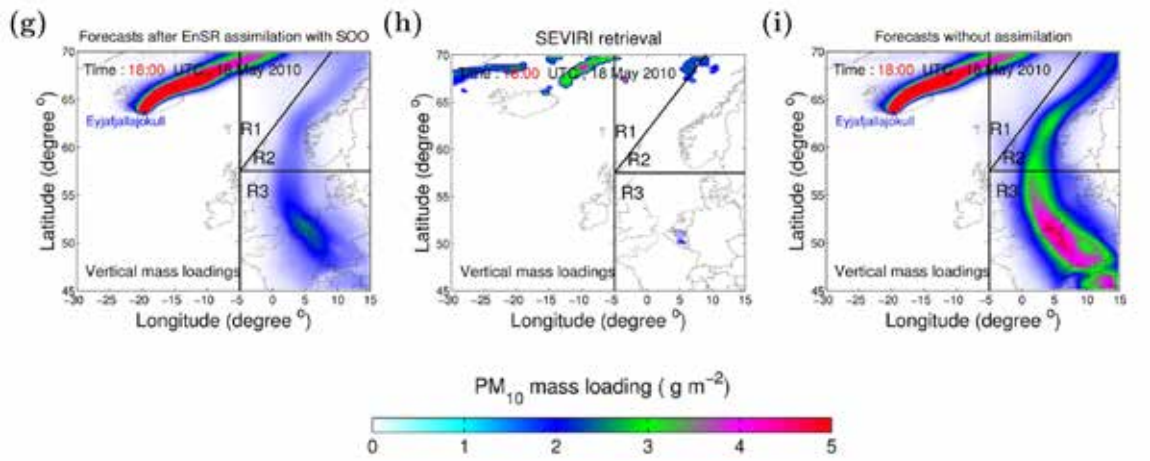
The Zebros all have their own colours and names, which is important for the interaction with humans

The project was launched in 2013. The staff involved come from various faculties and programmes. Mechanical engineering students figure out the best way for the robot to walk, University of Applied Sciences students develop the electronics, Embedded Systems students develop the swarm software, and Otten comes from Industrial Design Engineering. "In IDE we take a broad approach to a problem or situation, whereas Electrical Engineering focuses far more on the details. Electrical Engineering enables Zebro to function, but IDE's integral approach is important too. The Zebros all have their own colours and names, which is important for the interaction with humans. At Dutch Design Week, we saw that visitors viewed the robots as characters, empathising when they tripped and laughing when they acted clumsily. This empathy brings robots closer to people, which is necessary as the Zebros will eventually walk amongst people while completing their tasks." RVT

The eruption of Iceland's Eyjafjallajökull volcano in 2010 resulted in a loss of five billion euros due to delays, cancellations and rerouting. This economic disaster provided two Chinese mathematicians in Delft with a unique opportunity.

Volcanic ash is a hazard to jet engines. So when an Icelandic volcano erupted on 14 April 2010, spewing huge amounts of ash, air traffic in the European and North Atlantic airspace was rerouted for almost a month and a half. The maximum concentration of volcanic ash that aircraft can fly through is 4 mg/m3. But as not enough was known about the atmospheric distribution of ash, traffic was rerouted in a wider area of airspace around the ash cloud. Later, once the ash had settled, people started questioning whether predictions for the atmospheric transport of dust and ash could be improved. This could mean less rerouting of air traffic.
Iceland's question on ash cloud distribution found its way to Prof. Arnold Heemink's mathematical physics group in the Faculty of Electrical Engineering, Mathematics and Computer Science after Prof. Torgeir Palsson of Reykjavik University contacted him. "He knew we had worked on smog prediction with TNO and asked if we could do

Less rerouting around ash cloud thanks to TU Delft calculations



In the middle the satellite measurements of the volcanic ashes on 18 May 2010. Right the prediction of the spread without assimilation and on the left the improved prediction that shows a lot less inconvenience.

the same for volcanic ash," explains Heemink.
Coincidentally, we had just been joined by two Chinese PhD candidates with a government grant: the pragmatic Guangliang Fu and the more theoretically oriented Sha Lu. "They complemented each other well," says Heemink. "She provided the theoretical evidence while he was good at working with complex model systems and providing the data entry."

Step by step

The atmospheric distribution of ash clouds is a complex phenomenon. There are satellite images of the ash clouds, but they say nothing about the height. The researchers have a good 3D model for air currents (Lotos-Euros), but that requires well-defined initial conditions. Wind directions and wind speeds often vary at different heights, something used by hot-air balloonists. They release a squirt of shaving cream and watch how it moves as it falls. Wind profile data can be obtained.
"A satellite doesn't see the height of the ash cloud, but that information is hidden in successive images," Heemink explains. "If you know the wind profile, the height profile can be derived from the development of the cloud." This gives you the vertical distribution.

The distribution model uses 12 horizontal layers between 0 and 3.5 kilometres and sections of 25 by 50 kilometres (elongated in the north-south direction). The program calculates the next step in the distribution every fifteen minutes. Experience with weather reports has shown that calculations of air currents become less reliable with each successive step. Heemink and his team resolved this by including the latest meteorological data for each step in the model. Through ongoing correction, the prediction stays more in line with reality.

Further reading page 16

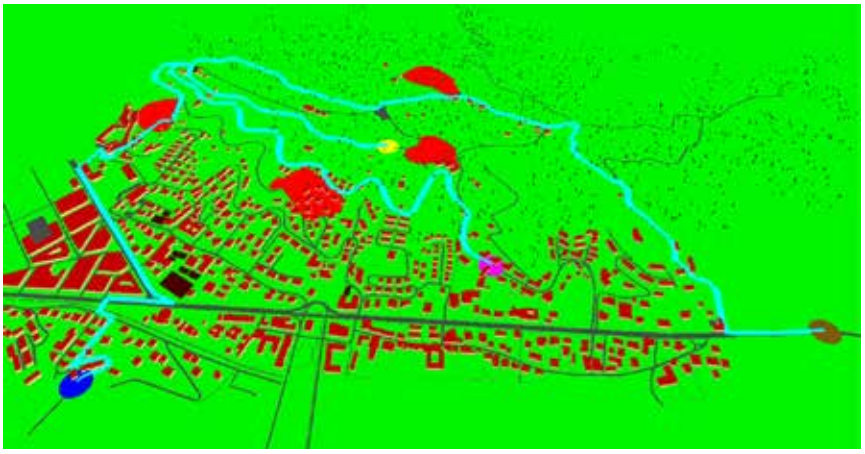
Continuation of page 15

The work resulted in a series of seven publications in renowned academic journals, and the insights were incorporated into the latest models of the European Centre for Medium-Range Weather Forecasts in Reading, England. Heemink is confident that the area of airspace in which flight paths are rerouted can be reduced during future eruptions. Thanks to better calculations of ash distribution in the air, the area of airspace in which flight paths are rerouted can be reduced during future eruptions.

Both Chinese PhD candidates completed their research successfully. Dr Guangliang Fu obtained his PhD in January, followed by Dr Sha Lu in March. At the reception following the ceremony, Fu went down on one knee and proposed to Lu. They married and both work as post-docs. Lu works in the Hydrology department of the Faculty of Civil Engineering and Geosciences. Fu works at the Netherlands Institute for Space Research (SRON) in Utrecht. JW

Navigation for **emergency responders**

Natural disasters 'shuffle the cards,' rendering navigation software, which doesn't know about impassable roads or advancing forest fires, unreliable. Researchers in the 3D GeoInformation group in the Faculty of Architecture and the Built Environment developed adaptive navigation for emergency responders.



The calculated roads in light blue from three departure points to the fire-fighting point in yellow. Red areas are forest fires. (Illustration: Zhiyong Wang, TU Delft)

Existing navigation software for emergency responders takes into account destroyed infrastructure such as flooded roads and landslides, sometimes based on social media reports, but not dynamic developments like the spread of forest fires or the dispersion of toxic clouds.

It is from that perspective that Dr Sisi Zlatanova and her former PhD candidate Zhiyong Wang developed a route planner in 2013 to show emergency responders the way in a changing environment.

The model uses both static and dynamic information. Static information concerns the type of responder (fire department, army or ambulance),the speed, and the road network. Dynamic information consists of measurements such as wind speed and wind direction, changes to the road network, forest fire spread and vehicle position. The forest fire takes on the form of moving obstacles. An expansion in the navigation software takes into account the predicted availability of roads.

The dynamic navigation programme was tested with the road network of San Sebastian, Spain, where three emergency vehicles go on the road to fight one of the four forest fires together.

The researchers were satisfied with the result, a safer route to the destination, but this led to a demand for dynamic navigation for other emergencies, such as floods or the release of toxic gas clouds. According to the researchers, the program can be easily adapted to various scenarios. Wang and Zlatanova wrote an article on this expanded version with Professor of Geoinformation Systems Peter van Oosterom entitled 'Path Planning for First Responders in the Presence of Moving Obstacles With Uncertain Boundaries', published last August in the journal IEEE Transactions on Intelligent Transportation Systems. JW

TU as a disaster area

People need help. Houses have been destroyed by an earthquake or gunfire. You are an emergency responder and have to get to where help is needed most ASAP. But how do you know where the hardest hit people are?

PHOTO: SAM RENTMESTER

'As a researcher you have to try to be a neutral observer'

The internet isn't functioning well. And how credible are the reports that do come in? "Providing emergency aid is extremely complex," says Dr Tina Comes of TPM. She heads the iTRACK research project, an EU project that aims to develop technology to make the work of emergency responders easier and safer.

From 16 to 20 April 2018, Comes will change the TU Delft campus into a 'disaster area'. Will we be hit by an earthquake or become a war zone? Comes isn't revealing the exact situation yet. "Emergency responders from NGOs will come here to test iTRACK systems together with students. We will simulate various situations in a virtual environment. An important element is collecting and sharing sensitive information. We will simulate situations in which you have to find your way past checkpoints and roadblocks. Participants will be assigned alternating roles: as emergency responders and coordinators."

Resilient and assertive

Besides TU Delft, Comes works for the Centre for Integrated Emergency Management of the University of Agder in Norway and the Disaster Resilience Lab, a joint initiative between Harvard University and Tilburg University.

Comes specialises in resilience, currently a popular term in the emergency response world. The key question is: how do you ensure that communities are resilient and assertive so that they can withstand a disaster, such as an earthquake or flood?

"I study how technology can help in this respect. I visit many disaster locations. I don't go there for emergency aid – to distribute food or water – but for research. That's not always easy," Comes recently told Delta.

"In places where natural disasters have taken place there is always a sense of hope for rebuilding, but that isn't the case in conflict situations. There's a sense of crisis in the air. As a researcher you have to try to be a neutral observer. That's virtually impossible; we're human after all. You should never do this work alone, and always be aware of your own limits." TvD

‘Don’t think up new rules for everything’

TEXT CONNIE VAN UFFELEN PHOTOS SAM RENTMEESTER

Executive Board member Anka Mulder is leaving Delft on 1 January 2018. We take a look back with her, and look to the future of education at the university. "We're moving towards evidence-based education."

As an Executive Board member, you were responsible for education and support services for the last 4 and a half years. Which role suited you best?
"I think most people know me from education. At the same time, my background is in support services: I worked in communication temporarily and was also Secretary General of the university, so I've seen many parts of TU Delft. I really enjoyed it all."

What was the most challenging dossier for you?
"There is a dossier which I hope my successor will be able to take further. Looking at education, I'm happy with many of the things achieved, but what keeps nagging away at me is teaching and the careers of our academic staff. How does teaching count towards becoming a professor or associate professor? I think a lot more attention is being paid to it, but the problem is that a career isn't determined by this university alone."

How do you envisage the future of education at TU Delft?
"I think we are doing well in terms of education. We have a healthy balance between teaching and research. A decade ago, it was all about money and research. Now there is far more attention to and appreciation of educational innovation. I also think we've been very successful in working on our international network with top-100 universities, a network that didn't exist a few years ago. We're seeing a lot more attention worldwide on providing good university education. We've also invested in this with a Teaching Lab. I think we'll move towards far more evidence-based education in the future."

What is evidence-based education?
"That you look at what does and doesn't work well in education on the basis of research. More use will be made of learning analytics, looking at how you can put together a curriculum and subjects better and personalise education. I think we'll go a long way with that."

The Vision on Education states that TU Delft wants to improve contacts with alumni. How will they be affected by this?
"I was pleased that the Student Council recently proposed offering our professional education - courses and programmes for people who are already employed - to alumni at discount. I think that's a good idea, so we're going to do that."

The number of students at TU Delft has increased from 13,000 to 22,000 over the decade. In the new Strategic Plan, the university aims for a maximum student population of 25,000. How will the Board control this growth?
"It's a scenario, but the underlying question is how many students we can handle within a certain amount of funding. Workload is not only related to how many students you have, but also the tremendous pressure on research funding and ambitions. In any event, we need to look at how we can manage the international intake as best we can. There are possibilities for this, but it's a technical matter. You have to distinguish between European students and students from outside the EU. We are primarily paid by Dutch citizens to educate the children of the Netherlands, or of Europe, as we no longer distinguish between them."

'We've been very successful in working on our international network with top-100 universities'

Speaking of workload: the Employee Monitor revealed that six out of 10 employees experience a heavier workload than they would like. What will the Board do about that?
"In any case, ensure that more people can be hired, also in support services. You have to make it open to discussion in teams, but talking is not enough: you need money for more people. We made that available a while ago, but the growth in academic staff is still too slow, in our opinion. In the period ahead, we are going to work with the faculties and Human Resources to see if we can speed up this process. That will make a real difference." >>

The same Monitor also showed that 28 percent of TU Delft employees have faced inappropriate personal treatment. This ranged from gossip(25%) and verbal aggression/ intimidation (11%) to bullying, psychological abuse and discrimination (8%). How will the Board deal with this?
"I find those figures far too high. They're higher than at other universities. I've asked all the University Services directors to formulate a plan. You have to look at what exactly is going on in a team or what a supervisor is doing wrong, and then provide training or have advisors help to discuss this. Sexually inappropriate behaviour is unacceptable. If I hear about it, I do something about it."

What have you heard about this kind of behaviour?
"Students come to me with stories about fellow students, for example. I don't think it's appropriate to mention the details. But measures are definitely taken."

Are there more reports because of #MeToo?
"No, but that might still happen. I've asked deans to keep their ears to the ground. It starts by your stating that it's not acceptable. And by making it a subject of discussion, so that people affected by it feel listened to."

What for you was a low point in recent years?
"Every time a student dies, that's terrible. I have children myself, but aside from that I think: terrible for his or her family and friends."

And what was a high point?
"I was at an education conference of edX [a non-profit platform of Harvard and MIT, ed.] and TU Delft was mentioned as best practice for educational innovation for each theme. Even the chief technology officer of the United States under Obama mentioned TU Delft. MIT recently commissioned a benchmark study on engineering education for which it invited three universities from around the world. We were one of them. Then I think: we've all done a great job together."

What will be the biggest challenge for your successor?
"I have a few tips:

- Continue to pay attention to the balance between research and education.
- Think big: TU Delft is a top-50 university.
- Sit in on the occasional lecture. I do that too, and it's really fun. It's important to talk to students and lecturers, and find out how the education process is really going.
- Don't be a manager who focuses on figures and rules; focus on motivation. Mentioning performance agreements and KPIs at every meeting won't inspire anyone.

What are KPIs?
"Exactly, that's what I mean: key performance indicators. Something else that doesn't work is thinking up new rules for everything: you must do this or that. It simply isn't necessary. Most people have an inherent desire to do something."
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CV

Anka Mulder studied history and taught international relations at the University of Groningen. She has also worked abroad. Since 2004, she has been the Director of Education and Student Affairs (E&SA) at TU Delft. She was also Secretary General of the University from July 2011 to April 2013. In addition, in 2008, she became a member and three years later president of the global OpenCourseWare Consortium. She became Vice-President Education & Operations of the Executive Board in April 2013. From 1 January 2018, she will be President of the Executive Board of Saxion University of Applied Sciences.

THE FIRM

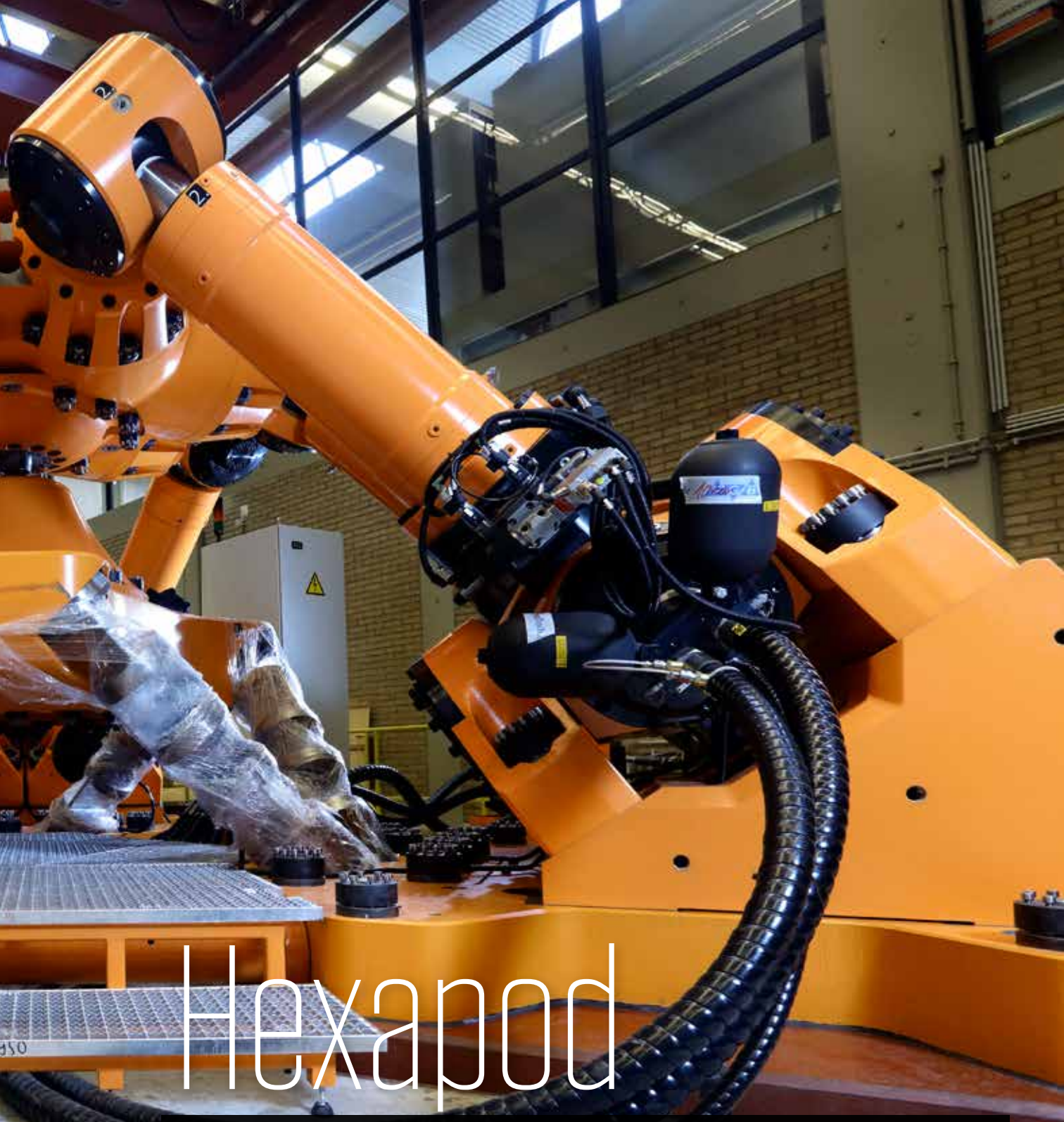
Say 'mobility scooter' and you think: dull, the elderly - anything but sexy. Then there's Scoozy, the first electric vehicle for people with disabilities that's smart, safe and trendy. Former Nuna champion Job van de Kieft is one of the brains behind the start-up.

It's jokingly referred to as the Tesla of the mobility scooters. Action sports magazine Mpora wondered what on earth were those guys were smoking when they designed it. Yet the Scoozy seems to be the only logical invention after 40 years of dead silence in the mobility scooter market. Industrial designer Job van de Kieft finds this remarkable considering that there were 38 fatal accidents among the 250,000 mobility scooter users last year, 75 percent of which did not involve anyone else. "So it's not only unsexy; it's also unsafe," says Van de Kieft. "In my opinion, the current mobility scooters include a bizarre design choice: we've grown up being used to 'squeezing' the brakes on bikes, but squeezing the handlebars of the mobility scooter accelerates it. This is the cause of 20 percent of all accidents involving mobility scooters."
High time to breathe new life into the vehicle, thought the designer and his three associates – all of whom were members of Nuna teams. "This is the only electric vehicle that has been around for 40 years. It can be driven and parked anywhere, from pavements to inside shops. That means the potential target group is huge. People with temporary disabilities, for example, such as a broken leg or pelvic instability during pregnancy. It can also be used on golf courses, in airports or for deliveries, and as a form of transport in car-free city centres."
Van de Kieft went on mobility scooter tours, spoke with users, insurance companies, municipal authorities and the ANWB, and found that many people with disabilities do not use the scooters, due to the stigma attached to them. Except for that one man in a high-end nursing home in Wassenaar, who had a truck battery built into his mobility scooter. "That's when I realised the market is ready for a trendy, modern version." 'Look at the market' is our greatest piece of advice. That will show you what product to make. The design team solved the problems of tipping over and operating errors, gave the scooter four independently suspended and steering wheels for stability, and a tight turning radius. What makes the Scoozy so smart is the on-board computer, which can be read remotely. Handy, because it enables you to predict when the battery needs to be replaced, for example. "It keeps you on the move." JB

PHOTO: SAM RENTMEESTER

Founder:	Job van de Kieft (36)
Company:	Scoozy
Founded in:	March 2016
Turnover:	none yet
In five years:	"We will have sold 10,000 Scoozy scooters and they'll be available worldwide. Scoozy should become the new standard for the mobility scooter and be available on new markets."
Employees:	Four, plus four interns

PHOTO: SAM RENTMEESTER



Hexapod

The Faculty of Civil Engineering and Geosciences is in the final stages of construction of a massive hexapod. The impressive test machine measures 6 x 6 x 3 metres and can move in any direction thanks to six hydraulic cylinders. “Shear, push or torque; it can generate any conceivable force,” explains Prof. Mirek Kaminski of Ship and Offshore Structures. Why this giant is being built? Floating structures are exposed to enormous forces caused by erratic weather conditions and waves. Kaminski can use this machine to study fatigue symptoms with wave, vibration and shaking tests. The hexapod has a maximum test frequency of 30 Hz, it can generate 100 tonnes of force and it is extremely precise; the position of the cylinders can be adjusted to 2 micrometres accuracy.

TEXT: DESIREE HOVING PHOTOS: SAM RENTMEESTER

MRI for Africa

MRI is one of the most powerful technologies for viewing the inside of the body. Unfortunately it is too expensive and complex for developing countries. That is why Martin van Gijzen, Rob Remis (TU Delft) and Andrew Webb (LUMC) are working on an affordable, simplified version.

A baby boy lies in the arms of his mother Nakira Manjeri. She is carrying him to the hospital in Mbale, a city in eastern Uganda. His head looks like a balloon that has been overinflated and is about to burst. His skull is almost three times the size of his thin body. He is on the way to a hospital which, thanks to donations from an American religious charity, has enough specialists to operate on five to seven children per day. A CNN report in April this year said the hospital's young patients suffer from spina bifida, brain tumours or – in this case - hydrocephalus.
Hydrocephalus is rare in the Netherlands, affecting approximately one in every 500 births. In Uganda, swelling of the skull usually occurs after birth and is often caused by a bacterial infection. It is estimated that hundreds of thousands of children in sub-Saharan Africa develop hydrocephalus every year, with 1,000 to 2,000 cases in Uganda alone. And the country, with a population of over 40 million, has just one MRI scanner, which is not in the hospital in Mbale.
"We do have a CT scanner, but the X-ray radiation is very dangerous for children. An MRI scanner doesn't have that disadvantage," paediatric neurosurgeon Steve Schiff of Penn State University writes by email. He travels from the US to the African hospital on a regular basis to operate on children. "The precise location of the fluid in children's heads can also be very complicated. This means we not only require safe equipment, but we also need help interpreting the images – as there is a lack of radiologists in developing countries."

LIMITED ACCESS

Magnetic Resonance Imaging (MRI) is one of the most powerful technologies ever developed for examining the inside of the body in detail without surgery. Unfortunately MRI scanners are incredibly expensive and difficult to operate and maintain. Therefore patients and doctors in many parts of the world have little or no access to this technology. "So it is high time for an affordable and simple MRI scanner," says Andrew Webb, Professor of MRI Physics at Leiden University Medical Centre, who worked with Schiff in his previous job.
When Webb moved to the Netherlands in 2008 to head the C.J. Gorter Center, where some 40 people conduct research on MRI, he soon met two people at TU Delft, with whom he continues to work regularly: Associate Professor of Electrical Engineering Rob Remis and Associate Professor of Applied Mathematics Martin van Gijzen. The three of them started by putting two Master's students to work. "They tried making images using a toy magnet measuring about eight centimetres, but were unsuccessful," Van Gijzen recalls.
That would have been a minor miracle. The magnet is currently the most expensive part of an MRI scanner. More precisely, it contains electromagnets, which consist of electric coils of superconductive wire through which electricity passes. The generation of a magnetic field with a strength of 1.5 to 3 tesla produces a tremendous amount of heat. For this reason, cooling is required. This is done using liquid helium, and requires a lot of energy.

> Instead of an electromagnet, he wants to use an ordinary magnet that does not require electricity

Further reading page 26

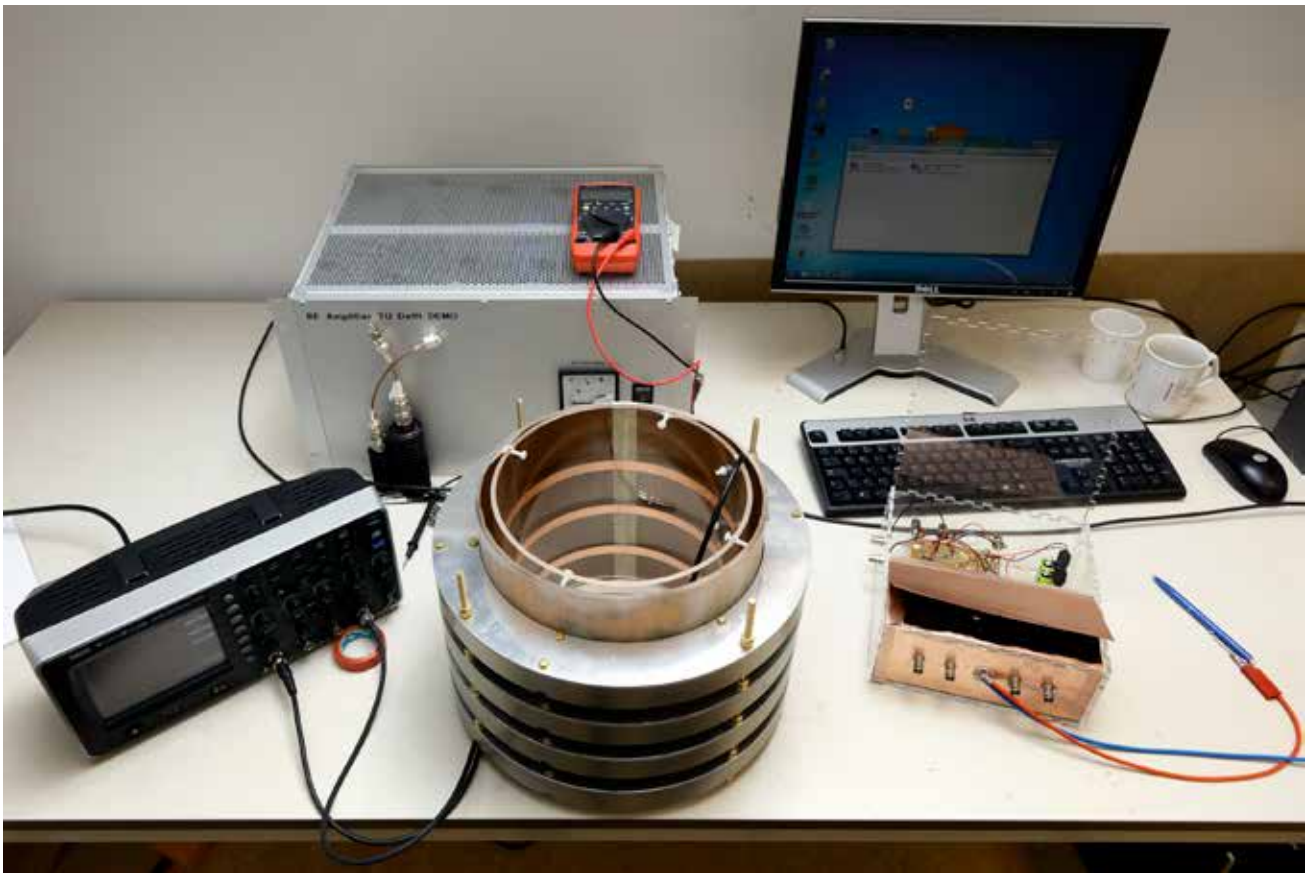
Professor Andrew Webb: "It's high time for an affordable and simple MRI scanner."

Continuation of page 25

Furthermore, highly trained staff are needed in order to operate such a high-tech device. And if something breaks, a specialised technician must be found to repair it. All in all, a conventional MRI scanner easily costs around two million euros excluding maintenance costs. In short, the MRI scanners we are familiar with consume too much energy, and are too complex and expensive for developing countries.

The next step. "The question is: will we be able to use low-cost hardware and excellent software to make an MRI scanner that is good enough to analyse hydrocephalus?" Webb asks. Instead of an electromagnet, he wants to use an ordinary magnet that does not require electricity. This means no heat will be generated either. According to Webb, the strength of the magnet has to be about 100 millitesla. This should produce MRI images with precisely enough detail to allow a diagnosis to be made. The location of the fluid in the brain should, in any event, be clear.

The strength of the magnet is one of the main obstacles. The reason for this is that, in a magnetic field, you become a type of magnet yourself. The hydrogen atoms in your body align along the magnetic field lines and become mini magnets. An amplifier then emits pul-



Andrew Webb, Professor of MRI Physics at Leiden University Medical Centre: "The question is: will we be able to use low-cost hardware and excellent software to make an MRI scanner that is good enough to analyse hydrocephalus?"

Associate Professor of Applied Mathematics Martin van Gijzen: "It is rather unique for me to make a product that can improve children's lives."

ses that disturb the balance of the mini magnets. If the pulse stops, the magnets start spinning, as a result of which they emit radio waves. The precise spinning motion depends on the tissue in the body. In other words, different tissues emit different radio waves. All the radio waves are monitored by a receiver and finally converted into images. So, the stronger the magnetic field, the more the hydrogen atoms are magnetised, the faster they spin, the higher the frequency of the radio waves, and the more detailed the picture.

Although the first proof of principle with the toy magnet did not produce an image, the three researchers from Leiden and Delft did learn a lot from it. They submitted a subsidy application to the NWO Open Mind programme, a special fund for developing ideas for socially engaged research. Last year, they received fifty thousand euros to further develop their idea. "This gave us a great opportunity to develop something serious," says Van Gijzen.

SIGNAL GENERATOR

Last week, he brought a signal generator and a 26 cm diameter magnet from Delft to Leiden in the boot of his car. "The biggest challenge was making a ring that is light and sturdy enough for 96 magnets each measuring three centimetres. We ended up making an aluminium holder and drilled holes into it. We then inserted the magnets into the holes very carefully, each at a different angle. You don't want to get your fingers caught in between, because the magnets exert great forces on your hand!" All in all, the compound magnet has a strength of 60 millitesla, i.e. 0.06 tesla. Webb and his team in Leiden are currently working on making

'The real work will be converting poor-quality signals into good images'

the receiver. After that, Van Gijzen can set to work on the last step: creating the images.

"So far, we've worked on developing methods to make images, but we haven't been able to test them on real signals yet," says Van Gijzen. "At the time our first prototype hardware will be ready, my work really starts, converting poor-quality signals into good images. That'll be a huge mathematical challenge."

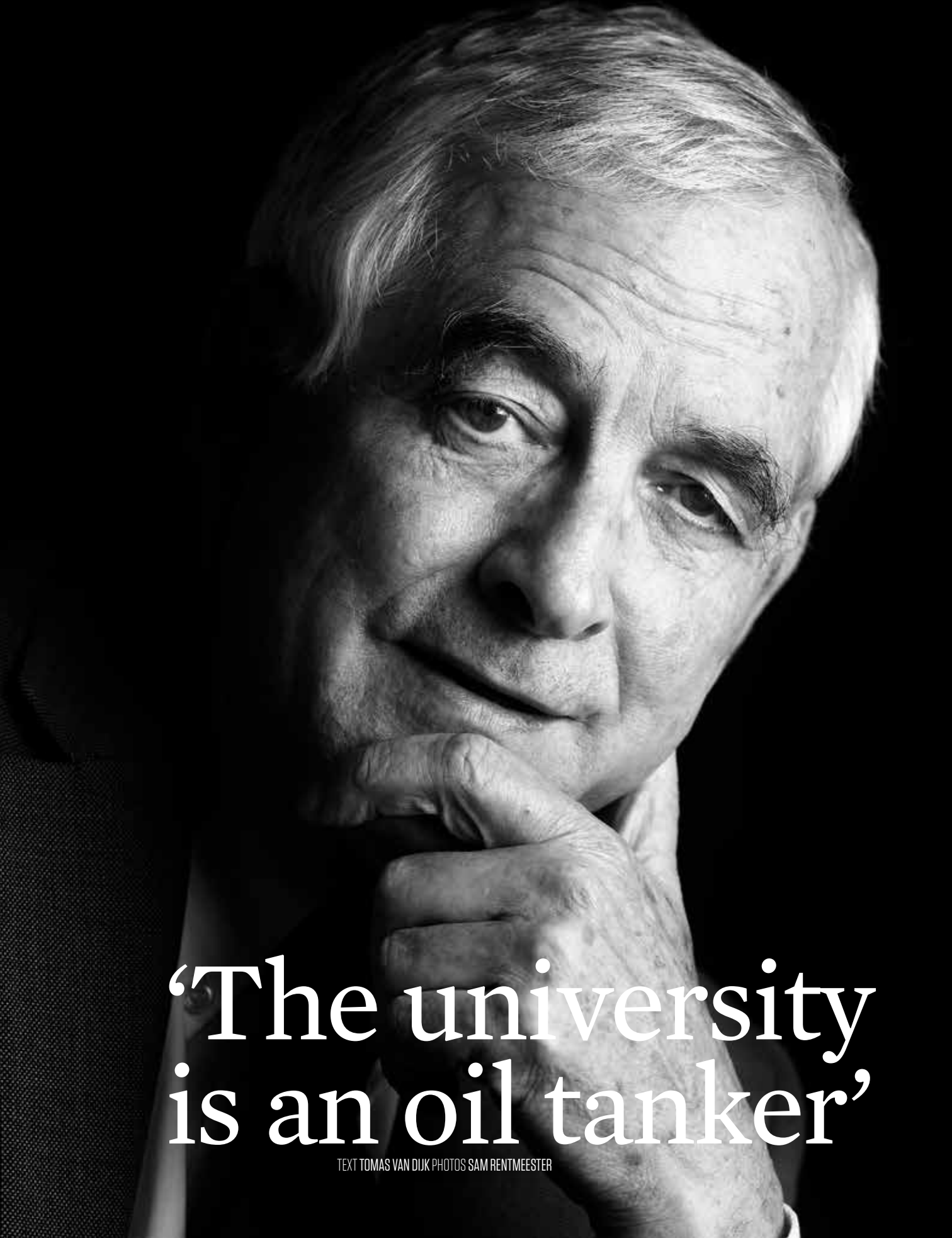
MRI scanners in the Netherlands have powerful magnets coupled with normal computers to process the data, but the three scientists want to try it the other way round: a weak magnet coupled with powerful calculations. After all, computing capacity is becoming cheaper and cheaper. "The problem is, though, that a weaker magnetic field also provides a weaker signal and more interference," says Webb. "So we really needs Martin's mathematics in order to produce useful data."

A HUGE CHALLENGE

Asked how he feels about doing a low-tech project for a change, Van Gijzen replied that the mathematics for this project is actually very high-tech. "It is also rather unique for me to make a product that can improve children's lives. I'm a mathematician and normally create algorithms, mathematical models or software, but this goes beyond that," says Van Gijzen. Webb also finds the project a huge challenge. He spends most of his time working on the development of a 7-tesla MRI scanner, which can provide super-high resolution images of the body. "A commercial MRI system is like a car, in which everything is now automated. Twenty years ago, you could repair it yourself. That's what we want now with low-budget MRI: we want to make a modular system in which everything can be easily replaced. So we have to develop everything ourselves."

In September, Andrew Webb won the 2017 NWO Simon Stevin Master Prize. It included a cash award of 500,000 euros. Professor Webb wants to use some of that money on a more affordable device. "My group receives grants worth 10 million euros, all of which are intended to develop advanced technology for wealthy people. That's fine, but of no use to 80 percent of the world's population. But the mathematical techniques we'll develop for our simple scanner can also be used in more powerful devices. It will be possible to scan people much quicker in the future."

The three researchers will continue their work at least for the next four years, thanks to support from Delft Global and the NWO. The next big step is to take the low-cost MRI scanner to Africa and, together with Schiff, to use it to treat hydrocephalus in children such as Nakira's son. <<



‘The university is an oil tanker’

TEXT TOMAS VAN DIJK PHOTOS SAM RENTMEESTER

Rector Karel Luyben is also leaving TU Delft on 1 January. If the government does not provide more funding, TU Delft risks changing into a university of applied sciences, he says. "Efficiency can't be increased indefinitely."

Do you think it's time to hand over to the next person?
"Yes and no. I have enjoyed this job, and could stay in it another four years. But when you spent too long somewhere, you risk behaving like someone who thinks he knows everything and doesn't listen to others. I want to take the knowledge and experience I've gained and apply it elsewhere."

In what state will you leave TU Delft?
"If you believe the rankings, we're in a good position. We've moved up on almost every list over the last 10 years. Of course, this doesn't mean everything. What I find most positive at TU Delft is the culture, which is improving. There is more transparency and less distrust than 10 years ago."

What do you mean with distrust?
"People do not trust one another by definition. If they did, you could turn the university into one big department in which everyone worked together perfectly. If research funding was left over from a project, it would go to the university as a whole instead of automatically to the leader of the study concerned. Unfortunately, that's not how it works. Most researchers keep that money for their own projects. That's stupid, because if we all put it in one 'pot', we'd be in a stronger position and have reserves for hard times. That requires mutual trust."

And there isn't enough of that trust?
"It's moving in the right direction. TU Delft used to be more hierarchical. Government funding went to the departments and then to the research groups and further. Now the money goes to the departments. Researchers decides what it's spent on together. That culture of trust helps define the quality of the university. I believe such a flat structure makes it easier for researchers to compete with the world's best. The university has almost 40 departments, about 10 of which are among the best in the world. I won't say which ones, or I'll get in trouble. Why aren't there 20?"

Why aren't there 20?
"It should be possible to have 20. Look at universities like MIT or ETH Zurich, where virtually every unit is among the world's best. I believe having a flat structure helps. We should also focus more on bringing in talent early on. The further people are in their careers, settled with their families and have arranged their finances for research on the other side of the world, the more difficult it is to draw them here."

How does the Executive Board promote this?
"We don't promote research in the short term, except sporadically when we decide to increase funding for certain studies, as we recently did for blockchain and Urban Water Infrastructure. The university is an oil tanker that only slowly changes its course. My job is to change the culture, and that means talking. Every four weeks, I hold a faculty meeting. I invite associate, assistant and full professors at random and debate all sorts of issues which these faculty members put on the agenda."

'That culture of trust helps define the quality of the university'

You will have discussed the heavy workload during those meetings.
"Workload is a catch-22 situation. Twelve years ago, we had 12,000 students. Today we have 23,000. The number of PhDs has also almost doubled in that time, but with the same amount of staff and government funding. Efficiency can't be increased indefinitely. We have to advise researchers not to write research proposals every now and then. And we can expand the numerus fixus. If we don't do that, we will eventually turn into a hogeschool, a university of applied sciences."

Why?
"Twelve years ago, we were able to put around 75 percent of government funding into research and the rest into education. When I took up the position of rector in 2010, the balance was still reaso- >>

nably good. Now, more than half of that money goes to education, while we continue to do the same amount of research. People are working 60-hour weeks. If there is another shift like that in government funding, we will be like a university of applied sciences, because we won't have enough money left for research."

The introduction of numerus fixus doesn't make you popular with students.

"'Karel doesn't want people to go to university,' is what I hear when it comes to numerus fixus. But the opposite is true. But if the Netherlands and Europe are not prepared to invest more money in education, we'll have a problem. When we first introduced numerus fixus in Aerospace Engineering, that programme was so popular that it could have accounted for half of the teaching at TU Delft. Is that what you want? No. We need to keep breadth. So people have to study something else.

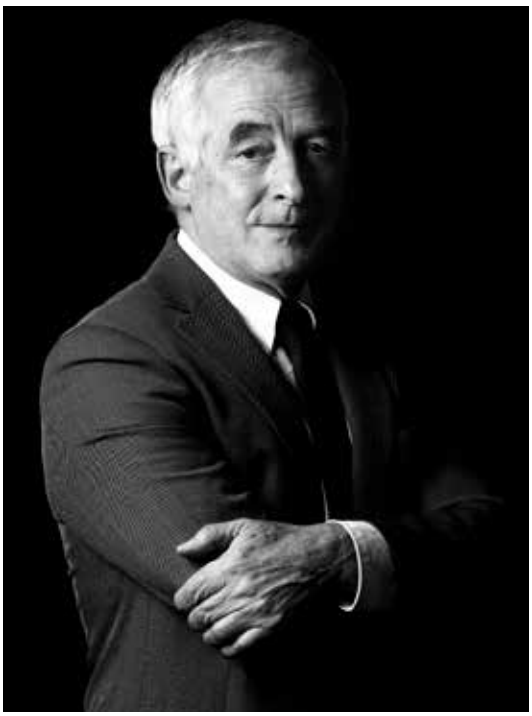
'We can't admit the whole world. I think we should set up a European education system'

We're not going to impose on people what they should study. We simply set limits. The demand for certain expertise in society is more important than the short-term interests of pupils.

I spent years visiting student houses and talking to students as part of the 'Meet the rector' sessions. Most come here for TU Delft and not just for a specific programme. Almost all of them have programme B or C as an alternative, and 30 percent have switched programmes. In short, a little directional guidance makes no difference."

It could mean that pupils without high marks soon won't be able to study at TU Delft.

"True. We can't admit the whole world. There are other universities in the Netherlands, and also universities of applied sciences. And what about other countries? The Netherlands is small. We have to think on a global, or at least a European level. I think we should set up a European education system. It isn't possible to get all the universities in Europe to the same level. Accept that and let the 'excellent' universities admit the 'excellent' people. That isn't elitist; that's differentiating. After my retirement, I'm going to work for a stronger European education system."



What else are you going to do after your retirement?

"For the time being, I will maintain a 0.3 FTE post at TU Delft for my activities with CESAER, a European association of 51 universities of science and technology. I will also continue to be involved in the Open Science Policy Platform, a thinktank that advises the European Commission on open science: open access publications, data management and integrity issues."

Looking ahead, what will TU Delft be dealing with in 2030?

"I'll try to look even further ahead. Human life expectancy is increasing rapidly. Eternal life is on the horizon."

That sounds like science fiction.

"We should assume that life expectancy will continue to increase. And we should assume that a lot of technology will be needed to keep people happy. If robots do all the work fifty years from now, people are likely to be bored to death. That is something we all need to consider." <<

CV

Karel Luyben (1951) became Professor of Bioprocess Technology at TU Delft in 1983. From April 1998 until his appointment as Rector Magnificus in 2010, he was dean of the Faculty of Applied Sciences. Since January 2014, he has been President of the Conference of European Schools for Advanced Engineering Education and Research (CESAER). In 2016, he became a member of the European advisory group Open Science Policy Platform (OSPP), which advises on the further development and implementation of open science policy to improve the quality and impact of European science. He is also vice-chairman of the Economic Board Zuid-Holland.

HORA EST

Mortality is the most precious gift to human beings.
Emre Mülazimoğlu, physics engineer

Housing is a right, not a commodity.
Donya Ahmadi, architect

In the near future, presidential candidates in the USA will disclose their full genome sequences.
Robert Mans, micro biologist

The only reparation for the damages caused by colonial rule is compulsory exchange programs between the two countries.
Sangeetha Hari, physics engineer

Scientific theories persist owing to their applicability, not to their ability to describe the universe consistently.
Önder Gül, physics engineer

The fact that tall people, on average, earn higher salaries is nature's way to offset their increased cost of living.
Jan Comans, aerospace engineer

Human beings will never evolve into robots.
Yan Ren, physics engineer

COLUMN

Masochism

I was not prepared for such bad tidings, I really was not. In 1983 I started a technical programme at TH Delft, the pre-eminent technical training college. I was going to be sent to the front in the war for progress, facts and nuance. Who wouldn't want that? In fact, many young people didn't. I was told there were too few technical students – and especially girls. Those that did choose a technical programme opted for the 'soft' courses, or so I heard. Technology had a poor image. It wasn't sexy. Technology was in trouble, they said.

The most surprising thing about this bad news was the people who brought it; they were the representatives of the industry itself. The very people who wanted to call positive attention to the trade left no opportunity wasted to emphasise the poor image they thought it had.

For reasons that are unclear to me, they had conceived the idea that, if they painted a sorry picture of the technology sector as a whole, this would somehow make it more attractive. That's the impression I got anyway. It's like trying to sell cars by arguing that no one wants one because they are so ugly.

I wrote the above in 2015 in my column in De Ingenieur, the KIVI club magazine. In De Telegraaf newspaper, the director had said that engineers were undervalued and that their trade was not sexy. This was also my last column in that magazine; interest groups are generally not very happy with criticism.

I had to think of this when I recently read that TU Delft has enrolled an unexpectedly large number of first-year students; more than the national average. The same applied in Eindhoven. I looked up the figures for TU Delft over the last five years.

The total number of students has increased by 24%, the intake by almost 40%, and female intake by 75%. 'Hard science' programmes like EEMCS (+ 52%) and Applied Sciences (57%) are also growing fast. In fact, the Civil Engineering department even faced a worst-case scenario this year: they enrolled the maximum number of students the faculty can accept. Only one dropped off.

So, even though technology has been framed as a problem for years and years, more and more young people are still choosing technical study programmes. Maybe because the financial sector has lost its interest, or because they want work, or because they like technology, or maybe simply because it's the right time. Who knows?

And so now there are 'too many' students. Or too few classrooms. Or too few lecturers. Or there is too little money. Whichever way you look at it, technology is in trouble again. Once again, there is plenty of reason to warn young people away from technology. You could be excused for thinking this is just what the sector wants.

Remco de Boer is a technology & science communication specialist.

TEXT: LEONARD VAN DEN BERG PHOTOS: JASPER VAN STAVEREN, TEAM BRUNEL/VOLVO OCEAN RACE

THE PLASTIC RACE

At this very moment, the best sailors in the world are fighting against heavy storms and huge waves in the Volvo Ocean Race. Seven carbon racing yachts are participating, including two flying the Dutch flag. One of these, Team Brunel, is participating in research on ocean pollution. TU Delft alumni Michiel Muller and Ronald Bolijn are helping them.

It is early November, and Michiel Muller has just arrived in Lisbon. In the harbour on the river Taag, the teams of the Volvo Ocean Race are preparing for the voyage to Cape Town, the first leg of their race around the world. Muller and Bolijn are visiting Team Brunel to discuss plans, opportunities and progress. They are representing their company, Abel Sensors, which develops and manufactures smart wireless sensors that can communicate directly through their own cloud platform using LoRa and NB-IoT technology. This means the sensors are suitable for Smart Everything: smart cities, industries, buildings, mobility and living environments.
Muller and Bolijn recently became involved in the rough and ready world of salty seas, immense waves and toiling

'Our sensor will measure concentrations of contaminating particles all over the world'

24/7 under the toughest conditions thanks to one of their investors. "The investment fund Embrace Tech Startups has close ties with Brunel," explains Muller on the pier in Lisbon. "That's what brought us together. Ronald is an experienced sailor and has since joined the crew on several voyages." The two alumni stepped into this project with a clear objective and a mission to promote sustainability. "We are investigating the potential of an on-board sensor that can measure the quantity of contaminating particles, such as plastic, in seawater," explains Muller. "We are also trying to find a method to measure the tiniest plastic particles. These are invisible to the naked eye and can easily enter the food chain. These measurements can provide us with insight into the total amount of pollution in the world's seas."

'INTERNAL' SOLUTION

These carbon yachts are pure speed machines. Anything that can negatively affect performance must be removed. This means that the sensors must be light and they certainly may not disrupt the streamlining of the perfectly smooth hull. So, Muller and Bolijn are testing an 'internal' solution. "We are currently considering a small pipe that branches off of one of the engine pipes. This pipe sucks in seawater for cooling and discharges it again. We plan to install our sensor in such a pipe for the next edition of the Volvo Ocean Race. It will be fitted inside the hull so that it doesn't affect the streamlining. The sensor contains a wireless controller we developed ourselves that logs the sensor data and GPS location every 5 minutes. The controller is in sleep mode most of the time and only uses a few milliwatts of power. >>

ONE DESIGN VO65: CARBON RACING YACHT

Ever since the Volvo Ocean Race of 2014-15, all sailing teams have been required to use completely identical yachts. The Volvo Ocean 65 was especially designed for this race. The VO65 is participating for the second time in the 2017–18 edition of the race. Seven teams are participating in total. The race started on 14 October in Alicante. After eleven stages and eight months, the race around the world will end in Scheveningen, the Netherlands, in June 2018.

Hull length	20,37 metres
Length overall	22,14 metres
Mast height	30,30 metres
Bowsprit	2,14 metres
Mainsail	163 m²
Masthead Code 0	305 m²
Jib	133 m²
Max. running sail area	578 m²
Net weight	12.500 kg
Draught	4,78 metres
Max. speed	approx. 35 knots (65 km/h)

When the yacht approaches a coast, it will send all the logged data to the shore. This will provide a complete data set of the quantities and locations of contaminants along the route of the race."
The sensor itself is still under development. This is being done entirely in-house by the company's own personnel using their own components. This means they are not yet exactly sure how it will work. "We do know that the system will use a built-in battery that lasts one year and so will easily last the entire race. It will be installed in the pipe in a compact waterproof and shockproof housing. The

'The sensor may not bring performance advantages or disadvantages'

device will include embedded software that has been programmed by our team. Whenever the ship approaches land, it will send us the data using our own cloud platform. We will store this information on one of our servers. We will analyse the data using a dashboard that displays a map of the world."
Muller makes it clear that developing a properly functioning, secure and reliable sensor will be a real challenge. "The most difficult part is to achieve the required high level of sensor measurement quality and reliability. This is why we are first taking samples in all the seas and oceans the team will pass during the race around the world. We will use the samples for our first tests and they will function as reference data for future tests."

TURN THE TIDE ON PLASTIC

This research is important, but of course it is also important that it does not affect the race. The Volvo Ocean Race is a one design race, which means that all teams race with technically identical yachts that also weigh almost exactly the same. Any changes to the vessel are subject to strict rules and stringent inspections, and this also applies to added sensors. "Modifications are not allowed to bring performance advantages or disadvantages. For the next edition of the race, we will examine whether additional measures are required to be able to fit the sensor without altering the weight of the yacht." They may even have to fit the entire fleet with one of the 'TU Delft' sensors.
And what do the sailors think of it? "The sailors of Team Brunel and the other teams are very committed to the environment and the health of the oceans,' says Muller. They have seen with their own eyes how polluted the seas are and how important our work is. It is for good reason that one of the mottos of this race is Turn the tide on plastic. They are happy to help by gathering data to provide us with more knowledge about pollution in the oceans." <<

CV
Michiel Muller (34) studied Transport, Infrastructures and Logistics with the Department of Civil Engineering and Geosciences. He focused on traffic models and the influence of policy decisions on infrastructure projects. His final project in 2009 involved calibrating traffic models for the road network of Zuid-Holland.

CV
Ronald Bolijn (31) graduated from the Faculty of Electrical Engineering, Mathematics and Computer Science in 2013 with a Master's in Transport Engineering. His final project involved studying how to increase the productivity of KLM's baggage handling processes at Schiphol Airport.

After Delft

Car manufacturer Renault brought in industrial designer Laurens van den Acker eight years ago to 'revive' the brand and 'give consumers goose bumps' again. Now 12 TU Delft students are designing Renault's car of the future.

Van den Acker refers to 'his' cars as 'beauty with brains'; irresistible looks-wise but also intelligent and efficient. He talks about each model as if it were the love of his life. The designer feels that cars are emotion, which his 500-strong design team creates.

"I think that, as a child, I became fascinated with the unique combination of speed, the sound of the engine and the beauty and colours of the bodywork. It was a complete sensory experience. The car is probably the most complex product there is, bringing together all forms of design, from sculpture to graphic design. It's one of the few products with human characteristics. A car has a face, shoulders, a nose and a behind. And it has character; it can be male or female, boring, aggressive or elegant."

His first car was a hand-me down: his mother's Nissan Micra, which he used to commute between Ghent and Delft (for his graduation project with Volvo Trucks). "The first car I bought with my own money was a 1973 Volvo 1800 ES. I lived in California; most of these rare Volvos had been exported there. I loved the 'shooting brakes': beautiful, exotic elongated lines yet practical."

Nevertheless, his love of cars was not the primary reason why Van den Acker chose to study in Delft over 30 years ago. "My choice of Delft was very practical really. I was good at science subjects and drawing, and Delft enabled me to combine those two interests at the highest level."

PHOTO: RENAULT

To such an extent that Van den Acker is now considered one of the most influential Dutch people in the automotive industry – although he has spent more time living abroad than in the Netherlands. "Honestly: my biggest dream was to become a car designer at a major company. This dream came true at the age of 27, when I was hired by Audi in Ingolstadt. I view everything since then as a bonus."

The fact that he moved to Ford in the United States, for example, where his responsibilities included the design of the Ford Escape. He left Ford in 2005 to become head of Strategic Design for Mazda, in Japan. And before joining Audi, immediately after graduating from TU Delft, he already had a career in Italy, where he helped design the interior of the Bugatti EB110 SS.

His link to TU Delft remains special, he says. He currently has six pairs of TU Delft students helping to design the car of 2030, for the third edition of the Renault Design Award. They are supervised by Elmer van Grondelle, programme manager for Automotive Design at TU Delft.

He thinks it sometimes helps that he has a Dutch background. "Dutch people are appreciated for our communication, directness and openness, pragmatic thinking and language skills. We have strong opinions, but we're also willing to listen to others. TU Delft engineers have a broad education, which helps us to understand views from other departments. But ultimately what matters is whether you get good results." JB

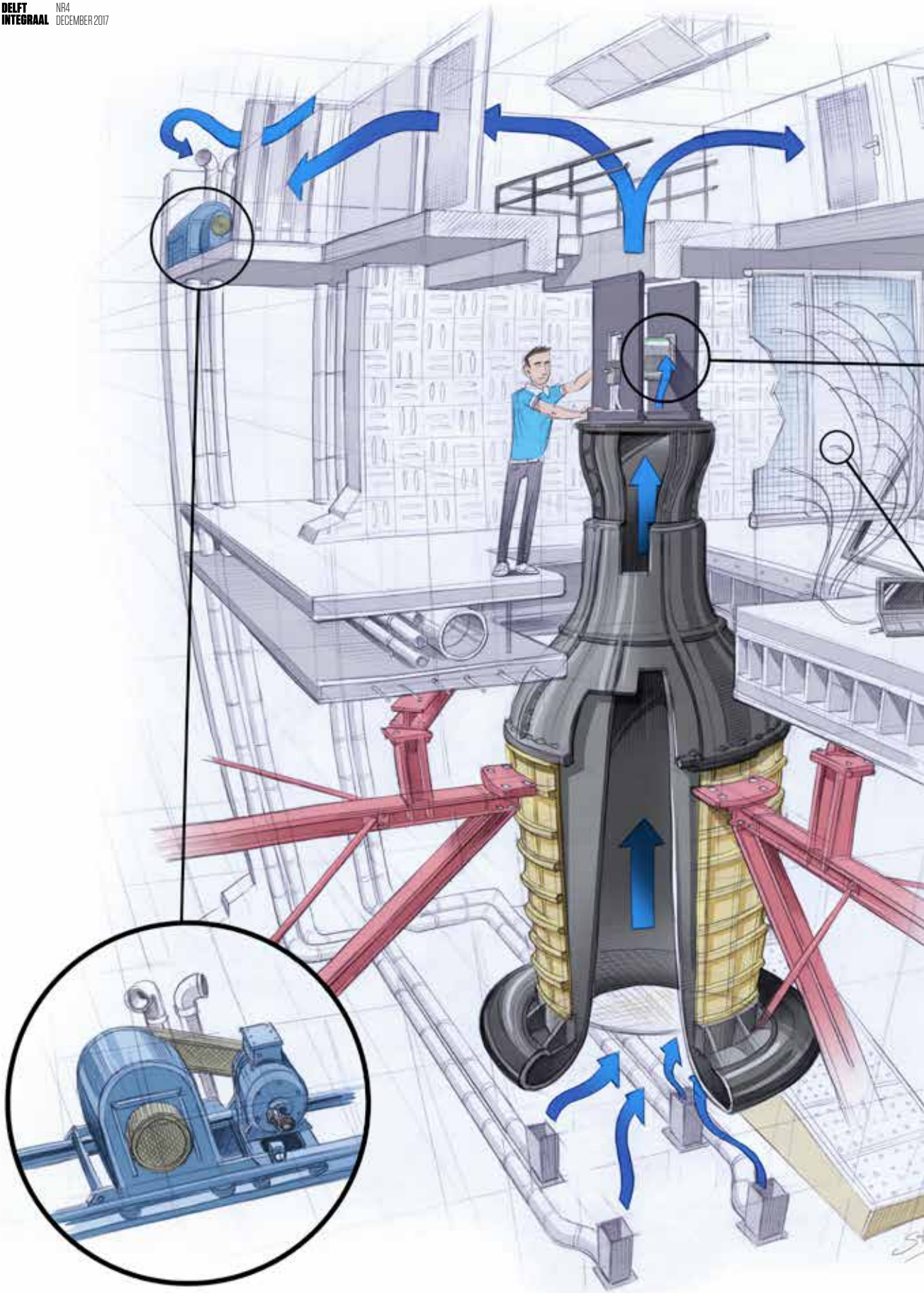


ILLUSTRATION: STEPHAN TIMMERS

Vertical wind tunnel

The **vertical wind tunnel** at the Faculty of Aerospace Engineering on Leeghwaterstraat is three floors high. Its official name is the 'Vertical low turbulence wind tunnel' and it is used to carry out acoustic experiments. All the walls, floor and ceilings are lined with pyramid acoustic foam panels to absorb sound waves, just like in an anechoic chamber.

The tunnel is used to make sound visible. Aero-acoustics is a new research field, and the Aero-acoustic research group has been awarded two European grants worth millions of euros. "We carry out measurements on propeller blades and aircraft wings", explains Dr Mirjam Snellen (Aircraft noise and climate effects, Faculty of AE). "It is important that aircraft, and also wind turbines, become increasingly quieter in order to minimise noise nuisance."
She points to PhD candidate Alejandro Rubio Carpio who is currently testing a metal foam that can reduce the noise of wind turbine blades. His set-up comprises a seven-armed spiral that leads to 64 microphones on a metal grid. These analyse the sound of the airflow passing over a section of wind turbine blade. The provisional results show that the metal foam leads to significant noise reduction.
Meanwhile, Dr Daniele Ragni (Aerodynamics, wind energy & propulsion, Faculty of AE) shows how it all works. Under the supervision of Dr Marios Kotsonis, he worked with Kotsonis and Master's student Mirko Sitter to completely rebuild the old V tunnel.
Fans are used to draw air into the enormous intake (2.3 metres diameter) in the basement. The funnel shape accelerates the air flow into the tunnel leading to the measurement chamber, where the wind reaches a maximum speed of 45m/s and where objects measuring up to 60x60 cm can be studied. The air continues to rise and can be pumped round in a closed circuit or vented through a roof hatch.
Ragni, Kotsnonis and Sitter have succeeded in doubling the level of turbulence in the new wind tunnel compared to the old tunnel, with more than a ten-fold increase in flow uniformity.

Want to read more? 'New lab makes sound visible', Delft Outlook 2017-1 and 'Metal foam helps to reduce wind turbine noise', Delft Outlook 2017-2.

ALUMNI NEWS

Alumni Activities

22 december
Sinterklaas drinks reception in Istanbul

12 January
Christiaan Huygens New Year's reception for alumni

24 January
Start of 'Design your next Career Move' Prof Ed course

24 January
Start of 'Design your next career move' online course

10 March 2018
Geodesy department's 'Snellius' alumni event

Contact:
Questions, comments or changes of address? Alumni TU Delft:
e-mail: alumni@tudelft.nl
website: alumni.tudelft.nl

TU Delft | SINCE 1842 FOR LIFE

TU Delft for Life online community

Tudelftforlife.nl is the worldwide meeting place for all TU Delft alumni. The community already has nearly 3000 alumni members. If you want to find students who studied in the same year and programme as you, you can do so easily by using the right filters. You can even see which alumni live in your region on a map of the world!
Do you want to know about upcoming events? Or do you want to find out more about our lifelong learning opportunities? You can read all about these on TUDelftforLife.nl too. Create an account today and join TUDelftforLife.nl.

It is easy to join:
1. Select 'Sign Up'
2. Preferably use 'Registration via LinkedIn'
3. Follow the steps and answer the questions
4. The system will verify that you are an alumnus
5. After you have created your own profile page you will be a member of TUDelftforLife.nl!

Start Online course 'Design your next career move' specially for Engineers

Ready for your next step in your career? Join our new online course and use our career-thinking model to explore, design and open up opportunities. The first course starts at 24 January 2018.
Our five-step, career-thinking model is specifically aimed at engineers. Whether you are in the early stages of your career or an experienced professional, following a systems approach will give you a unique advantage when planning and designing your next career move.This course has been developed by TU Delft's career consultants and educational engineering researchers. The course includes self-assessments, hands-on activities and quizzes to check your learning, as well as team discussions and online webinars where you can learn from and give support to other participants. 24/7 easy, online access to the discussion forums and course materials, makes it possible for you to accommodate this course into your personal schedule.
online-learning.tudelft.nl/courses/design-your-next-career-move

From Delft University Fund

Best graduate: Jet Gispen

Jet Gispen was TU Delft's 'best graduate' this year. She graduated from Industrial Design Engineering on the theme of ethics in the design process. "It should be logical for designers to justify their design choices," she thinks. All eight faculties nominated a candidate who recently graduated with honours and who pushed their boundaries in the final phase of the programme. The prize is awarded by the Delft University Fund.

Jet Gispen devised a theoretical framework in which she linked virtue ethics structurally into the design process. "Designers have a huge impact on how people live," she explains. "We are increasingly confronted with the negative effects that products and services can have. Problems like smartphone addiction and the brazen collection of personal data by companies have made this painfully clear. This is why I think that designers need to be more aware and critical of the effect of their work during the design process, when the design is still under development."
The other nominees are: **Linda van der Spaa** (3mE) has obtained a dual degree in Systems & Control and Biomechanical Engineering. She proved new piece of theory: the first realistic simulation of a robot arm without an external energy source. **Leon Helsloot** (EEMCS) researched how a user's privacy can be better secured with the current practices of online personalised advertising. **Samantha Tanzer** (TPM) designed new options for biofuels, which are highly relevant for the biofuels field, both in academia and industry. **Rob Richelle** (CEG) investigated the mechanisms to disconnect a rail system in subsystems to make it robust against disturbances and developed a methodology to evaluate the robustness of complex stations. **Alessandro Arcangeli** (ABE) examined the relation between war and architecture, taking Sarajevo as a case study. **Michelle van der Helm** (AS) worked through the entire path from the isolation and purification of an enzyme to the immobilization of this biological catalyst on an inorganic carrier material and to testing a continuous synthesis. **Tim van Leeuwen** (AE) developed an algorithm that can detect and separate, with an unprecedented accuracy, in the time and frequency domain, all types of motion.
Read more about the candidates at **universiteitsfondsdelft.nl** and the interview with winner Jet Gispen at **delta.tudelft.nl**

Photo: Tomas Koopman

The lab of...

Workshop Industrial Design Engineering

Hidde Pierhagen (fourth-year student of Industrial Design) is working with Sander Dominicus, Antoine Stöhr and Yoshi Verspaget on a collapsible mini-ramp for DROP, the student board sports club. His fellow student Ben Kromhout created the model of the design. The ramp's frame is almost finished. They want to be able to store the ramp in a shipping container at the sports centre and take it to events on a trailer. They are not building the ramp to earn credits; it is their own project for which they have been granted access to the workshop. The IDE faculty encourages its students get their hands dirty!

PHOTO: SAM REINTMEESTER