DELFT OUTLOOK
NO. 2 JULY 2020 YEAR 37
TU Delft

Francine Houben
Child of TU Delft

E-REFINERY
Towards post-fossil energy

Pioneers
Robots to Mars

Cover:
If e-Refinery becomes a reality, fossil fuels are no more needed. Oil refineries have had their longest time. With a sunset in the background they look pretty, but that goes for most things. (Photographer Sam Rentmeester)

Foreword
Tim van der Hagen

Coronavirus crisis

Our usually so lively campus has quickly changed almost beyond recognition, it's unimaginably quiet and peaceful. We had no choice. On 13 March we put all of our teaching and much of our research online due to the coronavirus crisis. This wasn't easy for anyone, but I'm proud of how all of our staff and students have got on with it. Most of the teaching has continued 'as usual', as have the exams.

Meanwhile, we have started preparing for a phased return to campus sometime in the future, but for the time being within the restrictions of the 1.5-metre social distancing requirements. Among other things this means we only have room for about twenty percent of our students at any one time. We will also have to take into account factors such as pressure on the public space. Many people use the same roads, for example, and not everyone has access to an online alternative like we do. How do you divide scarce campus time between the students fairly? After all, it's during your years as a student that you build up a network for your future.

So this sets us with quite a challenge, and we also need to pay attention to everyone's wellbeing. Because being able to work and to study is one thing but you also have to feel safe and be able to enjoy what you do. One thing that has become very clear in recent times, though, is that TU Delft is a resilient organisation and that we will beat this crisis too. I hope the same applies to you and yours, and that this publication finds you in good health.

I am also working from home, and I miss all the people and the encounters – including those with our alumni. So I am glad that you'll be receiving this Delft Outlook as usual. We may not be allowed to shake hands for the time being, but this at least gives us some tangible contact.

Professor Tim van der Hagen,
President Executive Board

PHOTO: SAM RENTMEESTER

02

COLOPHON
Cover photo Sam Rentmeester
Editorial staff Saskia Bonger (editor-in-chief), Dorine van Gorp, Katja Wijnands (managing editors), Annebelle de Bruijn, Tomas van Dijk, Sam Rentmeester (image editor), Marjolein van der Veldt, Jos Wassink
T +31 (0) 15 2784848,
E-mail delftoutlook@tudelft.nl
Contributing writers
Agaath Diemel, Auke Herrema, Deborah Nas, Stephan Timmers
Design Maters en Hermsen
Typesetting Liesbeth van Dam
Printing Quantes
Changes of address:
delftoutlook@tudelft.nl specified by 'Administration' in subject line.

Delft Outlook is the magazine of TU Delft

DELFT IN BRIEF

The QR codes refer to the longer articles. More science news on tudelft.nl and delta.tudelft.nl.

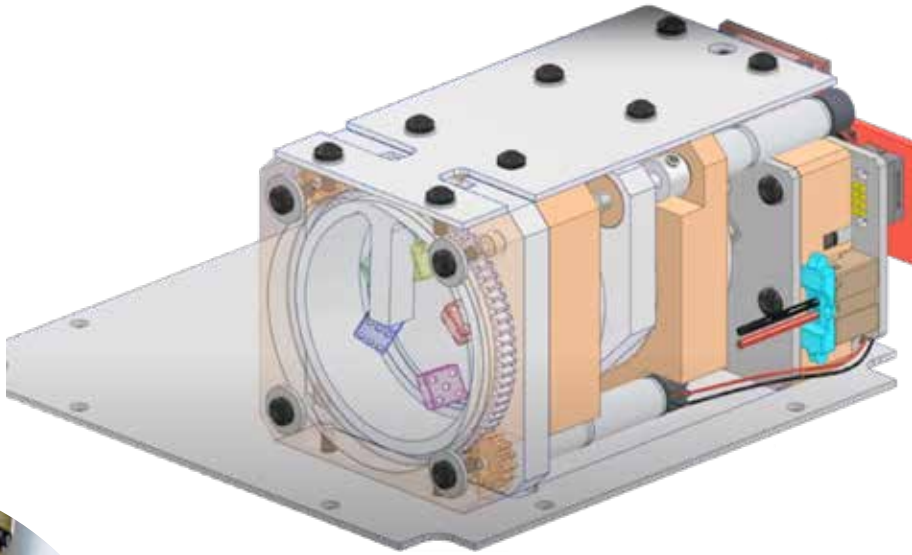


Photo: Sam Rentmeester

Doubts about publication in *Nature*

QuTech's Quantum Computing research group has informed the journal *Nature* that an article published in that journal in 2018 may contain incorrect conclusions. It concerns the Quantized Majorana conductance article by Professor Leo Kouwenhoven's research group. In that article the researchers stated that they had found the most significant indication to date of the existence of the mysterious Majorana particle. But the researchers are now saying that the raw data was processed incorrectly. The article has not yet been withdrawn, although *Nature* has added a warning to it. TU Delft's Integrity Committee is also looking into the matter.

Flying monument

Aerospace Engineering students are building a monument in space to commemorate the 75th anniversary of the study association VSV 'Leonardo da Vinci'. The construction of the satellite will start once the corona measures have been lifted. The students asked schoolchildren to come up with ideas, which led to the idea of constructing a satellite than could throw dice. Students from the Leidsche Instrumentmakersschool are building the dice-rolling part, and Delft students are providing the rest of the CubeSat. The launch is scheduled for next year, after which classes can log on to the on-board camera. The study association previously erected monuments in Ede (1955) and in The Hague (1960), but these were made of stone.

Screenshot VSV Leonardo Da Vinci / Youtube

'Girl in front of the green curtain'

Scientific research into the 'Girl with a Pearl Earring' painting by Johannes Vermeer in the Mauritshuis museum has revealed new insights. Delft researchers from Applied Sciences, IDE and 3mE played a key role in the project. One of the most surprising discoveries was that the background to the Girl is not just an empty dark space: Vermeer painted her in front of a green curtain. Using new techniques, researchers were able to detect diagonals and differences in colour in the upper right-hand corner of the painting, suggesting pleated fabric. The curtain faded over the centuries due to the fading of the green paint.

Photo: Mauritshuis / Ivo Hoekstra

TU Delft for Life | Xperience Week

The TU Delft for Life | Xperience Day is organised every year on campus especially for alumni and associates of the Delft University Fund. In these extraordinary times, the event took place online between 8 and 12 June, and there was not just one Day but a whole Week!
Inspiring online sessions took place over five evenings, covering a variety of themes: Urbanisation & Mobility, Energy Transition, Health & Care, Digital Society and Climate Action. Each evening a different TU Delft scientist gave a live keynote lecture, followed by interactive group discussions. The Alumnus of the Year 2020 was announced – Francine Houben, founder and creative director of Mecanoo architects – and each session ended with a virtual drinks party.
The event was so well received that speakers presented their keynote lectures again live in the last week of June specially for alumni on the other side of the world, in China and Australia for example, and alumni who were on the waiting list.

Student club commemorates surfers

On the evening of Monday 12 May, two members of the Delftsch Studenten Corps died in a surfing accident near the northern pier in Scheveningen. Three surfers from The Hague also lost their lives. Max and Mathijs, 4th and 5th-year students, were members of the Delftsch Studenten Corps and were actively involved in the student club.
'Words cannot express our deep sorrow at the loss of these two young men, who were always so enthusiastic,' writes the DSC. Members created a place of remembrance in front of the club building.

100 years of Institut Teknologi Bandung

The Bandung Institute of Technology (ITB) first opened 100 years ago, on 3 July. The ITB has traditionally had strong ties with Delft. Around 1900 about one third of all Delft engineers travelled to the colony in the Dutch East Indies, but the First World War put a stop to this. In 1917, industrialists and philanthropists raised three million guilders, without the engagement of politicians, to found a technical university in the colony. Delft engineers were closely involved in its establishment. Professor of Applied Mathematics and Mechanics Jan Klopper, for example, worked on the 'Programme of Lessons' and was the first rector magnificus in Bandung. Initially, the Institute only trained civil engineers. The first cohort consisted of 25 students, including one woman. In the Institute's second year, the most famous student from Bandung enrolled: Sukarno, who would later become the first president of independent Indonesia. Even today, there is still a special bond between Bandung and Delft; the two institutions cooperate in the fields of water management and architectural education. The annual Karel Luyben Lecture was scheduled to take place in Bandung in July, but was postponed due to the coronavirus pandemic. Exhibitions at the Faculties of Architecture and the Built Environment and Civil Engineering have also been postponed.

Photo: KITLV

'Just listen'

Photo: Sam Rentmeester

According to Jan Klein, anaesthesiologist and Professor of Patient Safety Engineering, more things go wrong in healthcare than we realise. The professor, who will retire in September, explained in an interview with *Delta* how things can be done more safely. Klein retired as an anaesthesiologist in 2018. 'It's an elite sport, and I doubted whether I'd still be able to respond optimally in a crisis situation.' He has another piece of advice for the medical world: 'The best hospitals are those in which multiple disciplines work together as equals. The world has become so complex, so just listen to each other!'

Bigger than an incident

Crises are normal for Kenny Meesters. He researches and teaches crisis management at the Faculty of Technology, Policy and Management (TPM). Since the end of March, he has been a member of the National Operational Team – Corona (LOT-C). 'This team liaises between the regional security regions, institutions and organisations, and the national organisations,' explained Meesters at the time. Two months later, in late May, he is still involved in the LOT-C, but the team is transforming from being a crisis management team to an organisation that is ready to scale up when needed. 'This is the first time since 1953 that the Netherlands has had a crisis that is bigger than an incident,' says Meesters.

Delft Outlook

Alumnus Freek Jacobs lives with three other TU Delft alumni, but the nine copies of Delft Outlook that come in the post are too much of a good thing. Do you get more Delft Outlooks in the post than you need? Send us an email with the subject line 'Administration', and we will take care of it for you.

Coronavirus and singing in a choir

On a number of occasions, singing in a choir has proved to be a Covid-19 super-spreader event. Physicist and conductor Ivo Bouwmans (TPM) collects relevant research on his website virmus.nl (virus + musician). In addition to his research and teaching on complex energy systems, Bouwmans conducts a choir at De VAK in Delft as well as a church choir. Radio 4 interviewed him in May on the dangers of singing together and he has provided information to the RIVM, which is tasked with giving well-founded advice to the Outbreak Management Team that advises the government.

Photo: P.H. van Straaten

Reuse of face masks

In response to the shortage of face masks in late March, medical entrepreneur Bart van Straten, together with biomechanical researcher John van den Dobbelsteen, developed a face mask sterilisation procedure. In a video about the research, Van Straten says: 'The great thing about the sterilisation procedure is that it can be used immediately and on a large scale. All hospitals already have the necessary equipment and can start tomorrow.' The video was watched more than 20,000 times, and dozens of questions flooded in. The researchers answered them all.

Photo: Screenshot TU Delft TV

Beautiful virus

Photo: Collectie Delftse School voor Microbiologie

When the Delft professor Martinus Beijerinck discovered the phenomenon 'virus' in 1898, it was considered a plant disease. There was 'something' that attacked tobacco leaves. Beijerinck had happened upon an invisible but living pathogen. According to biologist and historian Lesley Robertson, the excitement died down since there wasn't much that Beijerinck could do about it. That all changed in the late 1930s with the arrival of the electron microscope, which made it possible to actually see viruses – some of which, like the coronavirus, looked rather beautiful.

Ventilator arrives in Guatemala

A simple ventilator, built by the Project Inspiration team, has arrived in Guatemala. Why there? Because Mechanical Engineering student Diego Quan Reyes was worried about the coronavirus pandemic in his homeland. The country only had 56 ventilators for 17 million inhabitants. The idea is for the device to be copied by a local manufacturer, and for 50 units to be delivered to the Roosevelt hospital.

Photo: TU Delft

Working towards a fossil-free future

The Delft e-Refinery research institute is developing sustainable technologies for energy and chemicals.

"We are thinking about what the world will need in twenty to thirty years' time and starting to work on that now," says professor Paulien Herder about the e-Refinery research institute that she leads together with professor Bernard Dam.

"If we all want a future free of fossil fuel – which we do – then it's important that we carry out all kinds of research to make that possible. It will take between 10 and 30 years to convert the entire industry and it's important to make a start now because research takes time."

Last spring TU Delft, Shell and funds for knowledge and innovation jointly invested five million euros in the e-Refinery, with the aim of developing electrochemical technology and a sustainable petrochemicals industry.

E-Refinery brings this together in a single project with fundamental materials science research into electrodes and membranes and chemicals research into electrochemical processes and

'Away with all the energy-slurping separation processes in creating a greener industry'

separation techniques. Some researchers are working on scalable reactors, while others are working out how to fit the new technology into the existing industry. Yet others are exploring legislation, regulations and the markets needed to implement the new technologies in society.

This whole range of disciplines is vital if new technology is to have any chance of success. Thanks to the collaboration between five faculties (Electrical Engineering, Mathematics and Computer Science (EEMCS), Mechanical, Maritime and Materials Engineering (3mE), Aerospace Engineering (AE),Technology, Policy and Management (TPM), and Applied Sciences (AS) all this knowledge is available within the e-Refinery research institute in the form of over 30 staff researchers and dozens of doctoral candidates and post-docs.

Carbon dioxide and Sabatier

Accumulation of CO_2 in the atmosphere is the driving force behind climate change.

Read more on page 10

In the e-Refinery a range of researchers are developing electrochemical technology to make the petrochemical industry sustainable.

This is why we need to drastically reduce the level of greenhouse gas emissions, including CO_2, in the coming decades. Unfortunately there are some energy intensive processes, such as steel and concrete manufacturing in which CO_2 emissions are almost unavoidable. Alternative processes are being developed for these, using alternative non-fossil energy sources. Various groups are also investigating how to recycle CO_2 from the atmosphere to use as a replacement for fossil-based raw materials in industry. This does away with new CO_2 emissions into the atmosphere.
One way of using CO_2 as a raw material is to combine it with hydrogen to create natural gas (methane) using the Sabatier process ($CO_2 + 4H_2$ -> $CH_4 + {}_2H_20$ + heat). French chemist Paul Sabatier discovered this process in 1879, together with Jean Baptiste Sederens, and in 1912 he was awarded the Nobel Prize in Chemistry for the discovery.
Originally, at the end of the 19th century, the process was used to convert wood or coal into a natural gas substitute. Nowadays interest is being shown in the Sabatier process as it is seen as a way of storing surplus electricity from solar panels and wind. In this scenario, green electricity can be used to create hydrogen through electrolysis, which when combined with CO_2 forms methane. Methane can be easily stored as an energy reserve, in empty gas fields for example. These can then be used alternatively as energy storage and energy supply.

Electrochemistry

Researchers are also working on a way of using electrochemistry to simplify the two steps of the Sabatier process (first creating and then converting hydrogen) into a single process step. Electrochemistry is a collective name for chemical conversions driven by electrical energy. In the electrochemical conversion of CO_2, ethylene (C_2H_4) or methane (CH_4), for example, are created in a special cell. Hydrogen, carbon monoxide (CO), formaldehyde (HCHO) or methanol (CH_3OH) may also be produced. The substances produced depend on such things as the material used for the electrodes (such as copper, tin, nickel and graphene), the acidity (pH) and the voltage across the cell. Electrochemical processes may be used in the future to convert surplus electricity from solar cells and wind parks directly into chemical resources or fuel. Researchers are working on suitable materials for electrodes and membranes, and at scaling up the reactors.

Separation processes

The scaling up should result in a 100 kW test plant in five years' time. Herder explains: "This equipment would just about fit into our own labs. To build the equipment, we are thinking about what this means for the electrodes, for the type of cells we will be using, and how do we get the electricity inside with high power quality? And how can we keep it safe?

Nowadays there is a lot of renewed interest in the Sabatier process

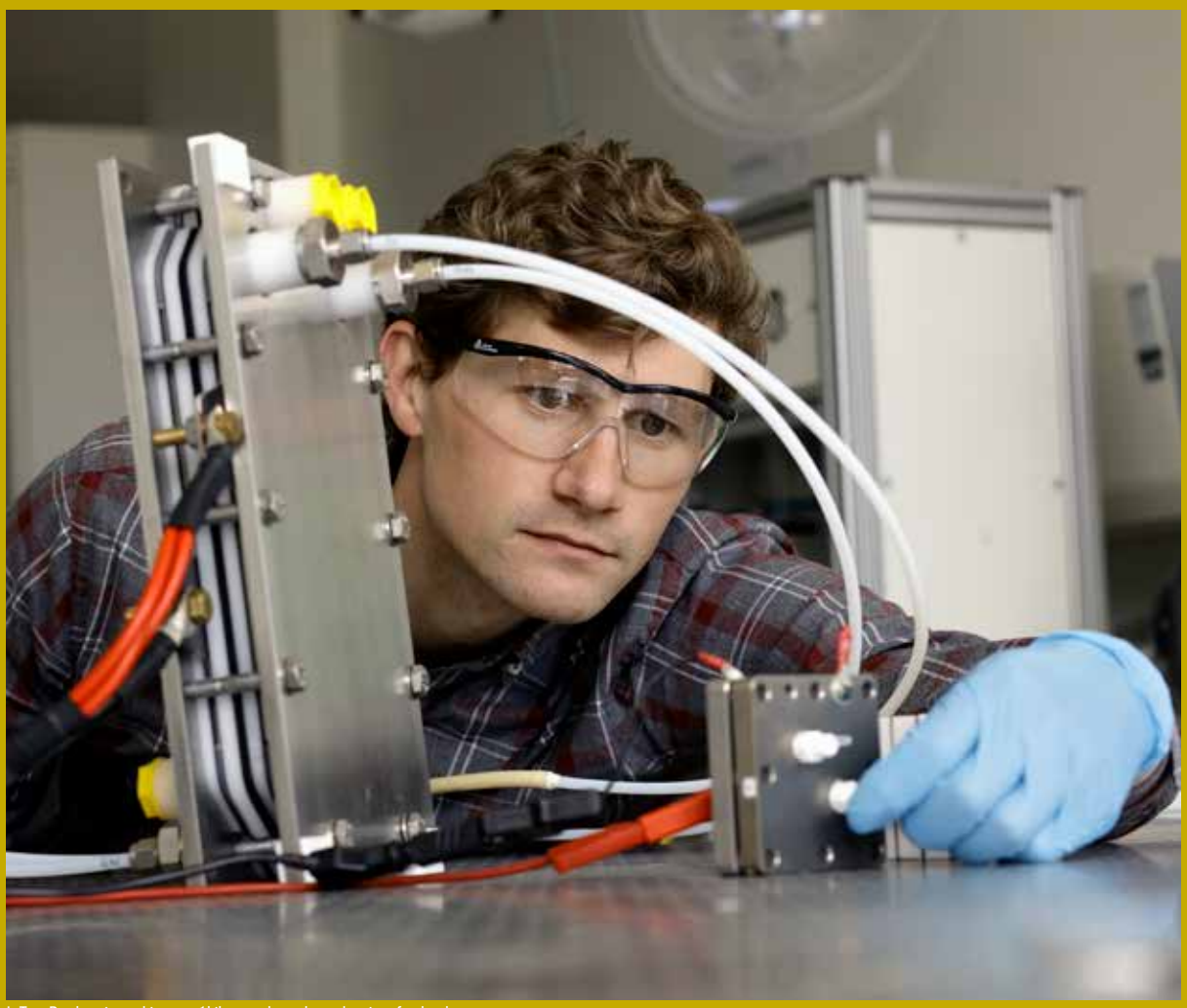
We are presently working on all kinds of designs to be able to achieve this on a large scale."
"We will soon be making a mix of products, and in every chemical process you have to apply retrospective product separation. This will also be the case here, but how should we go about it? Today's chemicals industry uses a lot of energy for its separation processes, for example in distillation. Would it not be better to work with membranes, for example? Or might it be possible to organise the reaction process so that less separation is needed? Maybe the reactor could be designed with this in mind, killing two birds with one stone: doing away with all the energy-slurping separation processes while creating a greener industry."
And the long-term vision? "Just like all the climate-related research, our research is aimed at 2030 and 2050. I just mentioned the 100 kW plant that we want to build; we have set ourselves a five-year deadline for this. That's pretty ambitious. You can also see in our research programmes that we consistently look five to ten years ahead, even in consortia with the government, research institutes and industry. Together with them we want to work towards a fossil-free future." <<

A person exhales around 1 kg of CO_2 per day

The Climate Agreement is aiming for 3-4 gigawatt electrolysis in 2030. That is four sizeable plants pumping their energy into a tank of water.

Last year the proportion of sustainable energy in the Netherlands was 8.6%.

In 2018 greenhouse gas emissions in the Netherlands fell slightly, by 2 %.



Ir. Tom Burdyny is working on a 1 kilowatt electrolyser the size of a shoebox.

Growing pains

Mechanical engineer Tom Burdyny (32) is working on the scaling up of electrolysis plants. The basis of the electrochemical reduction of CO_2 is developed with a small reactor which converts half of a CO_2 gas stream into other gases such as carbon monoxide (CO), methane (CH_4) and ethylene (C_2H_4) using electrical energy. When you scale up this kind of reactor, you encounter all sorts of problems of a chemical, electrical and mechanical nature, explains Burdyny. How can you supply electricity to a multi-cell system? How do you separate the gas flows? And how do you make such a reactor part of a far larger process? A small electrolyser uses 5 watts of electricity and a larger one 200 watts, but Burdyny's goal is to build a 1 kilowatt electrolyser the size of a shoebox within 30 months. In laboratory terms that is a colossal device, but Burdyny is well aware that industry operates in megawatts and tens of thousands of process hours. "The e-Refinery programme was set up to bridge this gap," he says.

Read more on page 12

Professor Wiebren de Jong is converting CO_2 into formic acid that can be used in the agricultural sector.

Formic acid

The plant for the electrochemical conversion of CO_2 to formic acid (HCOOH) is sturdily built, to cope with an internal pressure of 50 bars. This is needed in order to convert the gas in sufficient concentration on the tin-based cathode. The voltage is low (3.5 volt) with 1.5 amp current. In a recent publication researchers Prof. Wiebren de Jong, Prof. Thijs Vlugt (Process & Energy at 3mE), and Mariette de Groen (Coval Energy) reported achieving a current efficiency of 80 percent conversion. "That means a good selectivity of the desired product," says De Jong. That liquid product, formic acid, can be used in the agricultural sector. It can also be used as a base material for synthesis gas (CO and H_2), from which methanol (solvent, chemical building block, and candidate marine fuel) can be made.

This is an interesting conversion for industry as a way of reducing carbon emissions. Waste processor Twence, for example, is keen to use electrochemical conversion to largely meet the compulsory reduction of carbon emission from flue gases. Points for attention in the scaling up needed for this are heat dissipation (tens of percent of the electrical input) and even current distribution.

Dr Wim Haije makes hydrogen from methane, the most important industrial source of hydrogen.

Think the other way round

In the Sabatier process, CO_2 and hydrogen are heated to 650 °C in the cylindrical reactor in the oven, producing methane (CH_4) plus water vapour. The reverse process, making hydrogen from methane, is the most important industrial source of hydrogen. "We already have most of the processes at our fingertips," says Applied Sciences researcher Dr Wim Haije. "We just have to learn to think the other way round." Moreover, the conversion is an equilibrium reaction with $_4H_2$ and CO_2 on one side and $_2H_2O$ with CH_4 on the other. So you have a mixture of gases, unless you push the reaction one way by capturing water, for example. Then the water cannot react back, leaving you with almost pure methane. Haije captures the water vapour using zeolites, molecular sponges, that can absorb up to 25 percent of their own weight in water. The zeolites are also impregnated with a nickel catalyst. Once the zeolite is saturated it can be heated for re-use.

Dr Ruud Kortlever uses electrocatalysis to convert CO_2 into other substances.

Barrel of surprises

In Dr Ruud Kortlever's research group, electricity is used in electromagnetic cells to convert CO_2 into other substances that can be used as fuel or chemical material. This process is called electrocatalysis, the electrochemical reduction of CO_2 as it bubbles through the cell. What substances are formed depends greatly on the material used for the cathode, as well as the electrical voltage. A gold or silver cathode produces carbon monoxide (CO) in the solution. A copper cathode produces a mixture of hydrocarbons such as methane (CH_4) and ethylene (C_2H_4), an important base material for the chemicals industry. Formic acid (HCO_2H) and methanol (CH_3OH) may also be formed. The modest electrochemical cell turns out to be a barrel of surprises. The research is aimed at gaining better control of the chemical processes through the choice of electrode materials and other variables. What Kortlever would most like to see is longer chain hydrocarbons grow on the cathode like in the Fischer-Tropsch process in refineries.

Dr Ludovic Jourdin feeds his Australian bacteria purely on electricity.

Electric bacteria

When the French Dr Ludovic Jourdin joined the e-Refinery-programme, he brought his own bacteria culture with him. He had extracted the bacteria from mud in Queensland, Australia for his PhD research, and fed them purely on electricity. These electric bacteria live in a reactor as a biofilm on the cathode where they reduce CO_2 to organic molecules such as acetate (CH_3COO-) or caproic acid, both of which are platform chemicals for the chemicals industry. This conversion process is known as microbial electrosynthesis and is the third conversion route in the e-Refinery programme (alongside electrocatalysis, and the indirect route using hydrogen). Two PhD candidates have joined Jourdin's research group in the Faculty of Applied Sciences: Merijn Winkelhorst is studying the bacterial genomes to unravel the molecular processes of their CO_2 conversion, while Oriol Cabau Peinado is working on the reactor design. He is systematically eliminating the obstacles to creating a scalable design.

‘I’m a child of TU Delft’

Her designs include Mekel Park and the campus library. TU Delft owes its appearance in no small measure to the architect Francine Houben, who has been named as this year's Alumnus of the Year. "There's a tremendous amount of energy here for making things happen."

TEXT TOMAS VAN DIJK PHOTOS SAM RENTMEESTER

CV

Francine Houben (born 1955) is founder and creative director of Mecanoo architects. She studied at TU Delft from 1974 to 1984. At Mecanoo architects, her designs included the TU Library and Mekel Park. Houben has a wide-ranging oeuvre ranging from theatres, museums and libraries to residential areas and parks. She designed Europe's largest library, located in Birmingham. She has written several books: 'Compositie, Contrast, Complexiteit' (2001, 'Dutch Mountains' (2011) and 'People Place Purpose' (2015), and was professor of mobility aesthetics at TU Delft. She lectured at Harvard University and Yale. In addition, she was director/curator of the first International Architecture Biennale Rotterdam. Since 2010 Houben has been a member of the Berlin Akademie der Künste. Houben has been a member of the Society of Arts in the Netherlands since its foundation. In 2015, she received the Prince Bernhard Culture Fund award for her oeuvre. Houben has also received honorary doctorates from the University of Utrecht and the University of Mons. She is the only Dutch person on the Debrett's list of most influential people in the UK, in recognition of her unconventional approach to architecture.

First stop for contacts and clients: The office of Mecanoo architects at Oude Delft. This is followed by a regular route including stops at Delft station, Mekel Park and, obviously, the iconic central TU Delft Library. There are buildings by Houben across the globe, including a huge cultural centre in Taiwan, residential towers in South Korea and renovated libraries in New York and Washington. But to illustrate her vision, Houben prefers to take her clients on a tour of Delft, the environment that shaped her. These days, such tours must take place virtually. That includes this interview on 15 May.

You are successful, and you have made a huge mark on TU Delft, so you were bound to be named Alumnus of the Year at some point. Were you expecting this nomination?

"I didn't know the award existed, but I'm delighted."

You say that your works on the campus stand for co-operation. Could you elaborate on that?

"When I was studying here, from 1974 to 1984, each faculty was an island unto itself. In 1992, when I was designing the library, I spoke with researchers from all disciplines – from civil engineers to mathematicians – and Wubbo Ockels. I drew inspiration from all directions. We wanted to create a new future, and to bring people together. The library and Mekel Park, with its gentle green hills and kilometre-long bench, invite people to meet up. The university exudes green engineering and the makerspace. There's a tremendous amount of energy here for making things happen. I'm proud of that. It's unfortunate that the Faculty of Architecture and the Built Environment has not been in that flow of people at the campus since the 2008 fire."

It's a strange day. You should have been opening a library in New York today.

"I should have been in New York all month for the opening, but the city is in lock-down due to corona. I was supposed to be interviewed by the New York Times today. We have a library due to open in Washington in September, and another in Tainan in Taiwan later in the year. It's an unusual year. They've started calling me the library whisperer in the US."

Are the buildings corona-proof?

"Looking at our designs in view of the coronavirus situation, I think we've done well. Our buildings are suitable for the social distancing society. The library in New York has wide staircases, and you're not dependent on the lift. The building invites people to walk. And there are large tables so people can study without being too close to each other. Hygiene is important, too. The library is easy to clean. That's been an important issue for me for years."

You planted the seeds for success in your early twenties. In 1980, you founded the Mecanoo architects' firm together with fellow students. What was it like in those days?

"We weren't taken all that seriously while I was studying architecture. The rest of the university regarded us as some kind of playschool.
It was a time of democratisation and urban renewal. That didn't go unnoticed at TU Delft. Many architects went into politics. I also wanted to be part of the flow of democratisation and change, but by designing in a service-oriented manner. We began with our start-up, Mecanoo architects, long before the word start-up existed. It was an inspiring time. There was a major economic crisis, but our enthusiasm made us fairly oblivious to it. We worked non-stop. It has always been that way. We focused on urban renewal, housing and public space in Rotterdam, Amsterdam and The Hague. In 1983 we won our first major award for housing for young people at Kruisplein in Rotterdam. The fact that social housing could be seen as an architectural assignment, as we did, was an eye-opener for the Netherlands and the rest of the world."

'The main challenge is to keep people healthy in cities'

What was innovative about it?

"We were from an era in which housing was simply seen as a product. It didn't have to look particularly good, it just had to be built. We questioned that. I was a child of TU Delft. I saw housing as an architectural assignment; it had to look good, be properly built and offer decent facilities. It was a conceptual turning point. Since then, the Netherlands has produced some very good housing architects and has become a pioneer and a source of inspiration in the field."

You recently said in an interview that people need beauty, and that it was OK for beauty to have a price. Are you worried that less money will be available for architecture as a result of the coronavirus crisis?

"Architecture is never allowed to cost a lot in the Netherlands. It's never excessive. But I don't think the crisis will lead to less attention for architecture. Good architecture and urban planning are now more important than ever. There's a need for architecture and urban planning that encourages movement. You have to be able to walk and cycle in cities. Links are needed between the built environment, nature and biodiversity. The main challenge is to keep people healthy in cities. At the same time, community spirit is becoming more important. People are talking to their neighbours more again. I'm pleased that young architects and students are focusing much more on end users. People are central to them, as they were for us in the seventies and eighties."

Railway station areas, campuses, theatres, residential buildings. You seem to have built everything! What are your ambitions now?

"I have my growth rings. I do something different every few years. After working a lot on theatres, museums and libraries in recent years, I'm now enjoying looking at architecture and urban planning more holistically. I've developed a vision for Rotterdam Zuid, an area that is home to 200,000 people. In that vision, I outline how you can intertwine housing, the knowledge economy, the manufacturing industry, mobility, water management and the energy transition. As an architect, I visualise that societal task. And as an engineer – I'm from TU Delft – it's a gratifying challenge to bring all those tasks together. I could not have done this aged 25. Hardly anyone looks at spatial planning on such a large scale any more. They did in the past, though. You had VROM, the Ministry of Housing, Spatial Planning and the Environment, which applied itself to that. The art of spatial planning in the Netherlands has been pretty much killed off in the past decades."

What does the future hold?

"Three years ago I was saying that I wanted to focus more on the Netherlands. The coronavirus crisis is making that more self-evident. But you never know how things will turn out. With good clients, we can do significant things for the future. The interaction between architect and client is crucial in this profession. A good client will embark on an adventure with you, resulting in a better and more beautiful world." <<

Since 2011, the Delft University Fund has awarded the Alumnus of the Year Award to alumni who have earned their spurs in the world of innovation and research. The winners will receive a plaque on the Alumni Walk of Fame in the Mekelpark.
Want to know more?
Go to alumni.tudelft.nl/alumnusoftheyear

Investing in talent is particularly important right now

For President of the Executive Board Tim van der Hagen, the coronavirus pandemic emphasises the huge importance of TU Delft's work: groundbreaking teaching, research and innovation, and there is a role in this for the new TU Delft Excellence Fund.

TEXT: AGAATH DIEMEL
PHOTO: TU DELFT

"When I handed in my previous copy for Delft Outlook, we in Europe still thought that the coronavirus pandemic would leave us largely unaffected," says Tim van der Hagen. "Now we know better. We have no idea what the world will look like by the time you are reading this, but it seems clear that Covid-19 will be around for a long time and will affect us all, personally, economically and socially." For Tim van der Hagen, the coronavirus pandemic emphasises the huge importance of TU Delft's work: optimising an ecosystem for groundbreaking teaching, research and innovation. He sees a great role in this for the new TU Delft Excellence Fund. The last few months have given us a close-up view of what such an ecosystem can achieve. Van der Hagen: "Our researchers and students joined forces to work together with social research partners on combating the coronavirus problems and achieving the transfer to the new social-distancing society." TU Delft will be continuing these efforts in the coming time, funded in part by the TU Delft Covid-19 Response Fund.

Huge challenges

Looking ahead to the post-coronavirus era, Van der Hagen sees a society faced with many challenges, old and new. Because even though issues such as climate change and the energy transition may seem less important right now, they cannot be ignored. "They will have to be tackled against the background of the impending economic crisis, but must also be seen in the light of the lessons we are now learning on the consequences of globalisation – and what that will mean for production, distribution and transport networks, for example." And a revolution also awaits the healthcare sector, where we will have to deal with the problems that have come to light during the present crisis.

'The success of our mission – impact for a better society – stands or falls with the right people'

These are complex, interrelated issues, but issues that TU Delft loves to get its teeth into. "It corroborates our vision for an ecosystem in which top-class science, innovation and a new generation of engineers can flourish to their best," explains Van der Hagen. "We are working to strengthen that ecosystem in all kinds of strategic ways, through international academic partnerships and intensive collaboration with fellow universities in the region." These include our close links with Erasmus University Rotterdam, Erasmus MC, Leiden University and LUMC.
TU Delft is continually working on

educational innovation, so that it meets the expectations of ambitious students and to ensure that our graduates' competences meet the needs of a changing world. We are presently working hard on a new framework for the Master's degree programmes between now and 2030. The campus is also becoming more and more of a platform for public-private partnerships and open innovation, a place where companies and researchers work together on the innovations needed to answer the huge societal challenges.

Margin for negotiation

The success of our mission – impact for a better society – stands or falls with the right people, which is why TU Delft is constantly looking for top-class researchers in crucial knowledge fields. But how can TU Delft distinguish itself on an international playing field? "We have a campus and a community to be proud of, an excellent international reputation and a host of inspirational top-class scientists as examples to follow in our midst," says Van der Hagen. "Looking at the financial aspect, then our margin for negotiation is somewhat limited. As a public organisation, it is only right that we must keep to the salary standards set by the government and the VSNU. Even though we are successful in general in winning Dutch and EU research grants, the success rates for individual scientists are often discouragingly low."
"We know from experience that money is not usually the decisive factor for researchers choosing to come and work at TU Delft," explains Van der Hagen. "When asked, our 'internationals' praise such factors as the research climate, the safe Dutch society and the university's horizontal organisational structure. But a financial starting contribution can make the choice just that bit easier: it makes it possible to purchase a special research instrument, to start a new lab or attract research assistants."
A flying start like this more than pays its way: it makes the research group more attractive, it raises the standard of teaching and research, it strengthens TU Delft's international reputation and it increases the chances of success in finding external funding.

In 2019 alumni and friends of TU Delft established the Excellence Fund, specially aimed at developing our excellent ecosystem.

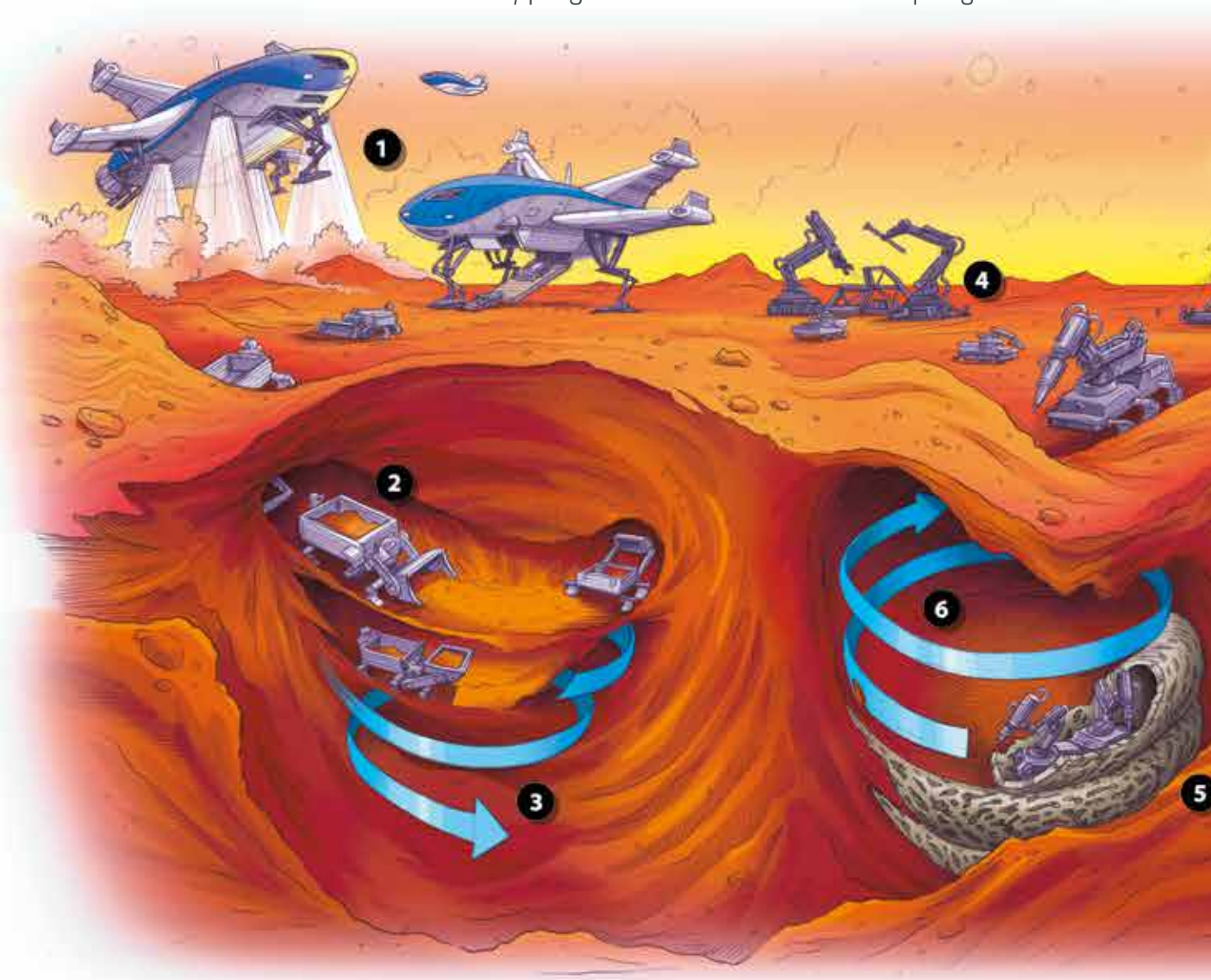
Excellence Fund

Until recently, the options for this were limited because the university does not have any non-discretionary funds for this purpose. However, in 2019 alumni and friends of TU Delft established the Excellence Fund, specially aimed at developing our excellent ecosystem. "The Excellence Fund has considerably improved the starting position of TU Delft in the international 'war for talent'. I am proud and grateful for that," says Van der Hagen in closing.<<

TEXT: JOS WASSINK ILLUSTRATION: STEPHAN TIMMERS

Will the first **Martians** be robots?

Start by sending a swarm of robots to Mars to prepare the way for human pioneers. This was the plan that took Henriette Bier and Roland Schmehl to the second round of an ESA Discovery programme ideas contest this spring.



If it all goes ahead, the first Mars pioneers can look forward to an amazing stay after an eight-month journey. The shiny round windows on the surface of Mars will already be visible from their Mars lander (9). Still a bit stiff, they walk to the entrance in their space suits. Luckily, gravity here is less than half that on earth. Dust and sand blow against their visors and around their boots. Behind them, kites fly in figures of eight in the red sky (7). A hatch provides access to a narrow tunnel. The corridor slopes gradually downwards before bending left. After a few more turns, they reach the end of the tunnel, and enter an egg-shaped space with rough walls (10). Daylight comes in from almost ten metres above. This rounded, almost sacred space, is one of many. Together, they constitute the accommodation for the first generation of Mars pioneers, who can now start setting things up, growing food, and getting on with whatever prompted them to come here.

Read more on page 22

1. Landing of first spacecraft on Mars
2. Commencement of excavation work
3. Downward spiral
4. Start of construction of kite/charging station
5. Start of reinforcement
6. Upward spiral
7. Activation of charging station
8. Excavation of accommodation
9. Landing of first colonists
10. Occupation of accommodation


TU researchers Roland Schmehl and Henriette Bier.

Rootstock

This arrival on Mars might sound like science fiction, but the underlying idea did take TU researchers Henriette Bier (BK) and Roland Schmehl (AE), together with students and colleagues, to the second round of the ESA Discovery programme. Bier and Schmehl, both from Germany, live under the same roof. At the Faculty of Architecture and the Built Environment, they developed methods for robots to build structures that often look surprisingly organic. At the Faculty of Aerospace Engineering, he conducts research into energy generation with large kites (up to 100 m2 and potentially larger) – proceeding from an idea conceived by the late Wubbo Ockels. It should be no surprise that builder robots and energy-generating kites are at the basis of the plan Rhizome: Development of an Autarkic Design-to-Robotic-Production and Operation System for Building Off-Earth Rhizomatic Habitats, involving eight researchers and students apart from Bier and Schmehl. Rhizome is the botanical term for a rootstock with buds from which new plants emerge. Apart from the similarities of form, the symbolism must also have played a role in the name choice.

The robotic building workshop of the BK City building contains examples of such small rhizomes. They consist of double-walled half domes with a complex internal structure produced by a robot in a 3D printing process. The researchers continue to be inspired by the porosity, complexity and variety of surface structures afforded by robotic building. Bier praises "the potential of robots for improved structural performance, reduced material consumption, increased production speed and enhanced insulation properties."

Molebots

The rhizomes owe their rigidity and load-bearing capacity to the internal structure between the inner and outer walls. On Mars, excavation robots will first start (2) digging tunnels in the ground. Schmehl jokingly refers to them as molebots. The debris and material left behind by the molebots can be combined with molten sulphur to form a kind of Mars concrete

> Working together as a swarm, the robots excavate, remove material, inject and print Mars concrete

that can be used to reinforce the tunnel walls (5). Bier believes there is sufficient sulphur and suitable material (regolith) on Mars to build in this way. The internal bearing structure is formed by helical tunnels (3) which create the cavities in the dome-shaped structures.

Working together as a swarm, the robots excavate, remove material, inject and print Mars concrete with a 3D printer (6). This type of co-operation between robots is inspired by collective behaviour in nature, such as flocks of birds flying in formation or termites that build structures thousands of times bigger than themselves. The robots intercommunicate, each knowing its role, and the whole is greater than the sum of its parts. The loss of a few robots, birds or ants here or there will not really affect the result.

The swarm first works together in a coordinated manner to create tunnels in increasingly wide circles and then gradually makes increasingly small ones before coming together again at around ten metres below the surface. The result is an ovoid structure in the Martian ground. When all the material has been removed from the interior of this egg (8), and a window has been placed at the surface, the rhizome becomes visible.

Exploration

Obviously, the robots will need energy to do all that. With the German aversion to nuclear energy, that wasn't an option. And there is little sunlight there, so solar energy could also be discounted. The air density on Mars is low (less than 1% of the earth's atmosphere), but the average air velocity is high (force 4-5). Together with a team of students, Schmehl is going to design a renewable energy system (4) that is optimised for use on Mars.

About ten TU Delft students can sign up to help work on this project. At Architecture and the Built Environment, twenty students participated in a Robotic Building workshop to explore the design and materialisation of accommodation on Mars.

The results will be presented this year as a detailed proposal for the next round of the ESA Discovery contest. <<

How Delft engineers are fighting the coronavirus

Delft students and scientists are contributing to the fight against the coronavirus. Thanks to the TU Delft Covid-19 Response Fund they can access funding quickly, so that valuable time is not wasted.

TEXT: UNIVERSITEITSFONDS DELFT PHOTOS: UNIVERSITEITSFONDS DELFT

Prime Minister Mark Rutte visited the OperationAIR team that developed an emergency respirator in three weeks.

Soon after the outbreak of the coronavirus pandemic, many Delft scientists and students launched initiatives to use Delft technology to help combat Covid-19. To support them, TU Delft and the Delft University Fund set up the TU Delft Covid-19 Response Fund, which to date has awarded more than €230,000 to sixteen projects in Delft. More than 900 alumni have contributed to the fund.

Air for All: OperationAIR

In just three weeks' time, TU Delft students developed a working prototype for an emergency ventilator for coronavirus patients: the AIRone. Thanks to the financial support from the fund, the team were able to buy parts. After undergoing all kinds of tests (functional, mechanical, safety, user), the device was modified and is now ready

Read more on page 24

to use. Eighty devices are currently in production. “The design, along with the test results and other documentation, is now available on an open-source platform so that other initiatives can start using the AIRone as well,” says Marijn Mostert, head of the testing team. In the Netherlands, the number of ICU admissions, and therefore the need for ventilators, has decreased considerably, so the students are now focusing on sharing their knowledge internationally.

Air for All: Inspiration

This ventilator is based on a proven mechanical principle and works without software, making it especially suitable for low-income countries.

Air for All: BTB Breathe

Researchers are testing the first prototypes of a ventilator that consists entirely of standard parts. These parts are available locally almost all over the world and can be produced by many manufacturers.

Project Mask

Due to the shortage of medical face masks, hospitals are looking for alternative suppliers. But how can you test the quality of those masks? Project Mask has pooled expertise to set up test facilities and support validation activities. You can find this study on the RIVM website.

Virus evolution and exit strategy

At the request of the RIVM, scientists are working on a special algorithm to forecast the evolution of the coronavirus. They are also working on an exit strategy.

Further Covid-19 Simulation Development

Researchers are using the Python COVID-19 Simulation project to gain insights into various exit strategies via a simulation platform.

Multifunctional UVC LED test platform

The coronavirus has been shown to be susceptible to a certain dosage of UVC light. To better understand this process, researchers are developing a test platform. They also hope to develop mini-UVC LED decontamination devices that can be used on door handles, taps, lift buttons and even smartphones.

We\Visit

“The Reinier de Graaf hospital was in need of a communication tool for its ICU,” says Dr. Elif Özcan-Vieira, director of TU Delft’s Critical Alarms Lab (CAL) and head of Care Technology at Erasmus MC’s ICU. “The patients were not only suffering from the coronavirus, but also from loneliness. I immediately felt that I had to do something about it.” In collaboration with Willem-Paul Brinkman, who uses virtual technologies to combat phobias (Faculty of Electrical Engineering, Mathematics and Computer Science), and psychologist Merijn Bruijnes, they came up with the idea of video-calling, set up in such a way that it wouldn’t put any further strain on the nursing staff. A prototype of We\Visit was ready within a week. The patient’s family can use a code to log in and to schedule a virtual appointment. At the agreed time, someone at the hospital sets up the video connection via a tablet. “EEMCS students did the technical implementation, all on a pro bono basis and in addition to their exams.” The application, Jitsi, is open source so it can be used by anyone.

Thanks to We\Visit, patients in care institutions can make image calls with their families.

Project Safeguard

Researchers are developing mobile testing facilities where patients can be helped without healthcare professionals having to wear personal protective equipment. The MediTent is intended for out-of-hours GP surgeries and MediShield for immobile patients.

ResilientSociety

Initiatives have cropped up all over the Netherlands to combat Covid-19. TU Delft has set up the digital

Project Safeguard separates patient and nurse. (Photo: AD / Fred Leeflang)

ResilientSociety platform where the business community, healthcare organisations and universities can effectively bring supply and demand in society together.

Relaxation of coronavirus measures

What does the Dutch population think about the relaxation of the coronavirus measures? Researchers surveyed the opinions of 30,000 Dutch people.

DelftScope: affordable video laryngoscope

There has been a sharp increase in the need to insert ventilation tubes using a video laryngoscope (VL). Thanks to video laryngoscopy, healthcare practitioners don't have to stand as close to patients – they can look at a screen rather than in the patient's mouth. VLs are expensive and are therefore scarce in low-income countries. Researchers are working on a new prototype using a low-cost screen with a simple user interface.

Agent-based simulation of the coronavirus pandemic

How is the coronavirus pandemic affecting people, society and the economy? To gain a clearer understanding of this, researchers are using agent-based modelling, a kind of simulation of how a population responds to certain measures.

Researchers developed a video laryngoscope with a greater distance to the patient, the DelftScope.

Endoscope

What specific surgical risks need to be taken into consideration for abdominal surgeries on patients with coronavirus? Researchers are trying to find an answer to this question.

Masks Off

Masks Off is an online platform where nurses can share their daily experiences. Its aim to help them safeguard their mental health.

The spread of coronavirus in indoor air

In the SenseLab at Science Centre Delft, a test installation is being built to visualise the spread of aerosols under various conditions. The objective is to be able to provide advice on ventilation in, for example, office spaces.

Thank you!

On behalf of all our researchers and students, we would like to thank you for your involvement and valuable donations. Your support is always welcome. To find out how you can help, visit universiteitsfondsdelft.nl/covid-19.

Want to read more about the projects supported by the fund? Universiteitsfondsdelft.nl/supported-projects

IN PERSON

TU Delft alumna **Lefki Loverdou** has been awarded the Marina van Damme grant for 2020, giving her 9000 euros to spend on her career. "I want to learn more about the process of developing and implementing innovations," said the hydraulic engineer after the online award ceremony. She aims to use this award to follow a two-year programme at the Erasmus School of Management. "Ever since I was young I have been fascinated by large engineering projects; they can have enormous societal impact," she told Delta. "I love civil engineering, especially its social aspect, which is something that is becoming steadily more important. Climate change, for one, shows us that we must protect ourselves better for the future." During the programme she hopes to develop a toolkit she can apply in her work.

Jury chair Professor Marina van Geenhuizen explained why Loverdou was the jury's choice: "In particular, the jury appreciates Lefki's systematic reflection and approach towards achieving her ambitions, making the switch from technical engineering to more general multidisciplinary innovation management."

This grant, made possible by TU Delft alumna Dr Marina van Damme, is awarded annually to talented female alumni to provide female engineers with opportunities for further development.

Where's the technologist?

When it became clear in late February that the coronavirus had also reached the Netherlands, our lives quickly changed. Just days later we were greeting each other with a foot kiss or shaking elbows, many started working from home, and mums and dads became at-home teachers.

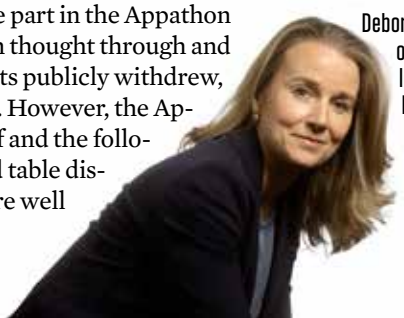
The government, advised by the Outbreak Management Team (OMT), made decisions that had a huge impact on our freedom of movement. The OMT is comprised of various experts, such as doctors, virologists, epidemiologists and microbiologists, but I found myself asking, where are the technologists? Our systems thinking and solution-oriented approach could surely prove very beneficial? It wasn't a deliberate omission, just that no-one thought to ask us.

Technologists are not permanent participants in the OMT and people have a tendency to choose people who resemble themselves. This is one of our subconscious biases that obstruct diversity. Diversity in the traditional sense of the word, such as gender, sexual orientation, cultural background or age. Or, as in this case, diversity in expertise.

In April something interesting happened: technologists were given a major role. The Ministry of Health, Welfare and Sport published a market consultation 'Invitation for smart digital solutions for coronavirus'. Over 700 teams spent their Easter weekend writing a proposal that had to be submitted three days later. The process for selecting seven proposals from the 700 to take part in the Appathon had not been thought through and several experts publicly withdrew, a disgrace. However, the Appathon itself and the following round table discussions were well organised, although here too there was a distinct lack of diversity in expertise. I stood on the virtual sideline watching a thrilling battle between technologists demonstrating a great technology push, and privacy experts who beat them back with their privacy legislation. The goal, to support tracking and tracing by the Municipal Health Service, seemed to have been lost sight of altogether. As a result, the government is starting again and building an app itself.

Now we have got the virus reasonably under control, it's time to look ahead. According to the experts, the question is not if there will be a second wave, but when. And then technology can play an important role. It can facilitate the social distancing society, for such things as booking a seat on public transport, access control, crowd management, and much, much more. Apps and tokens can make contact tracking and tracing much easier and algorithms can predict the spread of the virus. Multidisciplinary teams at TU Delft are presently preparing the start of the new academic year. The different perspectives within such teams are incredibly important for finding good solutions.

This should be copied at national level. How are we going to organise advisory teams for the next phase? The government and the OMT should involve technologists more often. But let us first and foremost search our own conscience and take an active stance as TU Delft alumni.



Deborah Nas is part-time Professor of Strategic design for technology-based innovation in the Faculty of Industrial Design Engineering and an innovation expert. She studied industrial design engineering at TU Delft.

THE FIRM

They were each taking a completely different degree programme, yet came into contact with the same material. Now TU Delft alumni Mark Postel and Joost Vette are working together to make the construction sector more sustainable.

"We use solid-state fermentation with a fungus to create circular applications for the construction industry from biomass," says Architecture graduate Marc Postel, pointing to a glass jar containing dried chips from a tomato plant. "In layman's terms you could say we are making tempeh with the properties of expanded polystyrene."
Together with Industrial Design Engineering graduate Joost Vetter, he launched the start-up Fairm.
In their office and lab in The Hague, the two men are carrying out research on mycelium – a filamentous network of hyphae – that acts like a sort of glue and joins plant remains together, for example. They have now succeeded in using this to make panels which can replace rockwool and expanded polystyrene. "Two materials that are widely used in internal and external construction, even though they have a relatively large carbon footprint."
It is reducing this carbon footprint that motivates them. "Our main goal is to have a positive impact on the environment."
It was their shared interest in mycelium that brought Vette and Postel together in 2018 despite their different academic backgrounds. They both encountered mycelium during their degree programmes. They saw that research had been carried out around the world for over ten years, but it generally remained at the same level. Vette: "The only thing you can buy from this material right now is a vase or maybe a sculpture. We want to make real steps forward and get this material ready for large-scale applications."

Joost Vette (left) and Marc Postel making panels from mycelium and reducing the carbon footprint of the construction sector.

Company:	Fairm (previously Fungalogic)
Founders:	Marc Postel and Joost Vette
Degree programme(s):	Building Technology and Integrated Product Design
Products:	Fairm-Foam: 100% natural and circular pressure-resistant insulation material
Founded in:	2020
Employees:	2
Turnover:	As yet negligible
In five years' time:	"Rolling out a million square metres per year, making natural the new normal for interiors."

And that is a real challenge. Fairm's products are already used in system ceilings, for example, as partitions between desks or as wall materials in telephone cubicles, but Postel en Vette have not yet been able to move on to affordable large-scale production. "Right now we know the parameters for small-scale production, but for large-scale production they are completely different. So now we are looking for partners who want to buy the product on a large scale as well as join in the production process."
Does the construction sector need such a product? Postel thinks it does. "Everything has to be made of concrete, glass or steel, and there's often a lack of a sustainable vision." Yet they are seeing hopeful developments. "In countries such as Austria, Denmark and Germany, biobased building has become far more mainstream. And things are changing in the Netherlands too, as part of the circular economy concept." Besides this, the people striking for the climate today are the businessmen and women of tomorrow. "That will really change the market from the inside out."
Vette and Postel are convinced that ten years down the line, every new building will contain a little bit of Fairm. "We have the drive to prove that this is possible." AB

Photo: Sam Rentmeester

TEXT: AGAATH DIEMEL PHOTO: GUUS SCHOONEWILLE

‘After 6 years at TU Delft I felt able to conquer the world’

Joop Heijenrath studied hydraulic engineering in Delft in the 1980s. Throughout his varied career, he stayed in touch with his alma mater. These days, as a Good Friend of the Delft University Fund, he is working hard to ensure that his fellow alumni get the same kind of bond with TU Delft that he has.

Joop Heijenrath: “That way, giving back to the institution to which you owe so much becomes much more natural.”

Born in Maastricht, Joop Heijenrath opted to study Civil Engineering at TU Delft in 1980 with a view to an international career. “I thought I should choose something that the Netherlands is very good at, and hydraulic engineering is the pride of Holland.” After his graduation he joined the Hollandse Beton Groep (HBG), then the largest construction company in the Netherlands. For HBG

he was involved in the construction of a concrete protective wall around an oil storage tank in the Norwegian Ekofisk oil field. “The extraction of oil and gas caused subsidence to the field, bringing the platforms and installations within reach of the sometimes twenty-metre waves. Building that wall with a diameter of 140 meters and a height of more than 100 meters was a gigantic project, involving a lot of Delft knowledge and experience”, says Heijenrath.

Career switches

Things couldn’t get much better for a civil engineer, he thought, so when the opportunity presented itself he became a strategy consultant at the company of strategy guru and Harvard professor Michael Porter. It would be the first of several career switches. After an MBA at international business school INSEAD, Heijenrath worked for an American IT multinational, then launched the first mobile phone network for KPN, and eventually became an entrepreneur. “I met some developers working on speech technology software, who were looking for people to market it worldwide,” he says. “Together with a colleague from Virgiel and several INSEAD alumni, we set up a company for that purpose: ReadSpeaker.” ReadSpeaker is now number four in the world of speech technology. “That is very special, especially because we launched the business from the kitchen, as it were. Since the sale of ReadSpeaker, Heijenrath has focused on investing in start-ups and coaching young entrepreneurs.

> ‘We do not have the same kind of culture in the Netherlands as there is abroad’

Learn, earn and return

These days, Heijenrath is also a Good Friend of the Delft University Fund (UfD), a network of alumni and other relations who financially support TU Delft. “As a Good Friend, I have gained so much insight into how the university operates. It’s interesting to see how hard the Executive Board is working to put TU Delft on the world map with top researchers and projects. The impact of TU Delft on themes like climate action, mobility, urbanisation and energy transition is impressive.” Heijnrath now wants to use his experience as a fundraiser for Business School INSEAD to support the UfD. “We do not have the same kind of culture in the Netherlands as there is abroad, where giving back to universities is more common. We tend to think that tuition fees paid at the time and the taxes we are paying now are sufficient. This should not be taken for granted. Alumni also owe a lot to TU Delft”, says Heijenrath. “The knowledge and analytical skills that you gained since the age of eighteen have brought you where you are today. When I came here after secondary school I couldn’t do anything; six years later I felt capable of conquering the world. In that respect, I agree with the philosophy of many of my Anglo-Saxon friends and colleagues. There are three phases in life, which can be described as: Learn, Earn and Return. That way, giving back to the institution to which you owe so much becomes much more natural.” <<

WILL YOU BE A GOOD FRIEND TOO?

Like Joop Heijenrath, do you want to be part of a network of involved alumni? As a Good Friend you will receive invitations for top events including the annual Taste of Excellence Dinner, the festive closing of the TU Delft Best Graduate Award Ceremony. With a five-yearly, fiscally attractive donation of (at least) 500 euros per year, you become a Good Friend. Do you want to sign up or do you have any questions? Please contact Machteld von Oven via m.w.vonoven@tudelft.nl or visit www.universiteitsfondsdelft.nl/goedevriend

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

Get in touch

Questions, comments or ideas?
Email: alumnirelations@tudelft.nl
Website: alumni.tudelft.nl
Community: 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.
You can also change your contact details and communication preferences there.

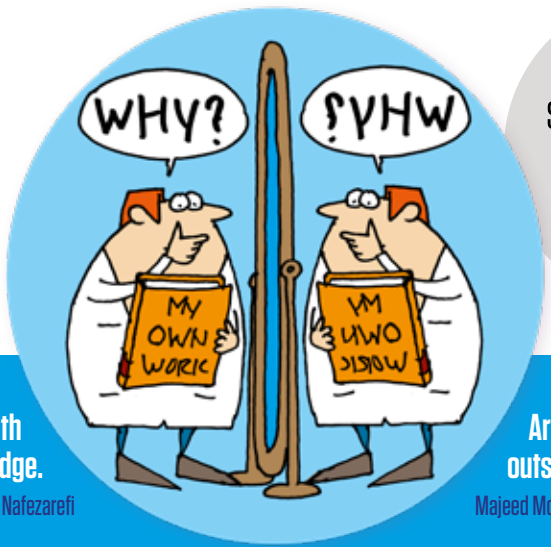
HORA EST

People with an endomorphic body type stay longer in a vortex.

Ir. Alex Duinmeijer, advisor hydraulic transport systems

"There was a practical reason behind my research into how floating particles behave in a vortex. Waste water in pumping stations often has a thick surface layer of solidified fat and other waste that doesn't sink. Because the intake of the pump is under water, this waste is not pumped away and needs to be removed manually. My research question was: Can you use a vortex to transport this material to the pump intake?

How can you initiate such a vortex, and what hydraulic conditions are needed to transport these floating particles? To answer these questions, we set up a test plant where we initiated a vortex and introduced different-shaped objects, round, square and oval. The balls often behaved similarly: somewhere halfway through the vortex they were expelled upwards'. This is partly because the balls themselves start spinning, thus generating upward force (Magnus effect). This is the same principle as using top spin or back spin in tennis, or a curved free kick in football. Continuing this line of thought, I came up with the idea that if you get caught in a whirlpool, you should roll yourself into a ball. The upward force means that rounder people have more chance of surviving than tall, thin people. It remains a hypothesis as we haven't actually put it to the test."



A true scientist should be the first to question his own work.
Dimitra Mamali

The level of complexity raises with you knowledge.
Fahimeh Nafezarefi

Artificial intelligence will finally outsmart human beings.
Majeed Mohammadi

It is fascinating to realise that people know what a cloud is but they are completely ignorant of the aerosols.
Dimitra Mamali

Knowledge is useful as long as it is beneficial to mankind.
Nauman Ahmed

Doing a PhD is a lifestyle not a job.
Panchamy Krishnan Krisnakumari

The easiest route to a biobased society is colonisation on a different planet.
Ramses Molijn

It is a lie that all your effort will pay off.
Ding Luo

Only with a clear mind we can have inspired ideas.
Dimitrios Eleftherakis

Leaving a legacy for the world of tomorrow

Delft University Fund receives donations from alumni all over the world in support of the university. These donations can also be in the form of a bequest or inheritance. By including TU Delft in your will, you will give future generations of students and scientists the opportunity to excel and make a positive impact on society.

"All my life I have been fascinated by natural phenomena. How to best treat the environment. Before I retired, I taught Natural Environment at the TU Delft Faculty of Architecture and the Built Environment. Newspaper articles about natural and man-made disasters still trigger me. In my former department of Landscape and Environment, I was involved in research and finding solutions for building problems caused by nature and mankind. To stimulate research in my field, I decided to set up a named fund through a bequest. "

Drs. M.J. Moens-Gigengack

Bequests or inheritances received by Delft University Fund may be unspecified or targeted for a clearly defined purpose, such as the Justus and Louise van Effenfonds, founded in 2010 by Mr. van Effen, alumnus Mechanical Engineering TU Delft. Van Effen was convinced that technological developments contribute to solving societal challenges. As such, each year, the fund makes scholarships and research grants available to excellent master students.

TU Delft contributes to solving societal challenges, such as climate change, the energy transition and robotics; but also the question of how we can improve healthcare with technological innovations. Delft University Fund provides financial resources to all eight faculties across a wide range of research fields. By doing so, the fund creates additional opportunities for research and scientific careers. All this thanks to donations and bequests, for now and for the world of tomorrow.

For more information or personal advice about including TU Delft in your will, please contact Machteld von Oven via m.w.vonoven@tudelft.nl or call +31 (0) 6 81060919

TUDelft | Universiteitsfonds

TEAM UP
WITH
EXCELLENCE

The lab of...

Project Inspiration

Biomechanical engineer Dr Gerwin Smit (Faculty of 3mE) decided to do something about the impending shortage of ventilators. He disassembled an English ventilator from the 1960s from the Rijksmuseum Boerhaave collection, and with a team of 40 people took just a few weeks to build a new machine. The bicycle gear hub from the old device was replaced by an adjustable electric motor. The weights on the bar for pressure regulation and a pressure cooker for humidification were retained in the new design. The team made the specifications publicly available (projectinspiration.nl) so that people in low and middle-income countries can produce the ventilator locally. TU Delft TV made a video about it, which is available on YouTube.

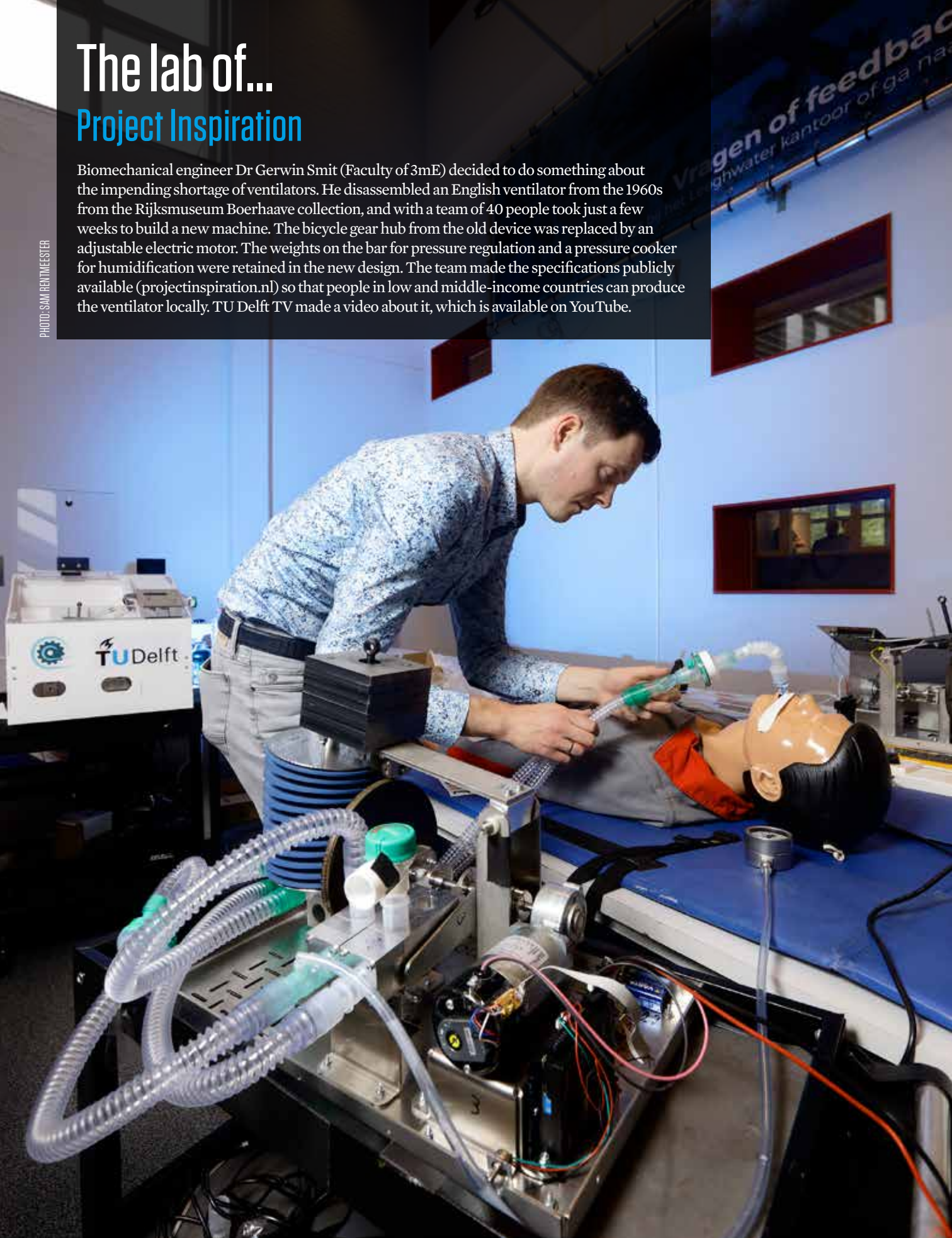


PHOTO: SAM RENTMEESTER