

**DELFT** NO.3 OCT 2021 YEAR 38  
**OUTLOOK** TU Delft

**Professor of Excellence**  
**Max Mulder**

What's the secret  
behind his success?

**TU TAKES CLIMATE ACTION**

Joining forces against  
climate change

**Lieven**  
**VanderSyden**

Spinoza winner  
has striking  
plans

**THEME**  
**Inspired  
by nature**



## Cover:

In Campus South, sheep ensure that the vegetation on wasteland is kept short. Warden Piet Doorn (45 years at the TU) moves the electric fencing every now and then, so that the flock can graze a new area. There they eat the hogweed first, which apparently is the tastiest. (Photographer Sam Rentmeester)

## Foreword

*Tim van der Hagen*

# Inspired by nature

Aircraft wings that take inspiration from birds and surgical instruments based on insects or octopuses. Not only does nature provide plenty of inspiration for innovation, it also features increasingly as part of the design itself. We are developing new materials using living organisms and creating coastal protection that spreads itself along the coast under the influence of currents and waves. By the same token, anyone who uses a Living Cocoon for their burial will no longer pollute the earth after death, but actually become a source of new life. All of this is part-and-parcel of an essential and urgent development: instead of plundering it, we need to live much more in symbiosis with nature.

It is essential and urgent, because, for nature, time is rapidly running out. Because of climate change, we face extreme forms of heat, drought and floods causing a shift in human and animal habitats and diminishing biodiversity. It is high time that society took concerted action and, as TU Delft, we are taking the lead with our Climate Action programme. Whether it concerns climate change or the crisis in the building industry, state-of-the-art research and

education remain the cornerstones of any solution. This is why we are so delighted to see Lieven Vandersypen awarded this year's Spinoza Prize, the Netherlands' most prestigious scientific award. It is also the fourth consecutive year that the award has been presented to a TU Delft scientist. Within the university, the Professor of Excellence award is the pinnacle of prizes. I recently had the pleasure of awarding it to professor of Control & Operations, Max Mulder, someone capable of providing unparalleled motivation and inspiration to students and colleagues, even in the time of coronavirus.

As Rector Magnificus, the time for prizes and distinctions may now be behind me, but even if it may win me no prizes, having the honour of leading the university is perhaps the most privileged role within the organisation. Of course, the Executive Board is ably assisted and advised by the Supervisory Board. This year saw two alumni join it: Heleen Wachters and Tijo Collot d'Escury. They introduce themselves in this issue.

*Prof. Tim van der Hagen,  
President Executive Board TU Delft*

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Inspired  
by nature



PHOTO: SAM RENTMEESTER



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## Professor of Excellence

Max Mulder, professor of human-machine systems in Aerospace Engineering has been made Professor of Excellence, for his outstanding achievements in teaching and research.



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## Climate action

TU Delft is launching a major climate programme with an important role for governance, focused on behaviour and policy.



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## Project Juul

Architecture student Nima Morkoç bought an empty church, which soon went up in flames. Four years on, he is creating four starter homes from the ruins.



# DELFT IN BRIEF

The QR codes refer to the longer articles.  
More science news on [tudelft.nl](https://tudelft.nl)  
and [delta.tudelft.nl](https://delta.tudelft.nl).



## Cancer DNA – pathway to therapy

Cancer researchers and bioinformatics scientists are working on techniques to enable 'personalised medicine'. They published positive news on this subject in August's *Nature Medicine*. It is hoped that whole genome sequencing will enable doctors to pinpoint exactly which cancer drugs are most effective

for that patient. Researchers from the Netherlands Cancer Institute (NKI) and TU Delft (Pattern Recognition and Bioinformatics group, EEMCS) demonstrated that this technique is even more effective at detecting potential targets for medicines than was previously thought.



## Climate impact on your plate

Anyone wanting to reduce their carbon footprint should look at what they eat. The food industry worldwide accounts for more than a quarter of all CO<sub>2</sub> emissions. By being more aware of what we eat and drink, we can help the climate. But how do you know which sandwich filling is better: chicken or cheese? Master's student of Artificial Intelligence Technology Jurrian de Boer (Electrical Engineering, Mathematics and Computer Science) came up with Carbonera, an app that calculates the climate impact of your recipes. The free app is available to download for Android and iOS.





## Stamp-sized innovations

The sand motor, charging tile and energy kites are just three of the ten Delft innovations issued as postage stamps by PostNL this summer. Cartoonist Erwin Suvaal did the drawings and TU Delft provided brief explanations in the margin. Additional background information is featured on a special website (use the QR code). The stamps are available for €9.60 at postnl.nl.



## Delft Olympians

Four Olympians from TU Delft returned from Japan with their badges of honour: two silver, two bronze. For some, disappointment and pride jostled for the upper hand. Of the five rowing medals that the Netherlands won at the Tokyo Olympics, three were won with input from TU Delft students. 49er FX sailors Annette Duetz (Applied Physics) and Annemiek Bekkering secured bronze, having started the medal race as leaders in their class. But their initial disappointment soon transformed to pride.



## Student associations still popular



Student associations may have had their most boring year ever because of coronavirus, but their popularity has not waned – quite the opposite. Like last year, most TU Delft student associations have actually been oversubscribed. The ‘general’ student associations have seen applicant numbers level off after peaking dramatically last year – up by 60% compared to the year before. Student sports associations have proved particularly popular this academic year.



## Summer flooding



Industrial Design Engineering student Emma Dijkstra received alarming news this summer. Her family in Maastricht had to leave their house. A rise in the river of between 0.8 and 5 metres was expected and surrounding houses were evacuated as a precaution. “It was an extreme event,” says Professor of Atmospheric Sciences Pier Siebesma. Is this an omen of climate change? He would like to work with KNMI to analyse weather data from the past 40 years to see if it reveals any changes in the jet stream. The jet stream, which carries high and low pressure areas, is driven by the temperature difference between the pole and the equator.

More at:



## OWee returns at last



After a virtual OWee in 2020, this year saw the Delft reception week return in physical form, albeit with social distancing and pre-testing. The programme was also spread across a week to keep group numbers down. First-year students visited associations, attended the information market and saw inspirational projects at the science park.



## A yeast that does not breathe

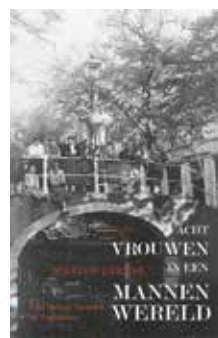
Yeast that grows without oxygen? TU Delft biotechnologists Sanne Wiersma and Jonna Bouwknegt (Applied Sciences) have dusted off a type of yeast that can perform this remarkable feat. They have high expectations for *Schizosaccharomyces japonicus*, which could revolutionise alcohol production. Aerobic micro-organisms produce CO<sub>2</sub> as a by-product when they burn sugar. They also generate a lot of heat, pushing up the costs of cooling. Micro-organisms that do not need to breathe could prove invaluable, explains Wiersma.



## Climate measures in aviation

In *Nature Communications*, aviation expert Joris Melkert (Aerospace Engineering) joined international colleagues in criticising the Corsia (Carbon Offsetting and Reduction Scheme for International Aviation), agreed in 2016. In it, the aviation sector outlines plans to prevent further increases in CO<sub>2</sub> emissions after 2020. According to the researchers, the plans go nowhere near far enough in terms of limiting warming to 2°C by 2100. “This problem can be solved, but we need to move hard and fast”, said Melkert.

## Book: women of Delft



Civil engineering alumna Marian Geense has written a book (only available in Dutch) about eight female contemporaries who embarked on engineering studies in Delft in 1956, often against their families' advice. In *Acht vrouwen in een mannenwereld* (Eight women in a man's world), Geense (herself one of the

eight) describes how they handled study, family and working in a man's world. The book provides a personal account of these women's development, against the backdrop of a shifting zeitgeist in the second half of the twentieth century.

**Marian Geense**, *Acht vrouwen in een mannenwereld*, 420 pages, €27.95 ISBN: 9789464247732



# THEME *Inspired by nature*

As humankind there is much we can learn from nature. The millions of years of evolution and adaptation to circumstances form an endless source of inspiration for technological solutions. Scientists at TU Delft understand that.

For example, various researchers are using organisms to develop new materials, and PhD candidate Tigran Mkhoyan is studying birds to create a flexible aircraft wing. The swarming drones from the MAV lab also have unmistakably animal-like characteristics. Led by Professor Paul Breedveld, the Bio-Inspired Technology Group works to develop medical instruments. The steerable laparoscopic instrument shown in the photo was modelled on an octopus. Breedveld stresses that "inspiration is not imitation, but a way of thinking".



# ‘I take inspiration from countless insects’

On their own, they often don't amount to much. But when combined in swarms, drones can solve complex problems. Just like a group of ants searching around their environment looking for food.

**T**he drones from the Micro Air Vehicle (MAV) Lab have distinct animal-like features. Take the fluttering Delfly drone, which has long been the lab's pride and joy, for example. Many liken it to a dragonfly, because of its two sets of wings and fluttering flight. Prof. Guido de Croon heads up the MAV Lab, where researchers from Aerospace Engineering (AE) and Electrical Engineering, Mathematics and Computer Science (EEMCS) are working on robots and artificial intelligence. He resists the suggestion that the creatures from his lab are like robot versions of insects. “A dragonfly can do so much more, such as controlling each of its four wings separately. But that doesn't mean that the dragonfly didn't inspire the Delfly design. But I take inspiration from countless insects.”

Several years ago, the researchers made an extremely manoeuvrable Delfly with just two wings, DelFly Nimble, modelled on a fruit fly. They managed to reveal a secret behind the puzzling manoeuvrability of fruit flies, publishing about it in *Science*. Just like these insects, the Nimble can simultaneously rotate along both the longitudinal and transversal axes. It



Guido de Croon: “We deliberately opted to keep the drones as small and light as possible, enabling them to manoeuvre in small spaces.”

turned out to be a crucial trick in fruit flies' flight acrobatics.

## LOCATING GAS SOURCES

In his latest project, a swarm of drones that seek out gas leaks, he and his colleagues took inspiration from ants. Together with researchers from the University of Barcelona and Harvard University, the MAV Lab team developed a swarm of small – and therefore very safe – drones that can independently detect and locate sources of gas indoors.

In this, the artificial intelligence was the most important challenge, because the tiny drones had only limited computer power and memory. This problem was solved by means of navigation and search





strategies taken from nature. While not capable of acrobatic flight, ants have certain characteristics that drone researchers can use as inspiration for enabling drones to fly in swarms and explore an environment as a group.

Ants may not be the smartest creatures, but they can quickly find the shortest route to food. They spread out in random directions until individuals locate food. They then secrete a pheromone as they return to the nest. Ants taking the shortest route leave fresher pheromone trails than ants that take a detour. Indeed, the pheromones

## 'Individually our drones are fairly limited'

fade and the ants follow the strongest ones. Ultimately, the collective ends up taking the shortest route.

"Our drones work in a broadly similar way", says De Croon. "They don't have much computing power so individually they are fairly limited. For their navigation, we gave them a simple but efficient insect algorithm, called 'Sniffy Bug'."

The drones spread out across the area as much as possible, avoiding obstacles and each other. If one detects gas, it communicates it to the rest. From then on, the drones work together to locate the source of gas.

Each drone weighs 37.5 g and has a radio transmitter, a camera and 192 kB of working memory. "That's very little in the way of memory", says De Croon. "In this business,



drones are usually equipped with a more powerful computer with ten thousand times as many bytes. We deliberately opted to keep the drones as small and light as possible, enabling them to manoeuvre in small spaces and preventing serious injury if you collide with one." This basically involves building an intelligent system using separate tiny computing units. "The main challenge is to develop the artificial intelligence that uses all these small separate units in order to solve complex issues."

They do this with little information: the drones do not know their own position in the room. "Larger drones use laser scanners to chart the area. That takes a lot of computing power, far more than our drones have."

## SPATIAL AWARENESS

But they need to have spatial awareness. This is why the researchers looked to ants for inspiration. "Ants keep an eye on how quickly the environment passes them by. Our drones do the same. They have cameras pointed at the floor keeping track of their movements relative to it. They're a bit like step counters. They share that information with the other drones.

This technique is called odometry. When a drone detects gas, it sends that information (gas concentrations) to the others and a wireless chip tells them where they are relative to each other."

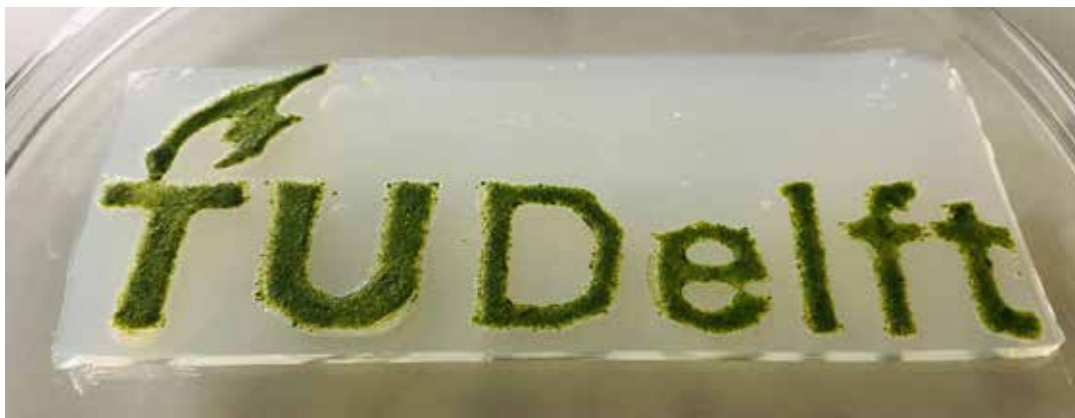
Further work will be required before this technology actually can be used in emergencies. This includes three-dimensional movement for localising gas sources at variable height. The navigation also needs to be more reliable. "This type of artificial intelligence shows great promise", says De Croon. He envisages several applications. "You could release swarm drones in greenhouses and let them search for diseases. When attacked by pathogens or pests, plants secrete certain chemicals. Drones could detect these, nipping the diseases in the bud."

He also sees a role for drone swarms in research missions on the moon. TU Delft is developing six-legged robots weighing 1.5 kg, the Lunar Zebros. The plan is for a swarm of these to be sent to the moon in a few years' time.



# A scarf made from algae

Scientists are increasingly using organisms to make new materials and discovering the advantages of living materials.



(PHOTO: MARIE-EVE AUBIN-TAM EN ELVIN KARANA)

Applied Sciences and IDE researchers succeeded in 3D printing a living material.

**A**t the end of April, TU Delft researchers were successful in printing a living photosynthetic material in 3D. It was the result of collaboration between the research group run by associate professor Marie-Eve Aubin-Tam from the Bionanoscience department (Applied Sciences) and Prof. Elvin Karana from the department of Sustainable Design Engineering (IDE).

They printed living micro-algae on 'paper' made from non-living bacterial cellulose and created a responsive material that absorbs CO<sub>2</sub> and produces oxygen.

Responsive materials are able to adapt and communicate information about their environment. An example involves piezoelectric crystals that produce electrical voltage when placed under pressure or materials that change colour as a result of

humidity or temperature.

Karana is seeing increasing demand for responsive materials in the design world. "The materials are already produced chemically, but that consumes energy and causes toxic waste. Working with living organisms that perceive and respond to external signals is an alternative. A torch can be made using bioluminescent algae. When you shake the algae, they produce enough light to find your way

## Hard-soft

"When there's a tumour in the bone, we replace the bone with a large, hard and porous implant", explains assistant professor Mohammad Mirzaali from the biomechanical engineering department (3mE). "It's all about ensuring that an implant is strong enough to replace the bone, but also soft to prevent damage to the skin." Creating the transition from hard to soft material is difficult. Mirzaali is seeking inspiration from hard-soft transitions in human joints.

Mirzaali is working on various biomimetic approaches and uses 3D printing techniques for metal and polymers. "Combining the two

techniques is a challenge, because metal and polymers need different printing conditions." Mirzaali is designing a hierarchical and geometric structure to enable the connection between metal and polymers. Nature itself is more complex than the hard-soft transitions that Mirzaali is developing. The resolution of current 3D printers does not yet enable an exact replication of nature. Even if it is successful on a small scale, it will be extremely time-consuming and difficult to upscale it. Mirzaali: "At times, you have to sacrifice some of the complexity to achieve a workable product."



in the dark. Rather than electricity, they need food.”

Aubin-Tam uses bacteria and micro-algae to produce materials. The first material her research group replicated successfully was mother of pearl.


Aubin-Tam: “Mother of pearl is 95% brittle calcium carbonate. But it’s incredibly strong because it’s made up of layers of calcium carbonate alternating with biopolymers.”

‘People may have some prejudices about wearing living material as clothes’

Masonry can be produced by alternating bacteria that secrete layers of calcium carbonate with bacteria that secrete a polymer.

A similar principle is used to make living photosynthetic material with the 3D printer. Karana: “Combining living bacteria and bacterial cellulose in a unique way enables us to create a robust material.”

Students used the material to print a living scarf. Karana: “Although our living material is not yet as flexible as textile, we’re working to improve these properties.” Karana also envisages the material being used for curtains or cushions. “People may have some prejudices about wearing living material as clothes”, thinks Karana. “Our research group is also researching the social dimension of living materials.”


Aubin-Tam also wants to explore how the material responds to light. Aubin-Tam: “The living cells use flagella (whip-like appendages that propel single-cell organisms, ed.) to swim. By shining light at the cells, we can repel or attract them. If we prove successful in influencing the position of the algae in the material, we can create a material that’s both responsive and dynamic.” 

# Sponge wall saves energy



PHOTO: SAM BENTMEESTER

**T**he closed structures in the middle of the photo are inspired by cellular structures, such as in sponges and bones. The air-filled hollows form an insulating layer between inside and outside. The fluid channels on either side of the insulation are more like veins or blood vessels through which fluid flows with minimal resistance. Pumping the fluid transfers heat from the interior to the outside to cool down at night, or it brings solar heat from the façade to the inside on a chilly day. The sponge wall thus saves energy for heating and cooling, as simulations have shown. The experimental façade

panel was made by a 3D printer filled with PET-like material (PET is known from water bottles). It was the result of the 4TU Lighthouse project SPONG3D (2016 - 2017) to test daring new ideas. Besides the 3D printing company KIWI-Solutions, eight researchers and students from TU/e and as many from the TU Delft Faculty of Architecture were involved. Dr Michela Turrin was one of them. “It is an experimental idea not yet ready for application,” she says. “Yet, it has provided valuable insights.” Later, several students graduated on optimising the sponge wall, such as the best use of materials and which shapes have the best performance. 



The North Sea cormorants and terns just love the Sand Motor, an artificial peninsula near Kijkduin made from 21.5 million cubic metres of sand. The hikers and kite surfers feel the same. It's now a decade since the first grains of sand were deposited there. This pilot, run by Rijkswaterstaat and the Province of Zuid-Holland, with partners including TU Delft, Deltares and Wageningen University, aimed to find out if wind and current would spread the sand along the coast and towards the dunes, ultimately reinforcing the coast and creating a dynamic nature reserve and recreation area. The results are promising: on the southern section of the Sand Motor, dunes up to three metres in height have formed on the beach.

TU alumnus Bas Huisman, now a coastal expert at Deltares, is monitoring developments around the Sand Motor.

“This shows us how sand spreads along the coast, how new vegetation and dunes grow, where life develops on the seabed and how we can combine recreation with nature.”


This knowledge has been used in developing the Hondsbossche Dunes. A small Sand Motor (five million cubic metres of sand) has also been created in the Amelande Zeegat and the idea has been applied internationally. A small Sand Motor was created in Bacton in the UK in 2018. 

PHOTO: SAM RENTMEESTER

# Sand Motor ten years on



# Learning from an octopus


Paul Breedveld (3mE) has always been equally interested in nature, anatomy and technology. How does it work? Why does it work like that? Can it be improved?

**P**rof. Paul Breedveld's office looks a bit like a bizarre museum. Where else would you find a sawn-open gear differential between an anatomical model of a head and a mechanical calculator? An octopus, snake and a parasitoid wasp have all served as models for the inventions produced by the Minimal Invasive Surgery and Bio-inspired Technology group (Faculty of 3mE). The wasp's ovipositor was used as a model to develop the world's thinnest self-propelled needle (less than half a millimetre thick). And the octopus' arm resulted in a tip that moves in all directions for keyhole surgery. Inspiration is not imitation, says Breedveld. Experimental zoologist Johan van Leeuwen (Wageningen University & Research) showed him the anatomy of octopus arms. "An octopus arm is extraordinary, because



PHOTO: SAM REINMEESTER

there are no bones in it", explains Breedveld. "It's made up solely of muscles, all running in different directions. When its sphincter muscles are tensed, the arm gets thinner and longer. If the muscles are tensed lengthwise, it gets shorter and thicker. By tensing and relaxing in this way, the arm can take on all kinds of shapes or stiffen up."

Applying all of this in a mechanical device crowned with cables surrounded by two springs proved a real breakthrough. However, it took another year to develop a working prototype with 20 cables and a thickness of 5 mm. Generally, engineers aim to minimise the number of components, but the octopus taught Breedveld to think again and maximise the number of components instead. Bio-inspired technology is teamwork, stresses Breedveld, who leads a group of three researchers (Dimitra Dodou, Gerwin Smit and Aimée Sakes), nine PhD candidates and two precision mechanics. When Breedveld developed the first steerable tip, the number of components was problematic. The emergence of 3D printing technology solved that. Rather than making just one movable segment, it became possible to develop a series of fifteen segments that take on each other's position, like a train on a bend. 

**More at: [bitegroup.nl](http://bitegroup.nl)**

## Living coffin enriches nature

**T**he Living Cocoon, the world's first living coffin, is all about becoming one with nature.

Developed by the Delft start-up Loop, it is made from mycelium. This living organism normally grows underground in the complex root structure of trees, plants and fungi. "Mycelium ensures that everything that dies is efficiently transformed into new plant food", explains Loop founder Bob Hendriks. "Nature's biggest recycler, mycelium, is



constantly looking for waste materials to convert into nutrients for the environment. It does this with toxic

substances, including oil, plastic and metal."

Because of these properties, the Living Cocoon can dissolve within 45 days when placed in the ground. "Thanks to the mycelium, the body decomposes faster and damaging substances in our body and in the ground are neutralised. So, instead of polluting the earth, we enrich it, enabling new life to come forth." The idea is catching on – more than fifty people have already been buried in the mycelium coffin.



# Flowers and bees on campus

Nature is playing an increasingly important role on the TU Delft university campus. Delft Outlook joined Rene Hoonhout, Green team leader in the Campus and Real Estate department, on a cycle tour of the campus.

**R**ene Hoonhout points out a grassy meadow next to the TU Library, with plumes of grass almost a metre high and golden yellow wildflowers in abundance. It's one of the dozens of sites where Hoonhout's team mows as little as possible. A deliberate choice, he explains. "A neatly manicured lawn does nothing for biodiversity, so wherever possible we allow the grass and flowers to run wild. That's good for the insects and the spread of flowers and herbs." This form of ground management is becoming increasingly popular in the Netherlands. "It's a return to the meadow management of the past," says Hoonhout, "when the hay meadows were full of flowers and herbs."

Now he only mows those areas where it is really necessary. In Mekelpark for example, where students and staff want to be able to sit on the grass. And along the tram route on campus, where pedestrians need to be able to see from a distance that they are crossing the tram tracks.

## DECORATIVE VALUE VERSUS INSECTS

Around ten years ago Hoonhout started gradually increasing the biodiversity on the 161 hectares of the TU Delft campus, not just by allowing the grassy meadows to run wild, but also choosing natural vegetation along the canals that cross the TU Delft site, and tree species that promote biodiversity. "We used to select trees for their decorative value, but now we look far more at their natural value,"

he explains, standing at the edge of a flowering meadow alongside Applied Sciences South. "A plane tree, for example, attracts ten to twenty types of insect, whereas an oak can be home to as many as eighty types of insect." Across the meadow a group of lime (linden) saplings sway gently in the wind. They were planted a couple of years ago. "Limes are excellent trees for bees."

Hoonhout has been working as landscape manager at TU Delft for the

*'A neatly manicured lawn does nothing for biodiversity'*

last 31 years, a task he really enjoys. "Otherwise I wouldn't have stuck it out for so long." During this time much has changed on campus, like the paved car parks at faculties such as Applied Sciences and EEMCS giving way to the green Mekelpark. How people at TU Delft feel about 'green' has also changed, particularly in the last couple of years. "Not so long ago, they were still asking: 'Why don't you mow that grass there? It looks so messy.' And now they think it's a shame if I do mow the grass. 'It's bad for nature,' they say."

## HELPING HAND FROM NATURE ITSELF

Hoonhout loves being outdoors every day and cycling across the campus. His favourite spot? A tiny hidden park near





the P-Sports car park. It was once a garden designed by landscape gardener Mien Ruys, but now it has been overtaken by reeds. In the middle is a path of large boulders. Hoonhout jumps from boulder to boulder. They are hidden from sight by all the trees and nettles surrounding the park. “No-one comes here, so you can really leave nature to its own devices.” Where possible he gets a helping hand from nature itself. For example, the grass on two undeveloped areas of TU Delft land is grazed by flocks of sheep. And he uses waterside plants as one way to maintain the water quality in the canals on campus. “Without this sort of measure the oxygen levels deteriorate rapidly, particularly in the hot summer weather, leading to fish kill.”

### INVASIVE ALIEN SPECIES

The efforts of Hoonhout and his team have borne fruit. He steps forward and picks a fluffy purple-pink flower. “This is hare’s foot clover, a plant that started growing here spontaneously.”

But not all spontaneous arrivals are welcome, he explains as a group of Egyptian geese swims by – an invasive alien species. “They lay three or four clutches of eggs a year and are very aggressive. A while back they robbed a falcons’ nest and they displace native goose and duck species.” Our campus tour ends at a field of giant hogweed, another alien species Hoonhout would rather not see on campus. “We mow them once a year.” In one year’s time the plants have grown around three metres. “Sheep love hogweed. If they could only graze there...”




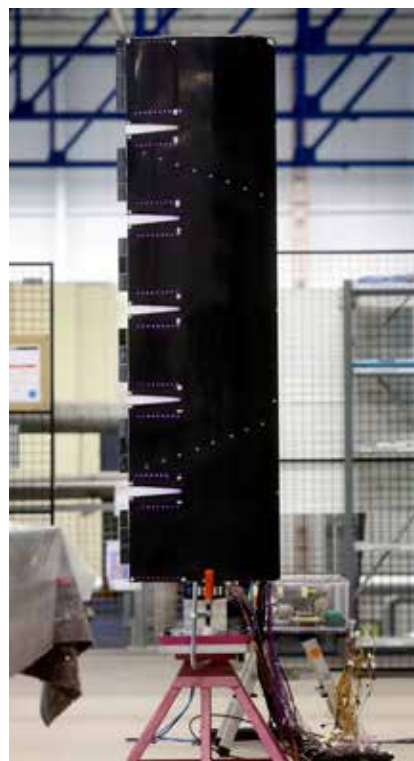
Rene Hoonhout: “Now they think it’s a shame if I do mow the grass.”

# Flexible wings

Watch a bird as it lands: the wings are turned back, the feathers correcting for gusts of wind. Aircraft wings are stiff and rigid and actually only optimised for horizontal flight at a height of 10 km. In 2006, head of research Dr Roeland De Breuker (Faculty of Aerospace Engineering) was awarded his PhD based on the idea of flexible aircraft wings. Since then, the Morphing Wings research line has continued as an option for making flying more sustainable. Flexible wings are smoother than today's wings with their flaps and slits. They change shape when the fuel consumption during flight changes the weight distribution, and they reduce the forces on the attachment to the fuselage so that the construction can become lighter. De Breuker estimates that flexible wings could save up to 10% fuel. Together with two fellow PhD students, Nakash Nazeer and Vincent

Stuber, Tigran Mkhoyan developed the SmartX-Alpha that uses sensors, glass fibres and servomotors to respond to gusts of wind. This summer, Mkhoyan built its successor in Germany: SmartX-Neo. When the mould was opened, the atmosphere was very tense. How would it turn out? In the days that followed, sensors and servos were added and connected using dozens of labelled cables and glass fibres.

According to Mkhoyan, the main differences from its predecessor are the lighter structure, servos that are three times faster and almost twice as many flaps (ten instead of six). Although the way the flaps connect to the rear of the aircraft is less smooth, that makes it respond more rapidly. The next step, SmartX-Beta, will be a medium-sized drone (span width 10 m) featuring two morphing wings as a demonstration platform. It is expected to take three years. 



## Online courses

### INDUSTRIAL BIOTECHNOLOGY

This industry-endorsed course provides the insights and tools for the design of biotechnology processes in a sustainable way. Learn the basics of industrial biotechnology and how to apply these to the design of fermentation processes for the production of fuels, chemicals and foodstuffs.

Over 25 employees of Zymergen participated in this online course. Stefan de Kok, Director Fermentation: "This resulted in increased understanding of microbial physiology and fermentation technology and how to scale up bioproduction processes. Through this course, the quality of our R&D work will further improve and timelines for commercialisation of bioprocesses will be shortened."



Start: 21 October 2021

### CIRCULAR ECONOMY: AN INTRODUCTION

In this course, we explore the Circular Economy: how businesses can create value by reusing and recycling products, how designers can come up with amazingly clever solutions, and how you can contribute to make the Circular Economy happen. You will learn to re-think the economic system you are experiencing every day, and act upon. The course is led by TU Delft and co-created with the Ellen MacArthur Foundation and the Leiden-Delft-Erasmus Centre for Sustainability.

Start: 2 February 2022.

A complete overview of all online courses can be found at: [online-learning.tudelft.nl/alumni](https://online-learning.tudelft.nl/alumni)





# View

The campus is an excellent advertisement for TU Delft, says researcher and landscape architect Nico Tillie (Faculty of Architecture and the Built Environment and Urban Ecology Lab), and should serve as a living lab for the cities of the future.

“Cities have already disrupted many natural systems, such as the carbon, water and nutrient cycles. Everything’s fine for a while, but there comes a time when things go wrong.

You can see this in such major issues as climate change, health problems and the nitrogen crisis. In the Urban Ecology Lab we ask how synergetic design can be used to make cities as natural as possible, from system level down to plants and butterflies. The TU Delft campus serves as a living lab for that.

The current vision for the campus is not future-proof. It’s based on outdated thinking: extending roads and adding extra buildings. The good news is that things are changing fast. Last year saw the start of the Sustainable Campus project, we have the Green Village and a lot is going on with Campus & Real Estate. But much more is needed: we need to think of how natural systems will be in the future and structure the campus accordingly. By natural processes, I mean things like water management. The northern part of the campus is draining water away to the surrounding residential districts and yet it’s too dry in summer. Surely we could store water on campus? Create purification ponds and ponds for swimming, filled with water lilies with canoe routes, footpaths and places to hang out. What my students call the ‘slow lane’. Create a network from the campus to the local neighbourhoods, from

the botanical garden to the Akerdijkse lake area. Less tarmac, from car park to park! We need to build in a nature-inclusive way, with nesting boxes for birds and bats, bee routes and transform some walls into living walls.

Create bio-walls bringing all of this together or add a semi-greenhouse for food crops and better energy management.

We could divide the campus from north to south into three habitats with forest, grassland and wetlands. The forest would be in the higher, northern section. The middle would be grassland and in the wettest area, the south, the focus should be on water and peat formation. We know that more water is coming. Seize that opportunity to show how we can live on water in the future. The ideas exist already: create mounds or buildings on stilts or floating buildings and roads. The southern campus will then have a combination of CO<sub>2</sub> storage in peat, water storage and nature. The smart campus will use sensors to chart natural processes. Every faculty would be able to contribute to a natural campus as a living lab, bringing everything together.

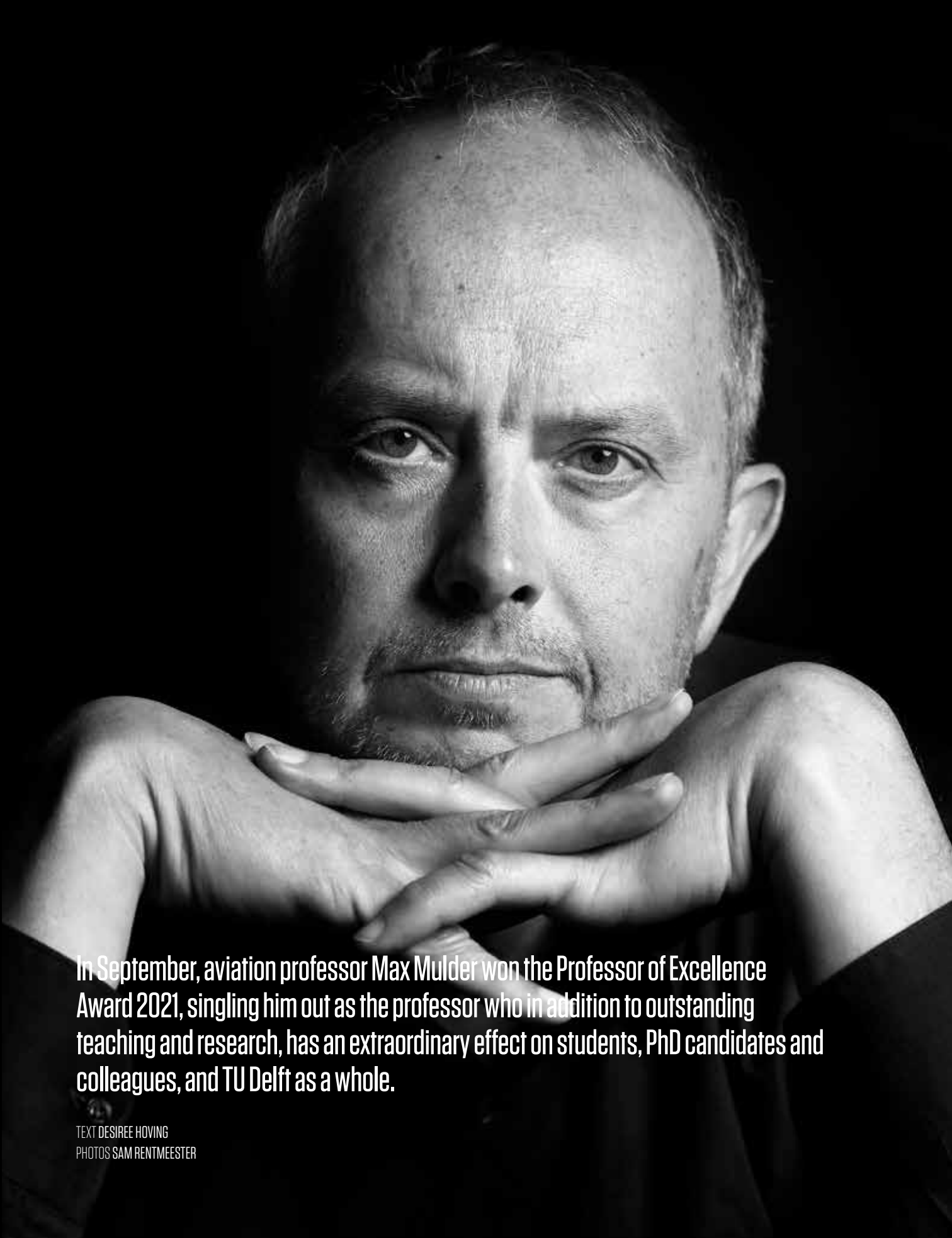
We can already achieve a lot tomorrow. It’s hardly rocket science, it’s all about a mindset. We need to think about life in a century’s time and start building and testing it now, from system strategy through to butterfly route.”





‘In everything  
I do, I’m eager  
to find out how  
things work’



A black and white portrait of a middle-aged man with short, light-colored hair and a light beard. He is looking directly at the camera with a serious expression. His hands are clasped together, resting under his chin. The background is dark and out of focus.

In September, aviation professor Max Mulder won the Professor of Excellence Award 2021, singling him out as the professor who in addition to outstanding teaching and research, has an extraordinary effect on students, PhD candidates and colleagues, and TU Delft as a whole.

TEXT DESIREE HOVING  
PHOTOS SAM RENTMEESTER

## CV

The Delft University Fund awarded Prof. Max Mulder the title of Professor of Excellence 2021 on Thursday, 3 June. He is professor of Aerospace Human-Machine Systems in the department of Control & Operations at the Faculty of Aerospace Engineering (AE). After his PhD (cum laude), he joined AE as an assistant professor, where he received a Vidi Grant in 2005. Nine years later, in April 2009, the Executive Board appointed him to the position of full professor. Prof. Mulder has supervised the graduation of some 330 students over the last 29 years. In addition to other nominations, he was made AE Lecturer of the Year in 2014. As supervisor and promotor, he has supervised almost fifty PhD candidates in successfully completing their research.

During the award ceremony, Rector Magnificus Tim Van der Hagen asked about the secret behind your success. He said that the award-winner not only needs to know everything about technology, but also human behaviour. Is he right?

"I think so. That's not to say that I spend all my time analysing people, but, without being immodest, I think that I'm easy to get along with. I'm someone who likes to get people involved. I want people to be content, safe and for everyone to be respected."

How come you're so good at it?

"Part of it's about who you are and your upbringing. But it's also partly because I have wider interests than many of my colleagues. Loes (his wife, ed.) always says: Max, you're not really an engineer. And there's some truth in that. I like doing sums and understanding how things work, but I could just as easily have been a history teacher. I find the Roman Empire incredibly fascinating and have a great interest in World War II."

Does that teach you how people behave?

"Yes, exactly. By not only reading books about maths, but also books by all kinds of writers, you gain an understanding of the many different lives people have led."

As a professor, you focus on human behaviour and technology. What exactly are you researching?

"My group is working on human-machine systems. We are aware that not everything can be automated in aviation. Humans need to continue to play a certain role as the ultimate problem-solver and supervisor of the whole system. How do you ensure that people are capable of that? We consider what information needs to be provided to the pilot in the cockpit and how and we develop some of the automation."

Are there still improvements to be made, with hardly any air accidents happening now?

"The discipline is getting smaller, partly because aviation has evolved into an incredibly safe mode of transport. On the other hand, we now face a much bigger challenge: sustainability. Currently, that's the biggest problem. It's receiving a lot of research funding, which is something I totally welcome."

What is your group's greatest research challenge?

"In the Netherlands, we have a major airline

and lots of people who need to train to fly. That's why the simulator industry is so big here. With my group, I look at the technology: how can you create a simulator that gives a pilot the same feeling as in a real aircraft? It's difficult, because a simulator is on the ground, with short supports that can only be pulled out so far. So, you have to do all kinds of tricks to give people the illusion that they're really flying."

When starting out as a professor and spending a lot of time managing research, you said that your greatest challenge was to keep up with the science. How are things now?

"My most important challenge is now stepping back a bit. I have younger staff members who partly work with me and partly work on their own research. I've always struggled with the fact that you can't do everything yourself, because I like so many things. I'm always seeing interesting things that I want to become involved in. Obviously, I can't, because I would get in other people's way. I try to stay sharp by lecturing and writing my own publications."

*'I hope to be able to apply my talents even more effectively for others'*

You have a reputation for being great at explaining everything in your lectures.

"That's extremely important to me. I'm not the kind of person who grasps things really quickly. As a student, I always had lots of questions and wondered if I was the only one who didn't understand. Fortunately, Delft has really changed since I started studying in 1986. I remember that if I didn't understand something and went to the lecturer, they thought I was asking a stupid question. If you didn't understand, you didn't belong in Delft."

Has the pressure to perform in terms of research and teaching increased over the years?

"That's something I've never felt myself. I've been lucky in that. I usually managed to secure half of my grant applications. Ultimately, however, your role changes and the young people have to submit research proposals. The failure



rate has risen dramatically. You now have to write eight proposals and maybe one will be approved, if you're lucky. Looking at those young people, there are some amazingly clever ones whose talent is wasted because there is far too little money for research. I think that's one of the biggest problems universities face."

**As a new professor, you said that life is very short. Why did you say that?**

"You have to invest an awful lot of time in a university academic career. I've done that for much of my life. When I became a professor, I thought: what now? I can continue as I am, publishing more and writing papers, but I also wanted to do other things. I've always wanted to learn to play the piano, so I've started doing that now."

**How is your piano playing now?**

"It's heavy going. I can just about hit the keys in the right order. But the tempo is difficult to learn, as is the dynamics of every touch of the key. So I can play, but there is little in the way of variation. When my piano teacher played the same piece, I thought: I might as well quit. But the only thing I regret is that I didn't start sooner."

**Is there anything else you'd like to learn?**

"Photography. It's partly a craft, but at least you don't need to have precision motor skills. Often, I'll get really technical taking all kinds of photos with my amazing camera while Loes takes quick snapshots on her mobile. But her compositions

often turn out so much better. Maybe I just wasn't gifted with that talent, but I really enjoy doing it."

**You've now worked here 28 years. What gets you out of bed every day?**

"We always attract smart young students. That's inspiring and an unbelievable luxury. Besides, the essence of research is that you're always doing new things. I just happen to be incredibly curious and I really like figuring things out. What's more, they pay me to do it. That's just amazing."

**Where does that curiosity come from?**

"In everything I do, I'm eager to find out how things work. I used to be really into music. Not only because I like music, but with some bands, I also wanted to know: where do they get that from? How did they come up with that? So I started looking at what music these bands listened to. Eventually I found music that made me think: that was someone who was doing something totally

*"I just happen to be incredibly curious. What's more, they pay me to do it"*

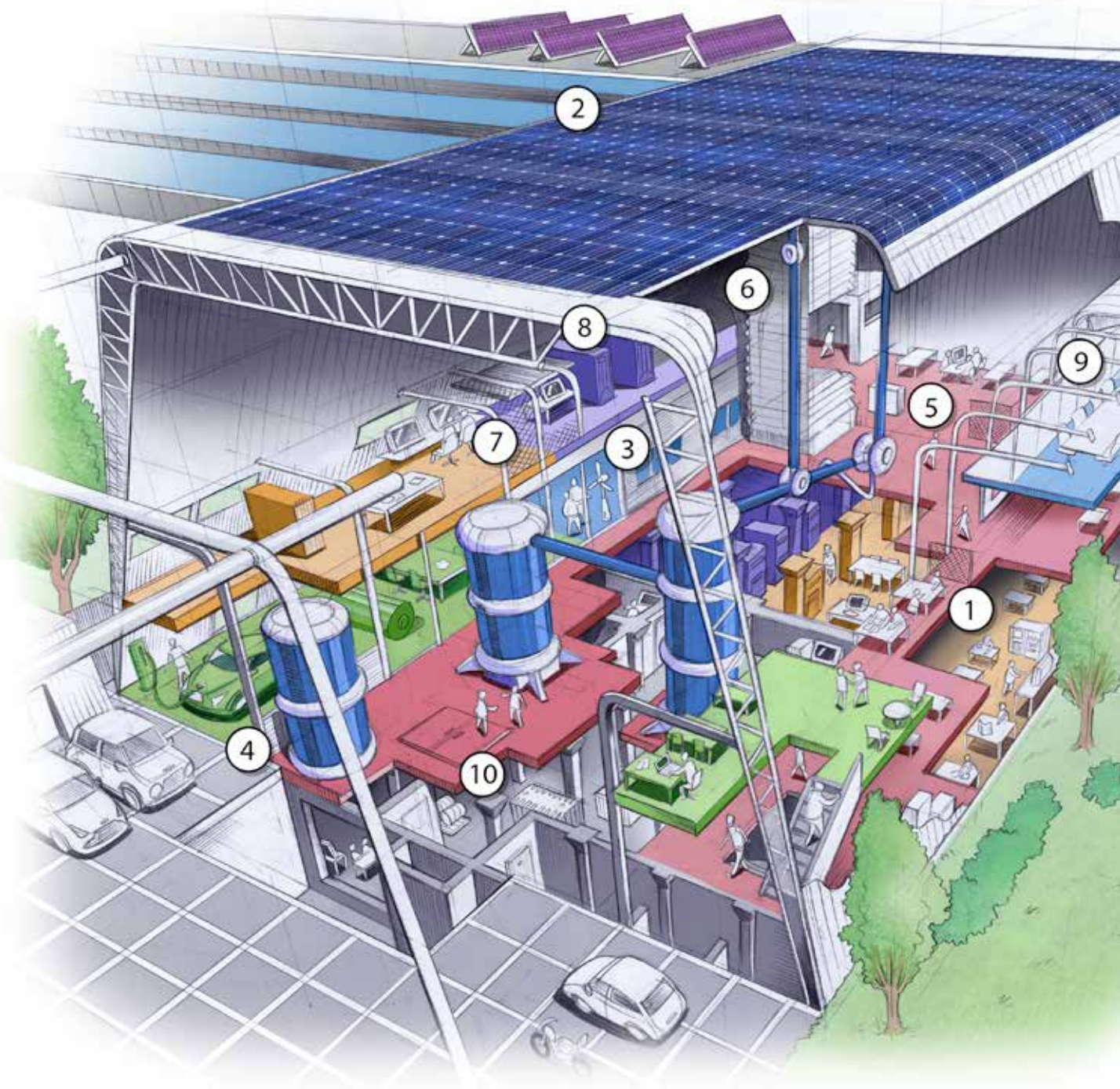
different! Take punk, for example, although I was more into new wave, because I found punk too simplistic. New wave was more romantic and for the doom generation, which is what I identified with. I thought Joy Division were the best band ever. I thought: wow, this really gets to me, where does this come from, how did they achieve that? I really loved figuring that out."

**In your speech after the award ceremony, you said people should remember that a professor of excellence is not just about your head and the content, but about putting your heart and soul into everything you do. How do you think this award will affect you?**

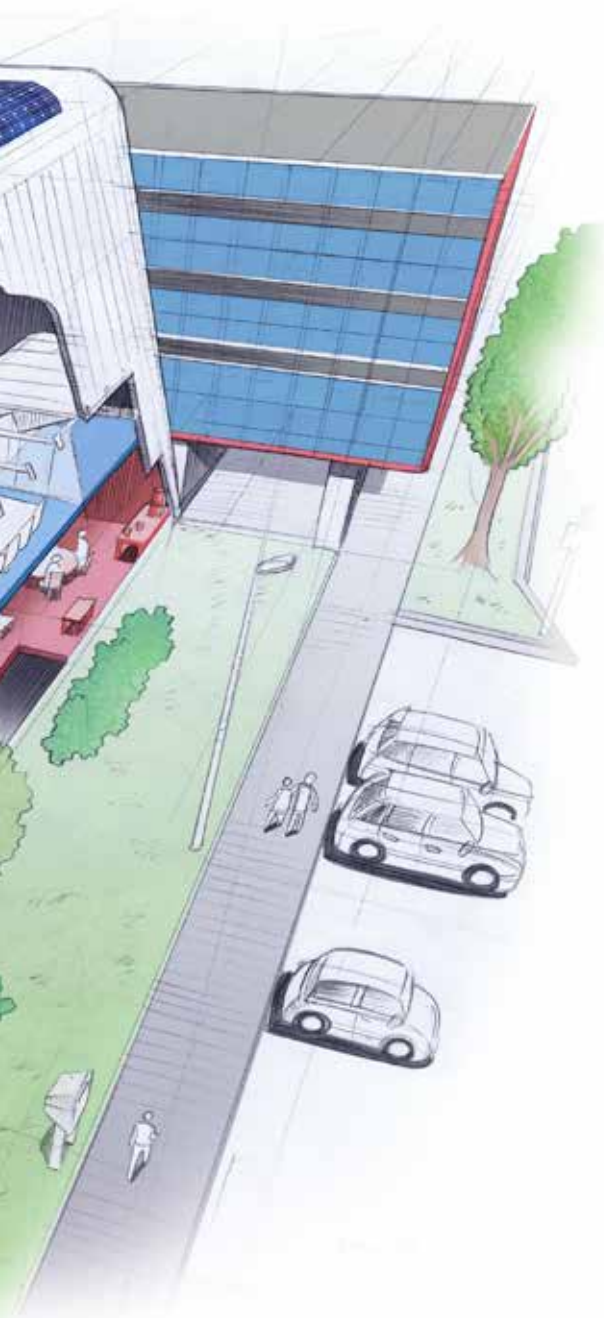
"The first few days were really emotional. Afterwards, it was like I was on cloud nine. I was the friendliest man on earth and kind and lovely to everyone. I've put that behind me now. But I do hope to be able to apply my talents even more effectively for others. At the ceremony, I met several people who wondered what makes a good teacher. Perhaps I can help with the things that I think made me a good teacher. That will hopefully result in even more good teachers."




# ESP-Lab: Temple of electrical engineering



On 1 October, a new, future-oriented lab was opened in the former High Voltage Laboratory (Faculty of Electrical Engineering, Mathematics and Computer Science): the Electrical Sustainable Power (ESP) Lab.



**T**he reason for the lab has become more urgent than ever since the latest IPCC report: renewable energy will need to quickly replace fossil energy if a climate disaster is to be prevented. But how do you develop a robust electricity grid based on fluctuating sources, such as solar and wind energy? This laboratory (at a cost of €20 million) has been established for this purpose, boasting both teaching and research facilities to educate future electrical engineers. Head of the department of Electrical Sustainable Energy, Prof. Miro Zeman, defines the lab's mission as follows: "The system integration of new technologies and components in the electricity grid."

The **yellow zone (1)** has been configured for solar energy. It will partly be used to test solar cells and develop smart modules. PV (photovoltaic) is one of the most important future energy technologies. The ESP Lab's huge **solar roof (2)** is anticipating that. Wind energy is another important source, mainly from large offshore wind farms. **Part of the lab (3)** has been set up to optimise electromechanical conversion in turbines and integrate the production of several turbines. **The green sector (4)** will be home to research into intelligent DC grids, power electronics, electrical mobility and storage. Electricity is transported over long distances at high voltages to reduce losses. **The red sector (5)** is reserved for high-voltage and transport networks, including practical research on high-voltage cables and connections. The combination of high voltages (of several 100,000 volts) and measuring minimal leakages requires advanced measurement technology. **The towering impulse generator (6)** and the high-voltage transformers that surround it in the hall play a special role. They can generate four million volts – a European record for academic laboratories, according to the manager – in order to test high-voltage components or the resilience of equipment to electromagnetic pulses. The surrounding laboratories and rooms are also isolated using a kind of **gorilla wire mesh (7)** that works as a Faraday cage (keeping electromagnetic radiation out). The **Real Time Digital Simulator (RTDS) (8)** can be used to calculate the impact on the Dutch grid of the addition or failure of a major energy source, such as an offshore wind farm. This supercomputer is a digital twin of the Dutch transport network and can calculate the effect of disruptions in real time. Tennen Hall has been set up for **receiving guests (9)**, with rooms for students to work and meet behind it. Clearing out the basement has created a huge area that is partly being used for laboratories. In it, there are also **climate installations and transformers (10)** that can generate 1.5 million volts for HV experiments. The rooms are separated from each other by shiny metal walls. 





# Climate action is essential, but how

Global warming is forcing governments, businesses and citizens to make major changes. So, how do you get everyone to take action? TU Delft is launching a major climate programme with an important role for governance, focused on behaviour and policy.

TEXT: SASKIA BONGER

PHOTOS: ROB BOON, SAM RENTMEESTER (PORTRAITS)


**F**orest fires, heavy rainfall, floods: the summer of 2021 had its fair share of extreme weather. Climate experts have no doubt that they were caused by global warming. Add to that August's shocking IPCC climate report and it is clear that the launch of the TU Delft Climate Action Programme in The Hague on 24 September could not have been better timed. Of course, this summer was not what initiated TU Delft's climate action. Hundreds of researchers have been working on climate-related research for years and the university published

its Climate Action vision in April 2019, clearly outlining its position: 'TU Delft is determined to apply its intellectual and innovative powers in protecting the world population against the risks of climate change.'

As a result, the university is spending €22 million over the next decade to establish its Climate Action Programme around four themes:

- Climate Science (using metrics and modelling to understand what's happening with the climate)
- Climate Change Mitigation





# do you get everyone on board?

- Climate Change Adaptation and
- Climate Governance

## Carefully-considered choices

Although these themes overlap and complement each other, it is the final theme – focusing on governance, as well as climate justice, policy and behaviour – that brings all the others together. Much of the necessary technology is already available – at least in theory – but is there widespread support, will the costs and benefits be equally shared, have the disadvantages been considered? If politicians or citizens and companies find climate measures too expensive,

what will the cost be of failing to implement them?

In its climate vision, TU Delft refers to carefully-considered choices ‘amid a range of technological, ecological, economic, ethical and social consequences’. ‘It is the role of climate science to support and guide this process by informing society about the latest insights on climate change.’

That is the plan, but what do things look like in practice? Expert in climate resilience and professor of computational economics, Prof. Tatiana Filatova is increasingly finding out. Having joined TU Delft in April, she is the academic leader of the

Climate Change Governance theme within the Climate Action Programme. In mid-September, she received detailed plans for six new research

*‘The issue is the timing and speed of the necessary changes. We need to act now’*

lines within her theme. Their focus includes new policy models, financial systems and human behaviour. (See box on page 27) All of the research lines involve proposals from TU Delft scientists



Prof. Behnam Taebi: "We want to see the discussion about this given priority and technological solutions linked to social, economic and ethical considerations."

in different disciplines for the appointment of a fellow researcher. Within the Governance theme, there is room for four tenure track candidates. "We've received some exciting proposals from six great teams. We plan to select projects that make use of Delft's strengths and those that will have the most impact on Dutch society and science at international level", says Filatova.

### Passing on Delft knowledge

According to Filatova, all of the research involves 'white spots': specific areas where there are gaps in knowledge. TU Delft intends to gather that knowledge to make its mark as a climate university. But there also needs to be a tangible social impact. The research proposals suggest that this will happen thanks to governments and citizens, but how exactly? From her work as a climate scientist, Filatova knows that governments are fully aware that new climate policy and participation by citizens and companies will be necessary, she explains. "The issue is the timing and speed of the necessary changes. We need to act now." She believes that this will require scientists to deliver

more than just knowledge and data. "We need to reach out and provide support. We need to collaborate closely with the people developing and implementing policy at local, national and international level. Currently, this is largely incidental and at personal level, but we intend to establish a shared agenda with various organisations. That's how we can make a difference."

One way in which TU Delft intends to shape this relationship with governments and businesses is the Climate Action Hub based on TU Delft's campus in The Hague. Its role will be to disseminate Delft knowledge, explains energy and climate ethics professor Behnam Taebi, the hub's figurehead. "We would like to see politicians, advisory bodies and international organisations in The Hague reaching out to us more", he says. That's why the hub's plans include organising events for MPs, civil servants and policymakers. There will certainly be a need for that, expects Taebi. "We don't have to convince the relevant ministries in The Hague that this is an issue that matters. It's more a question of how you achieve change, the role played by

technology and how you manage and embed that in society."

### Controversial

Achieving that will be essential, according to Taebi, as the debate about the location of wind turbines shows only too clearly. Local residents are often opposed, concerned about potential disruption, and are taking legal action to prevent the turbines. "The Netherlands lags behind on wind energy because of this controversy", explains Taebi. "The current solution is to build offshore wind farms, but that idea only emerged after opposition to onshore wind turbines. Far too often, technically effective solutions are found, but, sadly, technological advance and implementation are quite separate

Much of the necessary technology is already available but is there widespread support, will the costs and benefits be equally shared, have the disadvantages been considered?

from the social aspects. That's why we always fall behind."

In order to reduce emissions and adapt to climate change, such as rising sea levels, many more, large-scale transformative adaptations are needed, says Taebi. "We want to see the discussion about this given priority and technological solutions linked to social, economic and ethical considerations. We can contribute ideas, provide knowledge and bring parties together."

With his work in The Hague, Taebi and his colleagues are facing the



controversy around climate change head-on, trying to use research to point it in the right direction. How does he see it? “Global warming is a major problem that we need to tackle and any change will inevitably face a certain level of inertia. If we become part of the debate, we won’t run away from it. As scientists, it’s our duty to make a contribution to solving this century’s greatest challenge.” Technologies are available, but is there widespread support, and will the costs and benefits be shared fairly? ‘If we become part of the debate, we won’t run away from it’



Prof. dr. Tatiana Filatova: “We plan to select projects that make use of Delft’s strengths and those that will have the most impact on Dutch society and science at international level.”

## The potential new research lines within the theme of **Climate Action Governance**, in random order

1. Policymakers in climate negotiations worldwide are guided by integrated assessment models (IAMs). These models calculate the social costs of CO<sub>2</sub> emissions but have been brought into question. They fail to properly model human activity, ignore climate adaptation and also fail to take account of ethical considerations and the socio-political aspects of technological changes. Delft researchers aim to develop IAMs that do take account of these factors.
2. Another group of researchers plans to combine these IAMs – which predict what climate policy would do from the top-down – with opinions from stakeholders and impact analysis models. These analyse the actual effects of climate policy from the bottom-up. The aim is to use this combination to provide rapid answers to policy questions.
3. The successful implementation of any new climate technologies partly depends on economic, political and social factors. Which factors are inhibiting change and which are actually helping? Plus: how do you deal with the first and bolster the second? This is what researchers aim to achieve in designing technology-driven climate policy.
4. The transition to an emissions-free, climate-proof society calls for new forms of investment for regions, cities and businesses. Delft researchers aim to analyse and design the financial tools to achieve that, together with the related policy systems.
5. How does the behaviour of engineers, policymakers, citizens and businesses interrelate and how can behaviour be influenced so that it supports the necessary climate adaptations? By understanding behaviour, researchers hope to contribute to a more effective decision-making process.
6. How can you support, strengthen and upscale local climate initiatives that have been set up by and for communities of people? How can you learn from these initiatives and integrate what has been learnt in engineering practice? And how can you arm a new generation of engineers with this knowledge? Delft researchers aim to explore this issue and work out how education and research can reinforce each other.



## IN PERSON

July saw two Delft scientists receive Vidi grants worth €800,000 from the Dutch Research Council. Over the next five years, this will enable them to develop their own, innovative research line and set up a research group.

**Dr Giorgia Giardina** (Faculty of Civil Engineering and Geosciences) intends to use satellites with radar systems to observe the structure of bridges. Countless bridges across Europe are in a poor state of repair. Giardina's research will also take a close look at Amsterdam. The capital has 200 km of quay walls and numerous bridges that are not in the best of condition.

**Dr Laura Marchal Crespo** (Cognitive Robotics department in the Faculty of Mechanical, Maritime and Materials Engineering (3mE)) is researching robotic systems that maximise recovery following a stroke. Her aim is to visualise the processes that are essential for maximising individual recovery and apply these in a hyper-realistic multi-sensory training system that offers patients lifelike personal interactions with tangible virtual objects.

In July, **Dr Wawan Dhewanto** was appointed professor of entrepreneurship in the School of Business Management, part of the Bandung Institute of Technology (ITB), TU Delft's affiliated Institute in Indonesia. After completing his Bachelor's at the ITB, Dhewanto did a Master's in System Engineering, Policy Analysis and Management in the Faculty of Technology, Policy and Management in Delft.

In August, **Marien van der Meer** was appointed Vice-President, Operations on the TU Delft Executive Board. She succeeds Nicolý Vermeulen, who stepped down in January. Van der Meer studied Public Administration at Leiden and has spent a decade as an administrator in medical institutions, including the Antoni van Leeuwenhoek Netherlands Cancer Institute.

## *Fly like a bird*

Copying animals can be hazardous to your health.

Consider the advent of aviation.

Dreamers and daredevils who wanted to fly looked at birds for inspiration. How do birds manage to fly? Feathers: we can get hold of those. Shape of the wing: we can copy that. Flapping of wings: we can do that too!

So there they went, self-made wings strapped to their arms. According to tradition, for example, the Portuguese João de Almeida Torto jumped from the cathedral in Viseu, a city southeast of Porto, wearing self-made wings. His wife had her misgivings at the prospect and had her husband draw up his will beforehand to secure her future. With the assembled crowd watching on, Torto jumped from the roof of the cathedral, an eagle-shaped helmet askew on his head, and died shortly afterwards from injuries sustained during the fall. Draw inspiration from nature, but don't try to copy it exactly – in the centuries that followed, this became an important design principle for builders of aircraft. Take the Wright Brothers' first motorised flight on the beach at Kitty Hawk in 1903, for example.

These daredevils, originally bicycle mechanics, certainly looked carefully at nature, for example at how birds change course by adapting the shape of their wings.

However, the Wright Flyer most certainly was not a copy of a dove or an eagle. To achieve extra lift without large, unwieldy wings, the brothers chose to build a double decker. Speed was derived not from jumping of a church steeple, but from a motor and propellers. Nice touch: in tribute to that historic flight, NASA engineers fixed a piece of fabric from the Wright Flyer to the interior of Ingenuity, the small helicopter that this year made the first motorised flight on an extraterrestrial planet. The air there is so thin that the rotor needs to rotate ridiculously fast to generate lift, which requires so much energy that it can only fly very brief stretches before the solar panels need to charge up the battery again.

Interestingly enough, the challenging flying environment on far-away planets makes the flapping wings of the early pioneers of aviation interesting again. NASA engineers have suggested exploring the red planet with a swarm of flapping robot bees, for example. If this ever happens, we should engrave on the backs of the bees the names of those early daredevils who had hoped to become airborne by flapping 'their' wings. Rehabilitation for João de Almeida Torto.



Tonie Mudde is an aerospace engineer and science editor at de Volkskrant newspaper. He studied in Delft between 1996 and 2002.

# THE FIRM

Six years ago internet entrepreneur Bram Ellens decided to focus on the world of art. In his exhibition *Robots in captivity* he is working together with scientists, artists and philosophers.

Three flip stunt cars drive non-stop against prison bars, drones buzz wildly as they flutter in a birdcage and a chained robot arm struggles hopelessly against its restraints. Thanks to high-tech hardware and software, Bram Ellens' robots move about like caged animals. That evokes emotions among the viewers, and this is precisely the intention, as in this exhibition Ellens is investigating the relationship between man and robotics. He is both fascinated and alarmed by the emergence of artificial intelligence, which he experienced at close hand during his work in international tech companies in Silicon Valley and elsewhere.

'Investment in internet companies is almost limitless, while in the arts you have to beg for money'

"Almost everything is developed with an eye to turning a profit. How ethical is that, and who controls the algorithms?" Ellens' robots appear discarded and traumatised and they elicit a feeling in the viewer. This makes the exhibition a perfect living lab for the research project *Acting like a robot* from Utrecht University, VU Amsterdam and HKU University of the Arts Utrecht. "Here we have two PhD candidates from Prof. Maaike Bleeker's group who are studying robot behaviour from a new perspective (art and theatre) to bring




Bram Ellens with *The Mad King* in the background, a KR 470-2PA robot that escaped from a Detroit car factory. "Everything already exists, I make it alive and tell a story."

them closer to humanity." For example, 'Jan, an escaped AI developed by the US army', is becoming increasingly smart by monitoring the responses of visitors in his attempt to be freed from his display case.

Besides scientists and students, Ellens is cooperating with artists and philosophers on the development of the robots. "I used to work a lot with developers on things that were not finished yet, and we do that here too, giving scope for experiment."

The new entrepreneurship in art got Ellens thinking. "It is confronting to experience how society regards art, compared to how start-ups are regarded. Investment in internet companies is almost limitless, while in the arts you have to beg for money. It is valued totally differently. At the start of this project I applied to some cultural funds for funding, but somehow I never qualified. In the end I scraped together funding from all over the place.

Through sponsoring from Husqvarna, from my own capital - I work one day a week on the *Zuidas* - and through trading: while looking for an industrial robot arm we found a company selling six of them from a liquidation. We bought these and sold them on, in Dubai for example. This enabled us finance one for the exhibition." 

*The exhibition *Robots in captivity* can be seen until 9 January 2022 in the former country house Doornburgh in Maarssen. For more information see: [buitenplaatsdoornburgh.nl](http://buitenplaatsdoornburgh.nl)*

Company: Bram Ellens ([bramellens.com](http://bramellens.com))  
Product: Art  
Degree programme: Technology, Policy and Management  
Number of employees: 1.5 (a software programmer and a head of operations)  
Revenue: € 78,000 (after expenses € -12,000)  
In five years' time: "It would be great if we could break even, and still be able to do this fantastic work."

# Delft Spinoza Prize winner has remarkable plans

He made the world's first quantum mechanical calculation. Lieven Vandersypen will receive the Spinoza Prize this year to pave the way for quantum computers. "I find people who throw fabrications out there in the world hard to deal with."



Lieven Vandersypen is looking for initiatives he can support to get girls to choose science studies more often.

If you had asked him 10 or 15 years ago when the first quantum computer would finally emerge from the lab, the Professor in Quantum Nanosciences would have reluctantly said that it may never happen. "We were always clear that it was ongoing research and that the quantum computer may never be feasible," Lieven Vandersypen said in 2007 when he was just named the Antoni van Leeuwenhoek teacher. Not everybody appreciated his

saying that, but Vandersypen stuck to his guns. His electrons on gallium arsenide chips would simply not cooperate.

Ten years later, things are different. Vandersypen, now Scientific Director of QuTech (an alliance between TU Delft and TNO in the area of quantum technology), changed to silicon chips. A trio of articles about the wondrous behaviour of electrons on these chips followed in journals such as *Nature* and *Science*. The electrons only stayed on the gallium arsenide for 10 nano

seconds. Just try doing calculations in that time. But now, on silicon, they can be managed 10,000 times longer. "Our research has really taken off," says the Professor.

This did not go unnoticed by the Dutch Research Council (NWO). This year, the science funder awarded one of the four Spinoza Prizes – also known as 'the Dutch Nobel Prizes' – to the Professor at TU Delft. He will be awarded EUR 2.5 million to spend on science as he sees fit.

**Congratulations. You need to pave the way for the quantum computer. Does it feel like a burden?**

"No. I'm pleased with the recognition. It is carte blanche to get on with things. I do not need to look for funds for every new idea and wait for months for the decision, but can now hire people and buy equipment as I see fit. I do not feel under any pressure. I have been researching quantum calculations for 25 years and this has brought me to where I am today. I am doing my best. I can't do more than that."

Even while working on his PhD research, Vandersypen achieved a first in the world when he used the spins of atom nuclei in molecules as qubits and, using seven of these qubits, was able to divide the number 15 in the determinants three and five. In doing so, he proved that using qubits in calculations was not only theoretical, but could also be used in practice.



**What is the current status of the technique? In your latest articles you talked about 'a programmable two-qubit quantum processor in silicon'. So two qubits?**

"We are now working with more bits than that and we have improved the methodology to scale up. I can't say how many bits. We hope to publish the information soon. Some journals ask you not to publish your findings elsewhere first.

But just as important, we have managed to get much better control over the electrons. This is very important if you want to use them

**'It is not clear yet what this technology will bring society'**

to carry out calculations. The spins need to dance for you. I am the choreographer who decides the cadance."

**That is a good analogy to explain a technology that many people find incomprehensible. A technology of which the promise – the quantum computer – is also surrounded by so much uncertainty. Do you ever struggle with this yourself?**

"It is hard sometimes. My wife is a doctor. She helps people every day and gets feedback immediately. I do get feedback from students of course, but from research? It is not yet clear what it will bring society. We have a very long-term focus."

**'I want to support initiatives that help girls choose scientific studies'**

**You may use the money from the Spinoza Prize as you see fit, as long as it is used to further science. You mentioned that you wanted to hire people and buy equipment. Are there any other plans?**

"There is something else close to my heart. Girls and young women rarely choose scientific studies like physics or technical studies, even if they have an inherent interest in these.

Something puts them off, perhaps a certain image. I also think that girls often underestimate themselves. I recently overheard a conversation among some female students who had been accepted for an honours programme (a special programme for highly talented students, Eds.). They doubted whether they were good enough. You seldom hear boys expressing their doubts. I am looking for initiatives in which I can support more girls to choose subjects such as physics."

"And another thing is that I would like more people to learn to distinguish between fabrications and scientifically supported claims."

**Can you explain what you mean?**

"We are facing big challenges in terms of climate, energy and health. I respect people who wonder if they should have the vaccine as they are scared that it may affect their health. But I find people who throw fabrications out there in the world hard to deal with. Information needs to be right. Of course issues are seldom black or white in science. Scientists often disagree with each other. But the

discussions that they engage in are different. The way in which societal discussions are carried out is undermining democracy. I would like to see if it would be possible to design teaching materials for primary school that would equip teachers to deal with this issue and prepare children."

**Do you have any final tips?**

"I would suggest to anyone interested in quantum calculating to log in on our quantum system via [quantuminspire.com](https://quantuminspire.com)."

**Is it a simulator that shows you how quantum calculations works?**

"No, it is a real quantum computer. Well, a prototype of one. We have a system with some qubits that act like quantum bits in a real quantum computer. It follows the same principles and you can do simple calculations with it. We have them here in two refrigeration systems in a lab. We are not using them for our research and they are intended solely for people who want to experiment with them."

## Qubits

The qubits with which Vandersypen and his colleagues are working consist of individual electrons that are kept in silicon enclosed by electrodes. Using magnetic and electrical fields, the researchers can control the spin of the particles. As with transistors on chips in current computers, it should be possible to couple qubits together on a chip. The major advantage is that, unlike the normal bit that only has two separate states, zero or one, the quantum bit (or qubit) can be zero and one simultaneously. This is called superposition – a privilege of quantum mechanics – the electron spin can be left and right at the same time. So three qubits can thus consist of two to the third ( $2 \times 2 \times 2$ ) eight quantum states at the same time. And 10 qubits can handle two to the tenth, or 1,024 simultaneous states. A quantum computer should be able to carry out simultaneous calculations in all different combinations.

The hope is that quantum computers will thus be able to solve complicated calculations that are too complicated even for the best super computers, such as calculating the properties of molecules and materials.

# From the house of God to starters' homes

An architecture student bought a disused church to live in with friends. Then fate struck. Now, four years later, he is creating four starters' homes from ruins.

**N**ever waste a good crisis, they say. Architect and TU Delft alumnus Nima Morkoç put that saying into practice when his enormous shelter went up in flames. Everything is now pointing to the burned out Juliana Church on Heijplaat rising from the ashes as four welcoming and affordable starters' homes. "The biggest task for our generation of architects is to create affordable housing."

## Garden town of Heijplaat

The isolated village of Heijplaat lies in the middle of the Rotterdam port area. After piles of sea containers, villas suddenly appear amidst unexpected greenery. The Courzandseweg, 'steak lane' as it is called by the locals, was built for the Director of the RDM and his staff. Behind it is the 'meatball' neighbourhood for the labourers. At its highest point, 3,000 people lived here. Now the population has just about halved. The village was built as a garden town for the personnel of the Rotterdamse Droogdok Maatschappij (RDM, Rotterdam dry dock company). It had everything: homes, schools, shops, a bandstand and three adjacent churches – Catholic, Reformed and Dutch Reformed. However, the tide turned for



Nima Morkoç found a new function for the burnt down church. (Photo Sam Rentmeester)

RDM, which in its glory days was one of the largest shipyards in Europe. Eventually, in 1983, bankruptcy was inevitable. For the Heijplaat community, that meant unemployment, poverty and the loss of social cohesion. On top of that, increasing secularisation closed the churches in Heijplaat one at a time, including the Dutch Reformed Juliana Church. What had long been a meeting place for the believers in the community had lost its function and was empty.

### One chance in a million

Former Architecture and the Built Environment student Nima Morkoç was phoned by his father, who lives in Heijplaat, in spring 2017. The Woonbron housing corporation had put the Juliana Church on the market after 10 years of disuse. Morkoç senior, Nima's father, convinced his son to buy the Church and the vicarage together – Nima the Church, his father the vicarage.

Four TU Delft Architecture and the Built Environment friends were interested in moving in. The master students would build five tiny houses in the Church to live in. The Church hall would be used for parties, film nights and dinners. There would be space for an art atelier for Nima's sister Mina. Just before summer, everyone gave notice on their accommodation and moved their belongings to Heijplaat.

### NL alert

On Sunday 6 August 2017, Morkoç's father phoned. "The Church is on fire!" Driving over the Rotterdam Erasmus Bridge Morkoç saw a sea of fire and clouds of smoke billowing across the centre of Rotterdam. The Rijnmond news website reported on the fire the next day. "Only the stone walls and the Church tower are still standing. The building is a write-off." Experts concluded that the fire was probably caused by a faulty ventilator. Despite the grief of the lost personal

belongings, a graduation project was landed in Morkoç's lap – finding a new purpose for the burnt down church. What makes the Church a historic building for its surroundings? This is the burning question in Nima Morkoç's dissertation, *Social Monumentality* in 2018. The historic significance did not lie in the building itself that Morkoç describes as 'a barn with the addition of a bell-tower'. Nor, oddly enough, did it lie in the use: 'the

## After 23 rejections, all the lights turned green

church was empty for 10 years and nobody seemed to care'. He discovered that there are about 600 disused churches in the Netherlands at present, and that two join the list every week. The empty religious heritage is such an all-encompassing and complicated issue that a special platform (in Dutch) was set up to share knowledge, networks and experiences.

### Restoring social connections

The issues around the Juliana Church, now called Project Juul, also apply to other churches: the social cohesion has disappeared and loneliness is on the rise. The question, and the assignment that Morkoç has given himself, is how can the social monumentality of the Juliana Church be restored so as to benefit Heijplaat? It is about restoring social connections that had disappeared long before the fire broke out.

After 120 versions, Morkoç came up with a design for living space for students and employees from start-ups on the RDM Rotterdam premises. The living spaces are built round the empty space of the Church. Two blocks, one on either side of the clock tower and one on the site of the vicarage. That space, between the old windowless Church walls, will continue to be a meeting place for those living nearby.



The empty Juliana Church around 2017. (Photo: Nima Morkoç)



The fire spread and produced a lot of smoke. (Photo: Rob Engelaar)



The garden town of Heijplaat is encircled by the Port of Rotterdam. (Photo: DCMR)



The presentation for the people in the neighborhood. (Photo: Sam Rentmeester)



The space between the houses is intended to be a meeting place within the seclusion of the old church walls. (Image: HUM design & development).



He earned a seven for his graduation work.

### Affordable housing

After graduating, Morkoç started working as an assistant designer at West 8. Last year he moved to Mei architects and planners. He still keeps one day a week free for the redevelopment of the Juliana Church as a project for his own company, HUM Design & Development. "It became a sort of traineeship in urban development, architecture, landscape architecture, legal affairs, commercial viability and zoning plans," he says looking back. Before any plans could actually be made, the zoning plan and the leasehold had to be changed, and the Aesthetics



This is what the burnt down Juliana Church on Heijplaat should look like next year. (Image: Nima Morkoç)

'The biggest task for our generation of architects is to make affordable housing. Everyone I know is finding this difficult'

Committee had to give its approval. A new purpose for the Church had to meet all these conditions and the end product also had to benefit Heijplaat. After 23 rejections, at the end of 2019 all the lights turned green for Project Juul. The Aesthetics Committee approved the plan and a year later the contractor BIK Bouw signed the building team agreement. The application for the building permit was submitted last summer. Morkoç's strong preference was to repurpose the building into homes. "The biggest task for our generation of architects is to make affordable housing. Everyone I know is finding this difficult." This naturally was not in line with the repurposing plan of

the Church, but there was room for discussion.

The municipality preferred larger and more expensive homes for well-off families, but Morkoç's choice lay elsewhere. He pushed for a design for four compact (110 m<sup>2</sup>) and affordable homes (around EUR 400,000) within the contours of the Church. The vicarage, where his father lives, is no longer part of the plan.

### Meeting place

The homes are designed for modern life and work. The active part of life takes place on the ground floor – cooking, eating, social interaction and a communal open garden. The first floor is for sleeping, and the second floor has a high and spacious workspace. The windows on the outside are rectangular and sleek, in the Reformed Church style. The windows on the courtyard side are bigger and rounder. There are no hedges and the space between the houses is intended to be a meeting place within the seclusion of the old church walls. The building work will start at the end of this year and is

planned to finish at the end of 2022.

### Red pointed tower

Anyone squinting at the tower will see the roof of the Juliana Church again with an open groove in the middle. The reconstructed open pointed tower will be covered with a special species of ivy that will colour the pointed tower green. Once a year in autumn, the leaves change colour and the pointed tower will be bathed in red. This is in remembrance of the fire that instigated everything.

At the end of next year when the new residents occupy the homes, the young architect will have achieved a solution for two burning questions in housing and urban issues: empty religious heritage buildings and the need for affordable starters housing. In Morkoç's experience, "People in architecture want references, something that has already been done. I hope that Project Juul will be a source of inspiration for the hundreds of empty church buildings that people now don't know what to do with."

More information: [wonenbijjuul.nl](https://wonenbijjuul.nl)

# ‘The Executive Board does the real work’

This year saw two alumni join the TU Delft Supervisory Board: Heleen Wachters and Tijo Collot d’Escury. What is their take on TU Delft, then and now?



Heleen Wachters has been a member of the Supervisory Board since 1 January. Tijo Collot d’Escury became chairman on 1 July.

**T**his is not a job that you can just apply for. “A list is compiled based on profiles and you are approached”, explains Tijo Collot

d’Escury, Chair of the Supervisory Board since 1 July. “It’s really nice to be asked and most people will say yes”, adds Heleen Wachters, a member since 1 January. After accepting, there are interviews with the Works Council and the Student Council, followed by the official appointment by the Minister of Education, Culture and Science. We’ve already had our first meetings. “There are plenty of issues under discussion. Before the first meeting, I was sent around a thousand pages of documents that you have to read through, especially at the start”, says Wachters. “You often have to do that in the evening or weekends, but if you enjoy it, that’s no problem.” Collot d’Escury had been involved in TU activities for a while, including as a member of the Delft University Fund board. “I’m happy to do that, as I’m eager to give something back to the university.” He was at the beginning of Graduate Entrepreneur, an alliance of student start-ups from Delft and Rotterdam, and he co-founded the Excellence Fund, that brings leading



Tijo Collot d'Escury: "I'm happy to do that, as I'm eager to give something back to the university."

international academics to Delft. Being the Chair of the Supervisory Board will bring him closer to the everyday workings of TU Delft, although he is keen to stress that they have no desire to step into the Executive Board's shoes. "We have a very capable EB in charge of day-to-day management that represents the organisation to the outside world. That's the real work." The Supervisory Board's role involves contributing to university strategy and appointing new EB members. It also checks that government funds are spent responsibly. Wachters: "In practice, we serve mainly as a sounding board in terms of suggesting ideas and asking critical questions. For example, your experience tells you whether something involves certain risks or where additional expertise may be necessary."

### Balanced team

There is plenty of experience in the Supervisory Board. Collot d'Escury is a partner in consultancy firm Roland Berger and one of the founders of its Dutch arm. Wachters is a partner in the organisation for freelance consultants Eden McCallum and co-

founded the Dutch branch. Although a consultancy background is definitely useful within the board, its power lies in the composition of the team: "In Luc de Soete, we have someone with administrative experience in the academic world, Caroline Gehrels has a civil-society background and Gijsbert de Zoeten is from the world of business. It's a balanced team with people from a range of different fields", says Wachters.

### Major themes

Together, they are tackling the major themes for the years ahead. "The huge increase in student numbers is likely to continue. It's a good thing, but also brings challenges with it. The coronavirus crisis creates operational challenges, but also impacts on student welfare", says Collot d'Escury. "It's definitely an interesting time for a university of technology. There's so much

'We need to carefully protect the reputation of TU Delft'

happening in areas like sustainability, energy, AI, bionanotechnology, etc. Delft is leading the way. It's great to be able to make a modest contribution to that." Wachters is enthusiastic about the campus strategy. "An extensive plan is in place for new buildings and renovations over the next decade, in which sustainability features prominently. That appeals to me, as a civil engineer. What we intend to do is amazing, but also complex. For example, will we adapt the strategy in line with the new ways of teaching and more remote working?" They both have fond memories of their time on campus. "I was really

impressed by the place, with its wind tunnels, nuclear reactor and towing tanks. But it could get very wild. First-year chemistry students, like me, worked in the lab on Thursdays and Fridays. There'd usually been some partying the night before, so not all students were totally on the ball. The lab assistant was outraged when yet another experiment exploded in the fume cupboard", recounts Collot d'Escury. "I look back at what I learnt in Delft with gratitude. I'm increasingly aware that you don't actually understand how extraordinary it all is when you're still a student. Not only what you gain from it, but also the freedom you have to party and join committees – it's an amazing period in your life."

### Enormous boots

Wachters recalls the laboratory course in soil mechanics that she had to do as a civil engineering student. "Part of it was outside in a field. We did experiments with probes that had to go 10 metres into the ground and then out again. I spent two years as a student teaching assistant on that course with two other girls. We were standing there giving out instructions in enormous boots. It was quite a sight, as there were very few girls here at the time", she says. "Delft was like one big playground after having to do subjects at school that didn't interest me that much. I was very keen to do civil engineering. As long as there were numbers involved, I loved it. I'd be happy to choose Delft again, although then I might study maths." She also realised later what a difference choosing Delft really made. "It's later in life that you understand how special a degree from Delft is. It has a reputation for being a serious and thorough programme, that produces very capable graduates. We need to carefully protect that reputation, and, more importantly, help it reach its full potential", she says. "At Eden McCallum, we're also very happy to



recruit Delft graduates. The skills that you learn here – analysis, devising creative solutions, etc. – are also essential in consultancy, the strength of the TU Delft programmes is clearly evident.”

## Ecosystem

Collot d’Escury and Wachters have noticed that a lot has changed since they graduated in the early 1990s. “I took my children to the Open Days which were so bursting with energy that I almost felt like becoming a student again myself”, says Collot d’Escury. “I had my own company as a student, but the university didn’t really encourage it at the time. There was nowhere to go for help. It’s great to see how it’s encouraged now. The entire campus is becoming a wonderful



Heleen Wachters: “I almost felt like becoming a student again myself.”

‘It’s definitely an interesting time for a university of technology’

ecosystem with businesses and researchers collaborating.” Wachters agrees: “My son is also involved in a start-up. They enable students to practise skills and you occasionally hit on an idea that actually proves a commercial success. We need to encourage that culture of innovation even more.”

Collot d’Escury can’t emphasise enough the importance of a leading university like TU Delft. “We are a prosperous and happy country. Universities play a key role in that. Educating and retaining talent for the Netherlands is still essential. That’s why continuing to be an outstanding university really matters”, he says. Wachters: “We achieve high rankings in that respect, but you need a lot of

energy and investment to continue to perform at that level.” With that in mind, Collot d’Escury makes a renewed call on alumni: “The government contribution has recently been slightly adjusted, but after correction for inflation it basically still reflects the situation from years back although we now have twice as many students. That means we’re increasingly dependent on other sources of funding in order to continue to do special things. As an alumnus, there are all kinds of projects you can support, but we need to increase the involvement of alumni with the university, and vice-versa.” Wachters: “It’s an honour to be asked to make a contribution; I think a lot of people would agree. But not everyone knows how to. There’s room for improvement on that. It’s certainly something we will be revisiting.”

## Alumni activities

From online events to career coaching, to lectures on campus. If you want to participate in an event, the information offer can be found on the alumni events page: [Alumni.tudelft.com/events](http://Alumni.tudelft.com/events)

### 11 November

TU Delft Best Graduate Award Ceremony 2021

### 22 – 26 November

TU Delft YourCareer Week

### 14 January

Celebration 180th Dies Natalis TU Delft



### Get in touch

Questions, comments or ideas?

Email: [alumnirelations@tudelft.nl](mailto:alumnirelations@tudelft.nl)

Website: [alumni.tudelft.nl](http://alumni.tudelft.nl)

Community: [tudelftforlife.nl](http://tudelftforlife.nl)

‘TU Delft for Life’ is the online community for all TU Delft alumni. Expand your network, meet your old university peers and stay up to date on the latest news and events. Sign up on [tudelftforlife.nl](http://tudelftforlife.nl). You can also change your contact details and communication preferences there.

## HORA EST

In the Netherlands, cycling against a strong wind is a more useful skill than swimming in the canal.

Xinmin You



In the coming decade, Space and the Arctic will become battlefields where ICT is playing at the same time an enabler and disabler role to different super powers/actors.

Emanuela-Clara Maathuis

Women in science are that good that they do not need to be prioritised.

Marco ten Eikelder

Even in a technically advanced world, the value of a face-to-face meeting remains priceless.

Michel Bengtson

Whenever you feel like materials are useless, just remember they may have other applications.

Xinmin You

Science without debate is like a fireplace without a fire.

Johannes Leendert Visser

Research is similar to extreme sports: both require a lot of practise and courage.

Zongchen Li

A new space race is required for a quantum leap in technologies. Only meeting demands of the consumer market is not sufficient.

Amol Ashok Khalate

Artificial intelligence research will in time help us understand the phenomenological side of consciousness.

Thomas Moerland

To improve scientific integrity, all journals should publish peer review files.

Mohamed Abobeih

Slower driving vehicles are beneficial to the environment but not necessarily to road safety.

Kirsten Duivenvoorden

Not knowing the negative consequences of new techniques is not a licence to postpone precautionary measures.

Paul de Vet

There is no such thing as the perfect location for experiments, only great destinations.


César Jiménez-Rodríguez

Women will never be strongly represented in academia if men continue to work more than 50-hour weeks.

Laura-Lynn Fockaert

Self-reliance is vital for residents in developing countries to successfully govern their own lives and economies.

Valentine Uwamariya



## **Alumnus Jan Veraart:** “The things TU Delft is working on are extremely relevant to our society”

**Jan Veraart graduated in Delft in 1964 as a civil engineer. After that, he just started ‘pouring concrete’. In 2000 he resigned as President of the Board of HBG (now the Koninklijke BAM Groep). “I am very well aware of the momentous changes that have taken place at TU Delft and in the Netherlands since my student days, more than sixty years ago.”**

When he embarked on his studies in 1957, Jan Veraart estimates there were around 5,000 students. Today there are more than 27,000 students in Delft. And the population of the Netherlands today is 17.5 million, compared to 11 million back then. These were the first years after the Zeeland flood disaster (in 1953 ed), an event that was an important consideration in Jan's decision to study in Delft.

“Back then TU Delft also trained you for a good profession, in my case concrete. We learned how to build bridges, tunnels, roads. But I can't remember us ever discussing the social relevance of what we were doing. It was just necessary.”

Yet Jan does remember the rector back then, Professor Kronig, once commenting that “the real problem was that people were moving about too much, that things were being dragged all over the place and that everything and everyone was busy going here, there and everywhere.” This was an entirely new concept to him. It was well before 1972, when the Club of Rome published on the boundaries of growth.

“When I hear about the things people are working on at TU Delft today, they are extremely relevant to our society. That's why I still feel so engaged.” It is this sense of engagement that made Jan Veraart decide to become a Good Friend of Delft University Fund.

“Even though as a Good Friend of Delft University Fund I am happy to make an annual donation, I also strongly believe in the importance of a TU Delft alumni community where contributions are given back and passed on in the form of time, effort, knowledge and network. In this way we keep each other on the ball, we share our knowledge across the generations and we all play our part in achieving social impact.”

“And I finally have time to actually read Delft Outlook. I don't understand most of the contents, but it really feeds my sense of wonder. What Delft is doing in cooperation with Leiden and Erasmus, on the cutting edge of technology and medical sciences, for example with non-invasive operations, is unbelievably clever and inspiring. And that is no less true of the climate, sustainability and energy. It is this sense of wonder that made me decide to become a Good Friend.”



### ► **Would you like to become a Good Friend too, just like Jan Veraart?**

As a Good Friend, you become part of a network of engaged alumni. By becoming part of this network, you help students and researchers excel. A five-year, tax-deductible contribution of 500 euros (minimum amount) per year is all it takes to become a Good Friend. For more information, please contact **Machteld von Oven** via **M.W.vonOven@tudelft.nl** or call **+31 (0)6 81 06 06 19**



# ALL IN THE FAMILY

## Chemistry times three

In this series, parents and grandparents discuss their student days with their children and grandchildren. Read the original version here:



After completing secondary school, Quentin van Driel was unsure about what to study next. He was good at sciences, but wanted to do more than just sums. Biology? It seemed boring. He chose something in-between: Molecular Science and Technology at TU Delft and Leiden University. He completed his Master's in Chemical Engineering in June. Quentin was following in the footsteps of his grandfather Eric Houwink, who started studying Applied Chemistry in 1946. What Quentin didn't know, was that his grandmother had followed the same path.

"My grandmother, Han Bhik Hwa – known as Mity after arriving in the Netherlands – was the only woman to receive the Malino scholarship. She started studying Chemistry in Delft, but it didn't suit her. She had to work hard. And, to be fair, it wasn't made easy for her. Not being Dutch and also a woman, she was often ignored, particularly by conservative professors who disapproved of women at university, especially studying chemistry. I've learnt to accept everyone, irrespective of their appearance. Just like grandmother Mity and her motto: 'Take people as they are. Treat others as you would like them to treat you'." 