



DELFT	NO.1	MARCH 2021	YEAR 38
OUTLOOK	TU Delft		

Cynthia Liem
Young academic
in search of nuance
behind the data

**THE GREEN
VILLAGE**
Experiment
with solar-
heated house

Catalysis lab
Working
under
extreme
pressure

THEME
Resilience

Cover:
 A number of articles in the theme Resilience are difficult to illustrate, especially because of the corona measures. We have chosen to visualise those stories and the cover with member dolls. Although you can only work with poses, you sometimes even manage to portray an emotion. (Photographer Sam Rentmeester)

Foreword

Tim van der Hagen

Resilience

For more than a year now, our lives have been dominated by Covid-19. I am constantly pleasantly surprised by the resilient way so many people at TU Delft have managed to cope, each in their own way. Our researchers often draw strength from their work, even under trying circumstances. People such as Professor Neelke Doorn, who is studying how to make our Delta system flexible, or Alexandru Stefanof, who wants to make our electricity grid resistant to cyberattacks. They are working on resilience, particularly focused on the post-Covid-19 age, which we are slowly daring to hope will come. But for many that is still too far off – it's lasted so long! Who can you look to when your mental resilience has fallen to nil? So let's not just focus on the 'heroes' of this period. As Fares al Hasan puts it: "There must be space for resilience." Studying was difficult when he came to Wageningen from

Syria, with his head full of war. We are living in peace here, but I am still very concerned for our students. We see that they are increasingly suffering from a lack of personal contact. Their limit has been reached. Alumna Patricia Parlevliet also knows this: as a mentor and business coach, she offers students a listening ear. Meanwhile, with our VSNU colleagues, we are pushing for more face-to-face teaching as soon as possible. And we are testing how to do this safely on campus. Once this is all over, we can look at the suggestion from alumnus Tonie Mudde, who would like to see an extra endorsement on the degree certificates of 'corona students': 'Showed extreme perseverance and resilience, survived the lockdown of 2020-2021.' I can't wait!

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

Page 07
 Resilience



DELFT IN BRIEF
 04

THEME
 RESILIENCE
 07

IN PERSON
 26

COLUMN
 TONIE MUDDÉ
 26

THE FIRM
 WATTLAB
 27

FRIDO SMULDERS
 PROFESSOR OF INNOVATION
 28

HORA EST
 30

EXCELLENCE FUND
 34

ALUMNUS VOLUNTEER
 PATRICIA PARLEVLIET
 36

DELFT UNIVERSITY FUND
 39

COLOPHON

Cover photo Sam Rentmeester
 Editorial staff Saskia Bongers (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
 Sija van den Beukel, Agaath Diemel, Auke Herrema,
 Florine Koning, Tonie Mudde, Stephan Timmers
 Design Mafers 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

20

Cynthia Liem

Computer scientist and pianist Cynthia Liem wants to see greater emphasis on academic reflection. “For example by calling for greater focus on the nuances behind data-driven science.” And why does she have such a problem with the term resilience, the theme of the Dies Natalis?



24

Solar heat

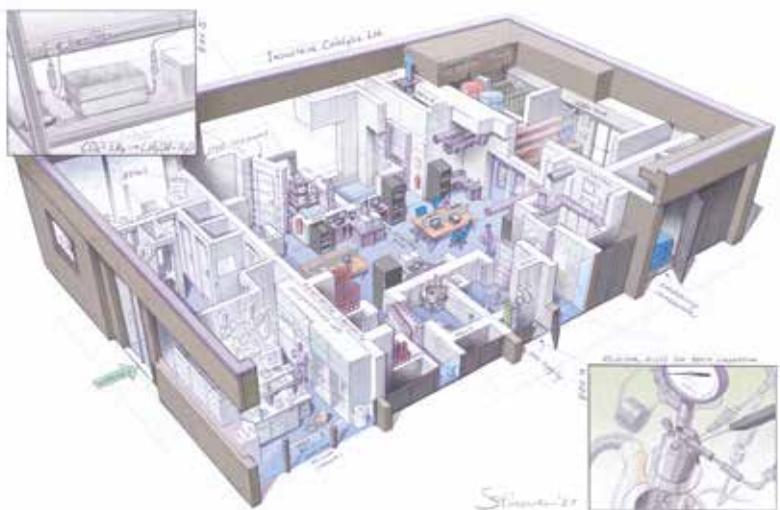
Since December, a solar heat trial has been running in one of the houses in The Green Village, the open air lab for sustainable innovation on TU Delft campus.



31

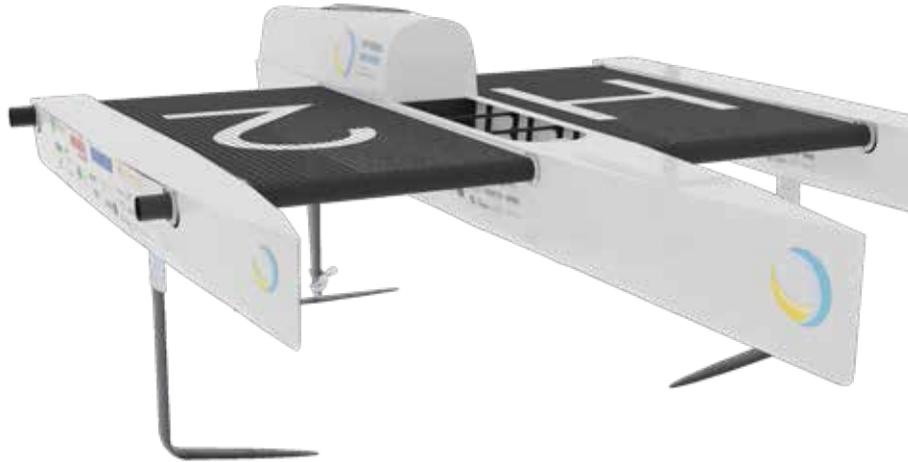
Catalysis

Operating pressures of up to 500 bar require a specialist building. The Industrial Catalysis Lab was designed for work at extreme pressures.



DELFT IN BRIEF

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



Humans and AI

Scott Robbins (Faculty of TPM) has written a thesis about artificial intelligence in combating terrorism. Robbins warns against unquestioning faith in, for example, AI surveillance systems that automatically detect suspicious behaviour (loitering, leaving a bag behind). Robbins argues that

society should insist that there is always a human, an analyst, in the system who can explain why there is suspicion and why information is being collected about someone. Because we do not know what AI systems base their decisions on.



Sailing on hydrogen

In late January, the TU Delft Solar Boat Team presented their new design. The characteristic solar panels have made way for a hydrogen tank and a fuel cell. Weighing in at a thousand kilos, the trimaran has surface-piercing foils that lift it out of the water from speeds of 22 km/h. The ‘Hydro Motion’ students are now working on construction and tests in preparation for this summer’s Open Class Races in Monaco. The boat needs to be light enough to emerge from the water, but strong enough to withstand waves in open sea.

IMAGE: TU DELFT SOLARBOATTEAM



Fun in the snow

February’s snow attracted plenty of people to the grass roof of the TU Delft Library for some skiing and sledging. It brought some long-needed vibrancy onto campus. By the end of the day, it was so busy that everyone was asked to leave because it was no longer possible to observe social distancing.



Maiden flight



PHOTO: SAM RENTMEESTER

Although most teaching is now online, the Exploring Aerospace module for first-year AE students is an exception. Lecturer Paul Roling had representatives from 40 teams demonstrate their aircraft. The other students watched via video link. Plenty of the maiden flights ended up hitting the ceiling or wall.



Save the date Xperience Week | 7 – 11 June 2021



Curious to find out what’s going on at the university? Join the TU Delft for Life | Xperience Week from Monday 7 to Friday 11 June 2021. During five virtual events, TU Delft alumni and relations of the Delft University Fund have the opportunity to get exclusive insights into the most innovative research and projects with a different keynote speaker each session. You are welcome to sign up for all the sessions or choose the ones that appeal to you the most. Check alumni.tudelft.nl/xperienceweek to watch the keynotes of last year, and for more details on the programme of 2021.

Treacherous traffic



PHOTO: SAM RENTMEESTER

The chance of sustaining traffic injuries in an old city centre is much higher than elsewhere in the country, concludes transport professor Bert van Wee, who took part in a study conducted by RTL News. Researchers analysed data from ten thousand neighbourhoods in the Netherlands on accidents that involved injuries and motorised vehicles. Conclusion: per kilometre driven, historical centres are ten times less safe than average. To make cities safer the traffic needs to be restricted, Van Wee says. Measures must be taken now. An estimated 21,400 people were seriously injured in traffic accidents in 2019. This is more than double the Government's target.



Superbus terminal?



The Superbus, brainchild of Prof. Wubbo Ockels, was transferred to the Transport Museum in Nieuw-Vennep last December. The limo had been at the Transport Museum

in Lelystad since 2017, but this faced closure late last year. For director Arno van der Horst from Nieuw-Vennep, the Superbus symbolises the “dreams, daring and deeds” of Dutch entrepreneurs like Ockels (who died in 2014). Joris Melkert, who was involved in the transfer, revealed that TU Delft will remain responsible for the vehicle. It is on loan to the museum.



Emancipation for farmers



PHOTO: KUSNANDAR

In agriculture, sustainability is usually a matter of environmental problems, but there is now a new perspective. In his thesis, Kusnandar (Faculty of TPM), who is from Indonesia, argues that the emancipation of farmers has top priority, especially in developing countries like his own. “Sustainability won't work if the players aren't willing to participate”, he says. In Indonesia, farmers have little market knowledge. They depend on local traders who serve as intermediaries. A lack of communication makes this partnership problematic. Kusnandar organised workshops where farmers and traders discussed their situation, identifying problems and finding their own solutions.



Quantum computer setback

QuTech is withdrawing a Nature publication from 2018. In it, researchers claimed – in error as it turns out – to have observed majorana particles. This was big news at the time, because these obscure particles, which have no mass or charge, could be used to make excellent qubits. Qubits are a quantum computer's calculating units. But the researchers may just have seen noise. Even if majoranas have to be written off, QuTech remains in the worldwide race for the quantum computer. The institute is working on superconducting qubits, qubits in diamond and qubits in semi-conductors, such as silicon.



THEME

Resilience



The climate is changing, fossil energy supplies are running out and we've been living in a pandemic for a year. The world is facing major challenges. One response to this is to make society more resilient. The four universities of technology are combining forces in 'resilience engineering': increasing the resilience of technological systems. In Delft, engineers are working to improve the resilience of mobility, the delta, energy networks and cities. But TU Delft's resilience is not just about technology. Students, whose lives have been turned upside down by the coronavirus outbreak, have developed all kinds of initiatives to help fellow students, the elderly or local businesses. Read all about it in this themed edition of Delft Outlook.

Resilience means designing for change

Natural disasters are familiar territory for Dr Tina Comes, researcher in disaster management at TPM and director of research at the 4TU Centre for Resilience Engineering.

“We all underwent a stress test last year,” said Dr Tina Comes in her online speech about resilience in society on Dies Natalis. She explains how she and her colleagues switched to online research and education. As the parent of a four-year-old son, she also experienced home-schooling at close hand. Without technology for transport and communication, she stresses, we could not have dealt with Covid-19 in the same way. “Without technology,” she concludes, “there is no resilience. Research has played a central role in our ability to adapt. Now more than ever, as vaccines start to arrive.”

Paradoxically, our dependence on technology also increases our vulnerability, as Comes discovered during a working visit to Nepal. Her team was visiting villages near Kathmandu hit by an earthquake in 2015 when she heard rumours that people had died in Amsterdam after a power failure. “Because of a power failure?” asked the bemused villagers. “We have them all the time here and nobody ever dies.” She

hesitated – the reason she was there was to explain how people could prepare for natural disasters more effectively. But who was the most resilient now: the victims in Nepal or the technology-addicted people of Amsterdam?

When there is a power failure in Amsterdam, telecommunications no longer work. The traffic lights go out, causing traffic chaos. If it lasts long enough, the petrol pumps also fail and society grinds to a halt. Specialists call it the cascade effect.

Inextricably linked

Anyone who looks for the source of the academic term ‘resilience’ will find its first use in psychology in the 1960s/1970s, referring to people’s ability to recover from trauma. The term was also used in ecology to describe the resilience of natural systems and its limits. If a forest dries out and becomes a savannah, that change becomes irrevocable. The ecological system has passed its tipping point. Two decades later, the term was also used for technical systems, such as a tram connection.

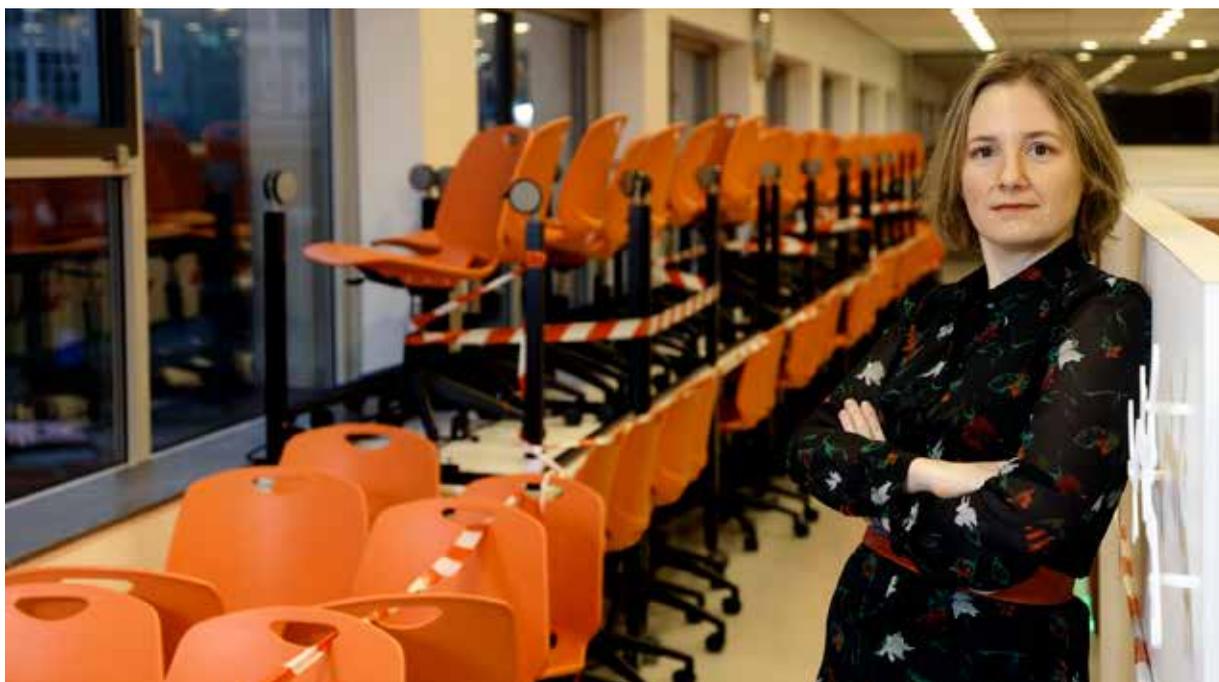
If a tree falls across it, how long will it take for transport capacity to recover? The shorter that time, the better the resilience.

In the 4TU Centre for Resilience Engineering, resilience is used in all of these senses: social, technological and ecological. Is it not too wide a concept to be usefully applied?

“Of course, it’s easier to consider a technical facility or natural biotope in isolation,” explains Comes.

“But that makes no sense, because everything is interconnected in our urban environment.”

As a result of information and communication technology, transport and energy networks are becoming increasingly intertwined with social networks. But that trend also increases vulnerability to external disruptions in the form of floods or diseases. In the last five years, there has been growing realisation that resilience is an overarching concept of social, ecological and technical systems. The importance of the social and institutional aspect was illustrated last year by the disastrous course



Dr Tina Comes: "Without technology, there is no resilience."

of the coronavirus pandemic in the United States. In its assessments, the World Health Organisation takes no account of national governance or social cohesion, explains Comes. Because of this, early impressions of the impact of Covid-19 in the US were far too optimistic. After all, the number

Paradoxically, our dependence on technology also increases our vulnerability

of GPs per hundred thousand inhabitants, hospital capacity and the qualifications of medical staff were all completely in order. But the country was hit by more fatalities than anywhere else (over 400,000) because of a lack of social cohesion and a divided strategy rather than

a targeted approach. The recent curfew riots also revealed fault lines in the social cohesion in the Netherlands.

No average day

Looking back is one thing, but engineers want to move forward. Comes thinks that this is probably the most important task of the 4TU programme DeSIRE (Designing Systems for Informed Resilience Engineering): translating understanding of resilience into tangible guidance for designers. Resilient design starts with the realisation that you can no longer assume an average day as the standard, whether it concerns a drainage pipe, a power cable or a road. Because of climate change, averages are no longer stable and outliers are becoming more extreme. Besides, engineers need to understand that their structures will have a determining influence for

50 to 100 years into the (changing) future. According to Comes, this means that infrastructure needs to be adaptable. "We need to plan infrastructure in such a way that we don't box ourselves in. It may be better to build and reinforce a dyke in phases."

Will it prove to be more expensive? "The Dutch healthcare system bases its planning capacity on estimated need. In an epidemic, you need to scale that up fast, which makes it an expensive business. Planners tend to assume a narrow band of scenarios, despite the fact that experience shows that this is not a sensible strategy. Designers need to factor in a radically different use of their creations: buildings should be made in such a way that they can be rapidly rebuilt and cities need to adapt to high water levels. Resilience means designing for change." <<

Resilient transport: shareable, small-scale and lightweight



PHOTO: SAMRENTMEESTER

How can transport networks become more resilient? Professor of Transport Modelling Bart van Arem (CEG) envisages plenty of opportunities.

The backdrop for his Dies Natalius lecture was a Renault Twizy. This is a one-person car programmed by Delft researchers to collect you automatically from the station. “It looks great on the video, but in practice it’s really difficult getting the car to drive in public spaces. But we can now control it remotely”, explains Van Arem. It is one of the first steps towards a more resilient transport network.

Van Arem identifies three areas of resilience: a person’s capacity to adapt their travel patterns, logistical adaptations, such as building up supplies, and alternative transport networks. “For example, the A13 motorway is an alternative for the A4.” Van Arem argues that transport networks are already resilient. “Even during the pandemic, we were capable of adapting our travel patterns and much more is possible online than we thought.” That resilience can

be used to make transport more sustainable, safer and more inclusive. Developments such as automated and electric driving can contribute to that. Van Arem: “I do wonder how sustainable a 2,000kg electric car really is.”

In other words, electric cars need to be lighter and preferably shareable. Van Arem: “We are moving towards a situation in which transport will be seen as a service, not as a possession. Besides, a shared car uses fewer resources and takes up less parking space.” Van Arem also believes people should start cycling more and Europe needs to invest heavily in high-speed trains, providing an effective alternative for cheap flights.

‘We are moving towards a situation in which transport will be seen as a service, not as a possession. Besides, a shared car uses fewer resources and takes up less parking space’

He also feels that resources need to be shared more fairly. Van Arem cites the example of the Delft start-up Scoozy, which is making mobility scooters safer and more modern through automation. Van Arem: “All groups in society need access to good technology.”

Even in twenty years’ time, Van Arem does not expect to see completely self-driving cars. “However, demand-driven autonomous shuttles will be used more in public transport. And delivery robots will be riding around in cities.” 

Software for improving suicide prevention



PHOTO: SAM RENTMEESTER

If you work for a suicide prevention chatline, a mental block can mean the difference between life and death, says Salim Salmi, who developed software to assist staff dealing with callers. For his graduation project in the Faculty of Electrical Engineering, Mathematics and Computer Science, Salim Salmi developed a support system for chatline staff. This computer program analyses thousands of previous conversations and uses natural language processing techniques (a form of AI) to identify similar scenarios that staff members can use to get ideas to keep difficult conversations going. Salmi used the database of the 113 suicide prevention helpline. With his colleague, Saskia Mérelle, from 113, he sifted through seven months of chats (from March to September 2018). “We started by filtering the chat data, removing anything with fewer than 20

interactions. We used 17,773 conversations in total.” The study results were recently published in the Journal of Medical Internet Research.

The program still requires further improvement. Chatline staff said that they preferred to enlist the support of more experienced colleagues in complex situations. However, this is not always possible in practice. Salmi is now working as a doctoral candidate at the Amsterdam institute for mathematics and computer Science CWI and is improving the software. 

Thinking of suicide? Contact 113 Suicide Prevention on 113 or 0800-113 (free of charge) or the chatline.



Resilience at a time of crisis

Coronavirus has turned student life upside down. Lecture rooms have been replaced by computer screens and study associations and catering facilities have closed. But many Delft students refused to be discouraged: now is the perfect time to make a difference for fellow students, the elderly or local businesses. A selection of some of their initiatives.

5 TO 12

When the number of coronavirus infections increased sharply, one group joined forces with the Delft National Chamber of Societies, the municipality, TU Delft and the Municipal Health Service in launching the '5VOOR12' awareness-raising campaign. It rapidly developed into an organisation committed to exploring how it can help the Delft community in the fields of well-being, education and communication.

THUISBESMET

In response to 5VOOR12, the website thuisbesmet.nl was also launched. Providing students with information about coronavirus, the platform led to countless initiatives, including the Delft De-stress Festival. In collaboration with the Dutch National Student Association (ISO) and students from Leiden and Utrecht, the 'Lieve Mark' (Dear Mark) campaign was launched, a study into student well-being and needs.

GEWOONMENSEN

Partly thanks to Jasper Veen (AE) and Thijs de Jongh (Applies Sciences), more than 40,000 people volunteered to help others. Via the website gewoonmensen.nl, used by people to request and offer help, they did people's shopping, dog-walking or gave tuition. On Liberation Day, over 43,000 elderly people in student cities received a surprise orange tompouce pastry and students joined rapper Ali B to distribute flowers to the elderly.



PHOTO: DALIA MADRI

On Liberation Day, over 43,000 elderly people in student cities received a surprise orange tompouce pastry

TAPS & CHAPS

Working with restaurants and cafés, the initiators of Taps & Chaps developed a platform to showcase produce from Delft hospitality businesses, from beers to bar snacks. Set up by and for students, the not-for-profit platform has the primary aim of supporting hospitality in Delft.

SUPPORT MATTERS

The Indian student association ISA set up a campaign to support hospital staff at the Reinier de Graafziekenhuis. TU Delft students and staff used a special website to send a personal message. The messages were printed out on a banner at the hospital entrance.

DELFT DE-STRESS FESTIVAL

The end of an exam week is a reason to party for many students. But the bars and clubs are closed and the number of guests allowed is limited. This is why Rob Mudde, Vice-Rector Magnificus at TU Delft, organised the online Delft De-stress Festival. There were performances by DJs

and artists on three different stages and students were connected to each other via Zoom.

LEVEN IN DELFT

The Living in Delft (Leven in Delft) foundation, established in 2012 by the Delftsch Studenten Corps, organised a three-day event for residents of Delft care homes in early December. Participants were treated to a corona-proof pub quiz, painting course and dance performance.

LOCAL MARKETS

The Local Markets platform gave customers an opportunity to do their market shopping online. The idea was suggested by students Yasin Sagdur, Dolf Verheul (TU Delft) and Tom van Doorn (EUR) who wanted to help out local market businesses. The range expanded from The Hague to include Rotterdam and Hoogvliet, but the concept proved unprofitable in the longer term.

CHRISTMAS HAMPERS CAMPAIGN

During Christmas week, hundreds of students presented Christmas hampers to thousands of elderly in Delft on behalf of voluntary organisation Studenten Vrijwilligerswerk Delft. They included a meal prepared by top chef Ed Hoogendijk and a card with a personal message and telephone number of a student. If in need of a chat, the recipient could give the student a call. 

'Anger keeps people's attention'

'The truth needs to be valued more,' says Dr Philip Zimmermann in a reference to the inherent resilience of the internet. That calls for both technological solutions and a sociological perspective.

Zimmermann (Cybersecurity department, Faculty of EEMCS) is a veritable internet guru. He developed the encryption software PGP and was made a member of the Internet Hall of Fame. But at the time of our interview, he was more concerned about the resilience of democracy in the face of social media. In the United States, his home country, the storming of the Capitol had just happened. "Before the age of social media, we had a shared reality," explains Zimmermann. "We got our news from newspapers, radio and TV and spent time in the local neighbourhood. People in daily contact with neighbours and acquaintances don't develop conspiracy theories. The physical social environment had a



PHOTO: SAMREINTEESTER

Dr Philip Zimmermann: "The physical social environment had a normalising effect."

normalising effect. If you believed in conspiracies, it never became really radical because people around you weren't taken in."

On the internet, however, you meet people with the same paranoid ideas, says Zimmermann. He cites the Qanon conspiracy theories as an example.

"They're very damaging ideas that propagate right-wing populism and set population groups against one other." According to Zimmermann, the algorithms in social media have been developed to maximise users' time and attention. "No other emotion is as effective in doing that as anger. That means it's in the interests of Facebook

and other social media to make people angry. Because that strengthens engagement with the application." "It's these algorithms that have created these problems for us, and we may be able to escape by changing them. Facebook is continually experimenting with changes to algorithms, testing them on several million users. If the result is favourable, they then distribute them across two billion users." Zimmermann is calling for this approach to be used to expose people to a wider range of views. "Ultimately, it's a technological problem, but in a broader sense. We need sociology to reach out to people's heads and hearts. The truth needs to be valued more. We also need to develop mechanisms that can stop lies and spread the truth, because lies always spread faster." 

Dr Zimmermann recommends the Netflix documentary [The Social Dilemma](#) for an understanding of the perverse effect of social media.

Resilience and the circular economy

TU Delft focuses a great deal of attention to the circular economy in its online teaching. Resilient designs play a key role in this.

Faced with the societal challenge to drastically reduce the depletion of our planet, all industries are looking for professionals

with a passion for the circular economy and - more importantly - with knowledge of circular product design methods and tools.

TU Delft now offers several online programmes on this topic, with various experts taking you into the world of the circular economy. These programmes vary from developing circular design concepts, to designing circular

products, to applying circular economy in construction.

Alumni receive a 25 per cent discount by using the code [alumni25](#). For an overview of all online programmes go to tudelft.nl/circular-economy-courses.

'You always need to have a plan'

Syrian engineer Fares al Hasan swapped Aleppo for the Netherlands, where he works as a researcher at TU Delft and as a GIS specialist at Utrecht University. Getting here was not easy. "There needs to be room for resilience."

Fares Al Hasan had a good job as an agricultural engineer in the department of Soil Science and Land Reclamation at the University of Aleppo. But everything changed when the civil war broke out in Syria in March 2011. He and his family moved in with his parents in Al-Bab, a village outside Aleppo. His daily commute by motorcycle and on foot to West Aleppo became increasingly dangerous. There were snipers everywhere. "When I heard a bullet fly past my ear one day, I decided to stop going to work." He lost his job.

'The first thing we need to do is build a new education system. A country is nothing without good education'

Ten years on, he is now doing research for TU Delft into the unprecedented drought of summer 2018. How did he manage that?

Just never give up, says Al Hasan. In Al-Bab, he came up with a new plan: create a life for himself as a scientist in Europe. He searched for scholarships and was welcomed in Wageningen, on the Master's programme in International Land and Water Management. In the first year, Al Hasan struggled to concentrate on his studies. There was little room in his head to think about academic work. All he thought about was war. "My family had stayed behind in Syria. I was constantly worried about their safety." After a year, he managed to bring his then wife and daughters to the Netherlands. Now he understands it: "There is not always room for resilience." But he still never gave up. He carried on studying and carried on with his life. "I had no other



PHOTO: SAM RENTMEESTER

choice." His Master's completed, he applied for Hestia, an NWO (Dutch Research Council) grant that enables refugee scientists to continue their careers in the Netherlands. Initially, he worked only for TU Delft, but Utrecht University soon followed in late 2019. "I heard that UU was looking for someone. I couldn't let that opportunity pass me by." His TU Delft research is being funded by Hestia until October 2021.

And then? He already has a plan, although he believes that coronavirus has reduced his opportunities. "I want to publish soon. After that, I'll focus totally on applying for a PhD position." Although he does not intend to leave the Netherlands for now – "My family and I have so much to keep us here" – he still has dreams of building a new Syria. "Eventually, things will calm down and people like me will return. Then, the first thing we need to do is build a new education system. A country is nothing without good education." 

Dr Alexandru Stefanov (EEMCS) and his team are developing a 'control room of the future' in order to increase the cybersecurity and resilience of the electricity grid.

The integration of renewable energy sources, such as solar and wind energy, has led to a huge increase in the use of information and communication technology to manage electricity networks, says Stefanov. Digitisation is essential for the modernisation of the electricity grid, but also exposes this vital infrastructure to cyberattacks. Before taking charge of the TU Delft group for the cybersecurity and resilience of electricity networks, Alexandru Stefanov spearheaded the computerisation of electricity grids in the United Kingdom and Ireland. Before that, he worked as a post-doc on cyberattack scenarios for smart grids at University College Dublin. Stefanov understands the cybersecurity of electricity networks inside out. Anyone who doubted that an electricity grid could be brought down from a simple laptop was given a demonstration on 17 December 2016 in Kiev. Some 20% of the capacity of energy company Ukrenergo was brought to a standstill after a targeted attack on a substation to the north of

Target for



cyberattacks



the Ukrainian capital. Cybersecurity companies blamed the attack on a piece of malware that was capable of identifying and deactivating circuit breakers, causing a power outage lasting more than an hour. Experts believe that the attack was a test.

SUCCESSFUL HACK

Stefanov and his team chose the electricity grid Real-Time Digital Simulator (RTDS) as the target for simulated cyberattacks. Would they be able to break into the control network and use falsified data to force the system to open the circuit breakers? The RTDS is a unique computer facility that serves as a digital twin for large energy systems.

The researchers successfully intercepted the most common data communication protocol (IEC 61850) and hacked it. This is bad news for all energy systems equipped with it. The resilience of the control systems can be improved by adding a standardised authentication code to every message, according to the researchers. They plan to use AI to develop a security system that can identify and prevent attacks and help network operators to resolve incidents. Software solutions will be tested in the 'control room of the future', a research facility run by TU Delft, TenneT, Siemens, Creon and others. It will open this spring as part of the completely new TU Delft Electrical Sustainable Power Lab. More details in our next issue. 



Render of the control room of the future. (Image: Creon)

designed by:

CREON[®]
ultimate 24/7 workspaces

Lessons from the Bijlmer Disaster

Detached engines or damaged wings? Algorithms could be used to enable aircraft in difficulty to land. Coen de Visser (AE) is working on it.



PHOTO: CLARITYSA / PIXABAY

Bam! The drone being used by Sihao Sun and Coen de Visser for their wind tunnel experiments in the Faculty of Aerospace Engineering is being tested to its limits. One of its four propellers keeps becoming detached because it has been deliberately screwed on too loosely. This makes the drone uncontrollable.

De Visser was recently awarded an NWO (Dutch Research Council) Vidi grant to develop algorithms that can calculate the remaining flight capacity of an aircraft in difficulty. In theory, the quadcopter in his experiments can fly on three propellers. He just needs to adapt the steering of the three remaining engines in order to correct the problem.

And it works. In a later video on De Visser's website, the drone remains airborne despite wobbling more than usual. How wonderful would it be to design something like that for aircraft? When an aeroplane is seriously damaged, it behaves very differently than normal. Take El Al flight 1862. That aircraft crashed in Amsterdam's Bijlmer district in 1992. Just before that, it had lost two of its four engines and a wing had also been damaged. "The pilots had no idea what to do: nothing was reacting as it should. But the aircraft should have been able to land," explains De Visser. This was revealed by computer simulations several years ago during an enquiry that De Visser also worked on. His new study builds further on the Bijlmer Air Disaster Enquiry.

The idea is that algorithms assess the new situation and identify how much flight capacity a heavily damaged aircraft still has. This room for manoeuvre is known as the flight envelope. "The El Al Boeing plummeted because it was flying too slowly. In normal conditions, the speed would have been enough, but it was no longer up to the job because of the damage," says De Visser. The aircraft lost its lift and became uncontrollable. The pilots could not have predicted this. In the future, algorithms could be used to indicate the room for manoeuvre in such situations, telling pilots what their limits are. This will be a long project. For now, the researchers are mainly focusing on safely landing damaged drones. 

View

How can we make the Zuid-Holland delta more resilient?
Ethics professor Neelke Doorn (TPM) is working on it.
She has plans for a living lab in Rotterdam-Zuid.

“**T**he hot summers we’ve seen in recent years have led to increasing realisation that climate adaptation is not just about rising sea levels, but also drought and adaptations to water consumption. This is

now being factored into urban planning and the setting up and maintenance of infrastructure. It’s no coincidence that the Rotterdam region is taking an enthusiastic interest. The city faces a series of decisions about investments in infrastructure and planning of the built environment. Some plans from the past have not turned out well; for example, they focused solely on preventing flooding and took no account of ecology or drought. A different approach is needed. But what kind?

The magic word is resilience: it means more flexibility in our delta system. We want to prevent floods, but also protect drinking water supplies. The demands placed by ports on the water system need to be harmonised with nature. In the past, people opted for a single function: protection against flooding or accessibility of the port, for example. Any other functions of the water system were given less priority. A resilient system fulfils all these functions and can adapt, for example, to the changing climate but also to demographic trends. It looks as if sea levels could rise quickly, but you don’t want to invest now in measures that in 30 to 40 years’ time turn out no longer to be adequate or even too extreme. Resilience means that you can adapt measures to

accommodate new developments and threats.

Engineers generally associate resilience with infrastructures, but it also relates to inhabitants. For example, Rotterdam-Zuid, the district that plays a central role in the Resilient Delta theme, has multiple problems.

Many inhabitants are unhealthy, poorly educated and have little chance of getting a job. Their living environment is not conducive to a healthy lifestyle and more exercise.

We can make a neighbourhood more resilient by structuring it in a way that encourages people to come outside to meet or play with each other. More green space in the city not only helps collect water more effectively in extreme downpours, but also promotes cooling during heatwaves and makes the environment more attractive. Health and exercise encourage social cohesion and bring people together.

The Convergence programme is working hard to achieve this. The City of Rotterdam is interested in the projects for the port and wider delta and in the plans for Rotterdam-Zuid. I hope to be able to launch a first Living Lab there this year.”

JW

Resilient Delta is one of the three themes within the Convergence programme run by TU Delft, Erasmus University and Erasmus MC. Prof. Neelke Doorn, Professor of Ethics of Water Policy and Water Technology in the Faculty of TPM, is coordinating the Delft contributions, together with Prof. Dirk van Gameren (Architecture and the Built Environment).





‘Resilience should
not be an excuse
for demanding
even more’

A black and white portrait of Cynthia Liem, a woman with long, dark, wavy hair. She is looking directly at the camera with a slight smile. Her hands are clasped together in front of her chest. The background is dark, making her face and hands stand out.

With her appointment as a Young Academy member, computer scientist and pianist Cynthia Liem intends to call for greater focus on academic reflection. What drives her?

TEXT ANNEBELLE DE BRIJN
PHOTO'S SAM RENTMEESTER

On March 23, you will become a member of the KNAW (Royal Netherlands Academy of Arts and Sciences) Young Academy. What will you bring to the role?

“It’s a very interesting position that enables young academics not yet in decision-making positions to make a contribution to the debate and so still exercise an influence on policymakers. I’m continually reflecting, asking what it means to be an academic. I intend to bring that to my activities on behalf of the Academy. For example, by calling for greater focus on the nuances behind data-driven science.”

Is there room for these nuances in the world of AI?

“I think this focus is starting to happen, thanks to the debate in society about issues like AI. But the AI field is so popular that it’s hysterically oversubscribed. Everyone suddenly wants to ‘do something with AI’ and there’s lots of competition. This sometimes leaves little room to take a step back and ask questions that not everyone may be expecting. If I allow myself to be driven by ‘publish or perish’ culture, problems are only interesting if I can devise a new, more complex algorithm for them. After all, that’s something I can publish about. But if I focus on the original, often societal problem, I need to ask questions like: are the data really suited for an algorithm? Do I need more context about the problem? Do I really need to develop a new algorithm? Or would it be better to opt for techniques that are a decade old – simpler, yet also easier to understand as a result?”

How do you integrate this in your work at the moment?

“I worked on a project with organisational psychologists who wanted to use AI for job applications. Then, the choices you make really matter, because you can quickly run the risk of discrimination or historical bias. For example, very few women held leadership positions in the past, so if you’re not careful you can end up suggesting that women don’t make good leaders. During the project, it occurred to me that my psychologist colleagues and I needed to learn to understand each other’s jargon and basic techniques better. Rather than writing a traditional paper, I focused on that communication. I’ve written several more educational texts on the subject of how psychologists and AI experts should talk to each other.”

You’re not only a computer scientist, but also a trained pianist. How did you manage that?

“It wasn’t easy. As well as working overtime a lot in order to be successful in both, I had to move mountains just to be allowed to do this combination. The academic counsellor at Delft opposed it, suggesting that doing two programmes prevents you from focusing. At the Conservatoire, I also faced a wall of red tape because they only support joint programmes with Leiden. So, I thought I’ll do it myself. I negotiated my timetable with individual lecturers. It worked. When I’d completed both programmes, I was told that I’ll eventually have to decide between music and computer science. But I’ve never actually wanted to make that choice. I’ve never wanted to make that compromise.”

Where does that refusal to choose come from?

“That’s a difficult one. I think it’s always been part of me. I like doing several things simultaneously. So, I combine music and computer science in a way that I believe in. It’s an

‘For me, resilience is actually about having the space to do things differently’

unusual combination, so I have few role models. But a more traditional path, with just a single focus, would never make me happy. If that were the more logical step towards a top career, I’d never pursue it.”

They seem so contradictory – computer science and classical music.

“Yes, at first glance it seems like hard data versus emotion. But my way of thinking as a musician is something I also use in my academic work, and vice versa. As a computer scientist, you learn how to extract information, generalise and work systematically. As a musician, you actually do the same. You ask yourself: will it be sufficient to play it this or that way? How should I compare my interpretation to those of others? It’s exactly these kinds of questions that you need to ask for responsible use of AI.”

How do you prevent the musician in you from being drowned out by the computer scientist?

“By setting clear priorities. For example, as a pianist, I no longer prioritise my solo repertoire,

CV

Cynthia Liem (1987) is assistant professor in the Multimedia Computing Group at TU Delft. Her focus is on algorithms for broadening perspectives in information services and methods for monitoring the validity of AI systems. As a child, she was such a good pianist that she was awarded a Princess Christina Concours scholarship to join the junior class at the Rotterdam Conservatoire. She then studied at the Royal Conservatoire in The Hague, specialising in solo play and chamber music. At the same time, Liem graduated cum laude in Media and Knowledge Technology (Computer Science Engineering) at TU Delft. In 2015, she also completed her PhD at Delft. This year, she became chair of the EEMCS faculty personnel committee and was made a member of the Young Academy on 23 March.



which involves having to learn traditional works by heart. I now focus on chamber music. Fortunately, my musical colleagues don't depend on me economically and we're selective in the offers we accept. That creates freedom and space for my academic work. But that selectivity also makes me freer as an artist. It gives me the freedom to programme a more unusual repertoire outside 'the classics', featuring work by relatively unknown composers for example."

How do you feel about the effect of the coronavirus on the world of music?

"What's currently happening is paradoxical. People are stuck at home and my concerts have been cancelled. But if you look at how people react to music or other things that distract from the daily grind, I get the feeling that we realise more than ever how much we need them. At the same time, the arts are the first area to be cut and the last to receive state support. Many musicians have simply given up as a result. That's painful to see. But I've also noticed that other musical colleagues have shown huge resilience and managed to reach people digitally with all kinds of new creative initiatives."

You mention resilience. What does resilience mean to you?

"Let me take a controversial stance on this. In January, we had the Week of Resilience. The

problem I have with the term 'resilience' is that it can easily become an excuse for saying: 'Hey guys, let's keep at it, we can do even more.' For me, resilience is actually about having the space to do things differently. To take a step back, think about deeper questions and then incorporate them in your field. For me, it means having the room to say 'no' if necessary. Saying something doesn't work is often seen as a weakness. When, actually, saying no also means that you're much more flexible when things occasionally go wrong."

Academics were already under pressure and the coronavirus has not improved things. Is there enough space for resilience in the academic world?

"Covid-19 is having a particularly huge impact on young families. If you have additional care duties, you automatically become less productive as an employee. As an academic, you probably also publish less. In the future, will we reward someone who has been more productive output-wise? That automatically means incentivising a certain type of lifestyle for senior academic positions. I don't think we should be doing that."

How can we minimise the effect of the crisis on people's academic careers?

"By everyone agreeing that we'll do things differently. There is already an ongoing discussion at the university about alternative forms of recognition. I hope to be able to contribute actively to this, both with the Young Academy, and also in my role as chair of the EEMCS faculty personnel committee. We need to stop blindly counting publications. Not only because the crisis is unfairly affecting productivity, but also because traditional publication doesn't always deliver the most impactful output for society. We need to free up time to think about why scholarship and engineering really matter. And how we can shape HR policy accordingly in a way that is clear and as concrete as possible."

You said compromises are not in your nature. Will you continue to work at the university if things don't change?

"In its current state, the university still places far too much emphasis on the traditional idea of a specialist scholar. That's definitely not my ideal scenario. But I still think it's the best place for me. Universities are public institutes, where you're more visible and more independent than at a company, for example. TU Delft has also identified social impact as a strategic theme. And I'm educating the computer scientists of the future. What more could you want?" <<

Solar heating in winter

Consortium demonstrates that thermal solar panels and a communal geothermal heating grid will heat a neighbourhood of reasonably well insulated homes without using gas.



Dr Ivo Pothof near the installation that connects the PVT panels to the solar heating network.

O For a month now, a test unit has run in the attic of one of the houses built in the 1970s in the Green Village. A couple of barrels of water act as geothermal heating. It is a solar heating consortium project of which TU Delft is a part. The partners already dare say that a neighbourhood with older homes with B or C energy labels can be heated without using natural gas.

Calculations show that PVT panels (solar panels with an in-built radiator) combined with a heating grid would deliver enough heat to heat the home and the water. On top of this, the PVT panels would deliver enough electricity to run the system's pumps, including

the heat pump. The remaining heat that the panels would generate from a few hundred houses in summer would be stored in the groundwater. This is the framework for the solar heating grid (in Dutch) which could make millions of older houses in the Netherlands climate neutral.

Innovation

PVT panels and heat cold storage in groundwater are well-known techniques in sustainable heating. The innovation in this system lies in the low temperature heating grid, explains Dr Ivo Pothof, a specialist in smart heating grid systems at the Faculty of 3mE and at Deltares.

The 'delivery unit' is all the equipment

that a household needs to be connected to the new low temperature heating grid. It is a small cabinet with pipes, pumps and valves that ensure that the heating from the heating grid and the PVT panels are optimally used. The household also needs a heat pump with a storage vat (a tall grey cupboard), four to six PVT panels and everything needs to be fitted. Pothof estimates that the cost of the communal hot cold storage for a couple of hundred homes would amount to “a couple of thousand euro per household for 20-30 years”. Once fitted, there are no consumption costs. The only costs incurred would be maintenance and, after a while, replacement of parts.

Cheaper?

The key question of whether this heating grid system would be cheaper than heating with a high efficiency condensing boiler may not be entirely honest, but it is imperative in choosing which system to install. The comparison is not honest because the benefit of saving an average of 1,500 (in Dutch) cubic metres of gas per

‘More than half the Netherlands has ground that is highly suitable for storing solar heating’

household would primarily be for the climate goals, while the equipment needed must be paid for. Whether that is cheaper or more expensive than the monthly gas bill depends on the interest rate, says Pothof. If the interest rate is 4-5%, it will be more

expensive for the household while if the interest rate is 1.3-1.5%, it will be cheaper. Municipalities can arrange low interest rates with the Bank Nederlandse Gemeenten (a bank of and for the Dutch public sector) if they are part of a relevant housing corporation.

The plan was made for the Ramplaankwartier neighbourhood in Haarlem, but will it actually be built? “The residents are really keen,” says Pothof, “so we hope that it will work out to get a low interest rate to make it attractive for the residents. There is now a basic design (in Dutch) and a manual that can be applied anywhere. More than half the Netherlands has ground that is highly suitable for storing solar heating.”

Other TU Delft researchers involved in the project are Dr Sabine Jansen and Dr Saleh Mohammadi, climate installation experts at the Faculty of Architecture and the Built Environment, and Dr Martin Bloemendal, specialist in hot cold storage at the Faculty of CEG.

Tuning the temperatures

The heating grid temperatures, with one hot and one cold pipe, are set in such a way that most of the heat generated on the roofs can be harvested. It does mean that the storage temperature may not be too high. That said, if the heating grid temperature is high, the heat pump’s yield will be higher (the COP, coefficient of performance, is the ratio between the generated heat and the electricity consumed).

The optimum temperature in the summer is 18 degrees for the hot pipe and 11 degrees for the cold pipe. In winter, these are 14 and 7 respectively. The heat exchangers have a temperature difference of two degrees so that in winter, the temperature of the heat pump as it enters the home is 12 degrees. The desired temperature



Four PVT-panels on the roof of the left house in the Green Village produce enough heat and power to keep the house warm and gas-free during the winter.

for tap water from the heat pump is 60 degrees and for central heating 35-55 degrees. Here too the idea is that the lower the temperature difference between entry and exit, the better the yield. <<

The solar heating grid consortium consists of TU Delft, Deltares, Greenvis, Stichting SpaarGas with the municipality of Haarlem, Triple Solar, Fortes Energy Systems, the WarmteTransitieMakers and ENGIE. The project is made possible by Topsector Energy Subsidy, TKI Urban Energy, the Ministry of Economic Affairs and Climate, reference TEUE018017 for low temperature feed-in solar heating grids (DeZONNET).

IN PERSON

The last Delft Outlook accidentally listed the Vidi grant winners from several years ago. The researchers awarded Vidi grants (worth €800,000) by the Dutch Research Council (NWO) in 2020 are: Dr **Doris van Halen** (CEG), Dr **Toeno van der Sar** (Kavli, AS), Dr **Coen de Visser** (AE) and Dr **Monique van der Veen** (AS). This enables them to continue their research for a further five years in the following fields respectively: safe drinking water; quantum materials for nano-electronics; autonomous robot safety; and ‘nano-ovens’ to unravel catalytic reactions.

The Executive Board has appointed Prof. **Paulien Herder** as Dean of the Faculty of Applied Sciences. Herder did her degree (Chemistry) and PhD (TPM) at TU Delft before becoming Professor of Engineering Design in Energy & Industry. She was also Director of Education and the Director of the Delft Energy Initiative. In 2019, she transferred to the Faculty of 3mE, becoming programme leader of the e-Refinery. She also holds various energy-related administrative and supervisory roles.

Architecture alumna **Laetitia Smits van Oyen** is stepping down from the TU Delft Supervisory Board after eight years. Her advice for the future of TU Delft is: “Don’t strive to achieve more, but ensure that you’re the best. And judge that in terms of what students think of it and where they end up after their degree programmes, rather than on citation scores.”

The European Research Council has awarded three Consolidator Grants to Dr **Stan Brouns**, Dr **Simon Gröblacher** (both Faculty of AS) and Dr **Kristof Cools** (EEMCS). The grants (€2 million) are intended for academics with seven to twelve years of working experience who can use the money to set up their own research teams. Brouns is working on bacteriophages, Cools is researching simulation methods and Gröblacher is focusing on quantum physics.

Advice from an astronaut

In March of last year, we published an interview in *de Volkskrant* newspaper with astronaut André Kuipers giving tips on quarantine.

It seemed quite an original and amusing idea. We thought astronauts who orbit the Earth cooped up together could give some experience-based advice on quarantine to us normal earth-dwellers who suddenly had to stay at home and live in small social bubbles. Kuipers spent two missions in the ISS space station, the longest lasting 193 days. I remember thinking when we published that interview: no way will this last that long. Now we know better. Apart from a relatively carefree summer vacation, we’re still saddled with the virus and related restrictions.

As a 42-year-old family man with a permanent job, my own suffering is relatively limited. But what if this had happened in my first year at Delft? I didn’t know anyone then.

I was on tenterhooks about my ability to cope with the degree programme, or even to make friends. Then you’re suddenly being educated online from your student room: your lecturer and fellow students are on screen and the study association is closed.

These seem to me to be extremely difficult conditions for feeling at home and thriving in a new city.

There’s also the added factor that the coronavirus often doesn’t affect young people so badly. They’re sacrificing their freedom for

older generations who can become fatally ill from Covid-19. Is the cost-benefit balance of the measures tilted too far in one direction?

As a TU Delft alumnus, I just love calculations, but this one’s not so easy. What’s worse? Older people who die five or ten years earlier than usual because of a coronavirus infection? Or young people in the prime of their lives unable to flourish because of lockdown measures? And how should we factor in people with ‘long Covid’ or those with other medical issues who are receiving less effective help, or pub owners and theatre actors forced to abandon their life’s work? You simply can’t calculate it – or at least I can’t.

Looking back, André Kuipers’s quarantine tips suddenly don’t look so crazy. Tip 1: Don’t shy away from discussing anxiety and stress, take the time to listen to each other’s concerns. Tip 2: Form a close-knit team. (“Whether it’s your housemates or your family: you need to arrange group activities. Eat together, play games. Paint your house, whatever.”) Other tips ranged from “make time for sport” to “cherish nature”. All good advice, but of course lockdown is still an interminable struggle for students. I suggest that every graduate who experienced lockdown during their degree should have a positive endorsement added to their certificates. Something along the lines of “extremely persistent, demonstrated huge resilience, survived the lockdown of 2020-2021”.

Tonie Mudde is the Head of Scientific News at De Volkskrant newspaper. He studied Aerospace Engineering in Delft.



THE FIRM

Wattlab was launched in 2017. Three years later, the founders already had dreams of Wattlab hubs worldwide, developing innovative solar products with local partners.

Bo Salet (1992), David Kester (1994) and Siebe Roefs (1993) are Wattlab's founders. Their aim? To kickstart new solar energy applications and accelerate the energy transition. They all studied in Delft; Roefs studied Applied Physics, Kester studied Electrical Engineering and Salet

'A close contact with your client is essential in enabling growth'

Aerospace Engineering. Salet: "We met as part of the Nuon Solar Team. We hit it off and, after the project, felt compelled to do something alongside our degrees. That became Wattlab." The students agreed that the start-up would not affect their graduation.

MILLIMETERS

"During the World Solar Challenge, we wondered why solar panels are so large and cumbersome and not as light as the panels we use in the solar car. If you integrate solar panels in existing structures, you can keep them ultralight. You still often see panels being installed on roofs, but a roof is already a sturdy structure and if you put a panel on top of it, that's also structural. It's duplication."

Wattlab has a different approach. As an example, Salet cites a pilot involving the inland vessel De Oleander. Together with Blommaert Aluminium, Wattlab



Bo Salet: "It's going faster than expected."

designed solar panels just a few millimetres thick and integrated them into the ship's hatches. That kind of structure is capable of meeting 10% of the energy needs of a ship with

850 m² of available surface. For the online supermarket Picnic, Wattlab integrated ultrathin solar panels into shopping trolleys in order to cool them in summer.

PAYROLL RECORDS

Whereas it used to be Salet, Roefs and Kester who were approaching other companies, it's now the other way around. "And earlier than expected", Salet says. In April 2017, they registered at the Chamber of Commerce and Wattlab started life in Kester's student room, doubling up as an office and production facility. A year on, Wattlab already had the funds to rent a workshop and buy their first machine. What was the biggest obstacle in the early years? Salet sighs. "You imagine you'll just develop a product and sell it. But there's more to it. We found ourselves facing all kinds of administrative hassle. I tried to go through a 200-page book on payroll accounting, but it's just gobbledygook to me. Fortunately, we've now outsourced that."

They also noticed that close contact with your client is essential in enabling growth. Salet outlines his vision for the future: "We want to see Wattlab hubs across the world working together with local partners. Our aim is to push innovations." So, what about the promise that Wattlab would not be allowed to affect their degrees? Salet: "We managed it. Siebe and I have already graduated, David will follow this year." 

- Company: **Wattlab**
- Product: **Innovative solar products**
- Founded: **2017**
- Degree: **Aerospace Engineering**
- Number of employees: **10**
- Revenue: **"I'd prefer not to say. Wattlab is a wholly-owned company."**
- Target group: **Companies (mainly transport) that aim to deploy solar energy effectively.**
- In five years' time? **Developing smart solar solutions with local partners from local hubs worldwide.**

'INNOVATION DOES NOT ALWAYS HAVE TO COME FROM START-UPS'

'That's impossible' is the frequent response to the wild ideas of company employees. A pity, says Professor of Entrepreneurial Engineering by Design Frido Smulders.

Start-ups and entrepreneurship are sexy, says the new TU Delft Professor of Entrepreneurial Engineering by Design Frido Smulders. Is this a good subject for a new professor of entrepreneurship? Not for Smulders. He believes that most innovations that are needed to solve social problems should come from existing companies. They are the ones, after all, that have the finances, knowledge and experience. And the people. At least 90% of all TU Delft students work for existing companies after they graduate. He believes that there is a problem with real radical ideas in companies such as listed companies. These companies are not designed for new ideas and do not encourage entrepreneurship. They often view wild ideas as unfeasible, too expensive and a potential threat to their current products.

Smulders wants to change this. He wants to give teachers the tools to teach their students to operate in entrepreneurial multidisciplinary teams. To design the online courses for this, he will receive starting capital of EUR 50,000 from the 4TU Centre for Engineering Education, an alliance of the four technical universities in the Netherlands.

Why is radical innovation, as you call it, so hard for existing companies?

"It's because it is hard to take a decision, which is usually based on rational criteria, on what is at that point an irrational idea. Firms are often driven by financing, market share, and the in-house knowledge and expertise. If an unorthodox idea emerges and you don't know if it fits in your company and if so how, it is simply too left field and is either shot down or ignored."

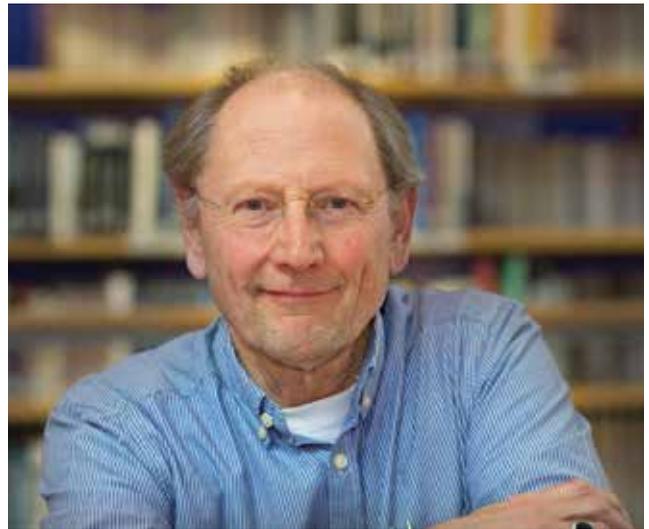
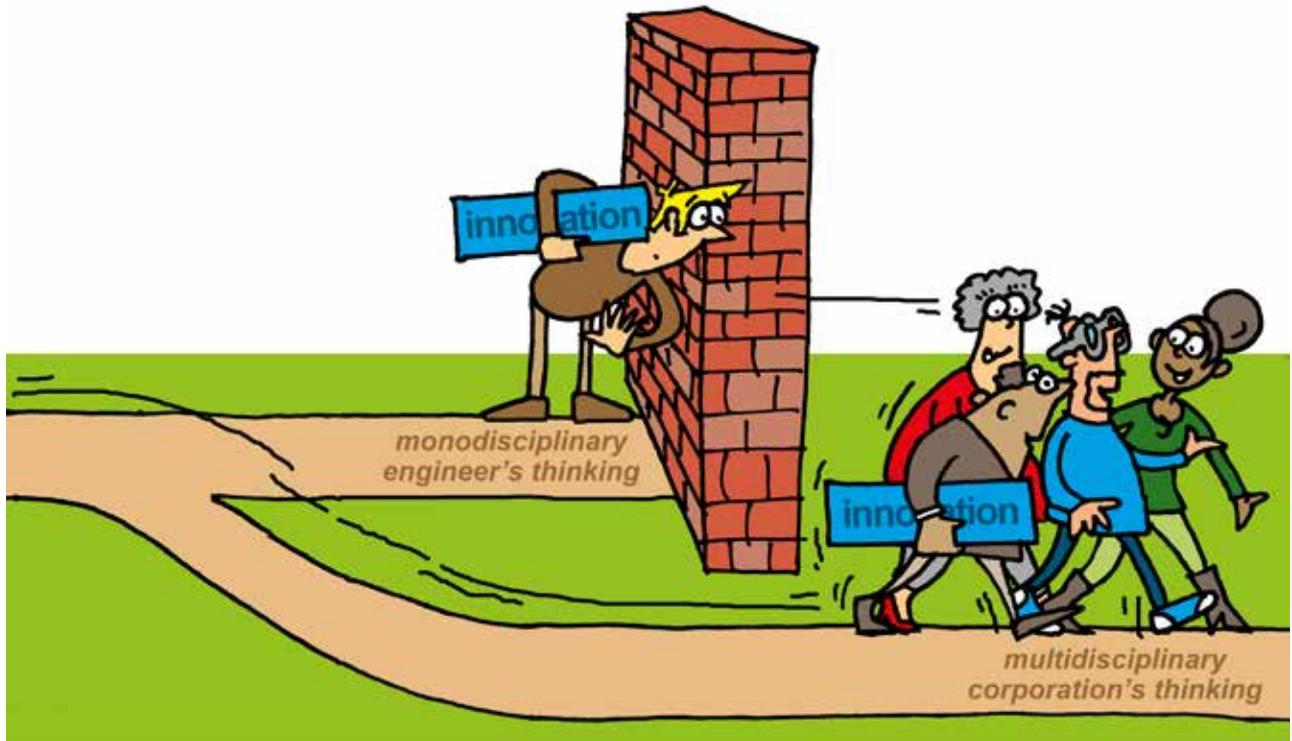


PHOTO: ESTHER ERKLENS

Frido Smulders: "We fall well short of multidisciplinary organisational thinking."

Many companies often take over start-ups if they want to be innovative. That is all right, isn't it?

"That is indeed common practice but the price that companies often have to pay for start-ups is far higher than the costs that they would incur if they would do it themselves. For example, in 2016 Unilever bought the One Dollar Shave Club for USD 1 billion. The usual practice is to buy the company that you want to take over for five to eight times its profit. In this case, it was more than five times the turnover. Let's assume that it cost about USD 10 million for the One Dollar Shave Club to generate its first clear turnover. Many start-ups fail of course, and in this case you would only have lost USD 10 million. You are now paying USD 1 billion for something that is up and running. If you



look at it this way, you can actually fail 99 times for every one success. A large company with a lot of knowledge and resources should be able to do this.”

Why don't they do this then?

“Companies’ operations are often completely directed at its current products and there is fear of cannibalising them. But in truth, it’s often because the innovation process is little understood. If you really want to collaborate for innovation, you need a multidisciplinary team in which each discipline regularly sticks out its neck to come up with new ideas. And this is challenging. People who come up with different ideas in companies are often put down with arguments such as ‘it will take too long’, ‘it’s too expensive’, ‘it’s impossible’ or ‘he’s at it again’. You therefore make yourself vulnerable if you come up with a wild idea. But in reality, it’s the environment in which you work that has not learned to deal with ideas. This can affect your career in a company. We teach our students to think like monodisciplinary engineers and fall well short in terms of thinking as a multidisciplinary corporation.”

Does that mean that every engineer should think like an entrepreneur?

“No. It’s not about individuals, but teams. You need entrepreneurialism in a team, and the rest of the team members should understand this. Large corporations need it, and this has become clear in the corona crisis. We want to prepare our engineers for this type of unpredictable and

uncertain situation so that, if need be, they can innovate quickly in collaboration with many other disciplines. This also implies an attitude of learning along the way instead of fearing making mistakes. You cannot fail if you innovate, you can learn from what does not work.”

How can you teach students this while the education system judges them on their final grades?

“That’s a hard one. I would like to work with my 4TU team on designing a framework which will help teachers to include this in their teaching. This will be the online module. What they will teach as validated knowledge will in fact be the outcomes of the process of a technological innovation. If they can demonstrate how the innovation

‘You cannot fail if you innovate, you can learn from what does not work’

process was underpinned by entrepreneurship, they will learn from this and will be able to identify the underlying theoretical framework. This may not be the case in every subject. They will go a long way with just one or two subjects in a master’s and we will be able to reach all the engineering students.” <<


 HORA EST

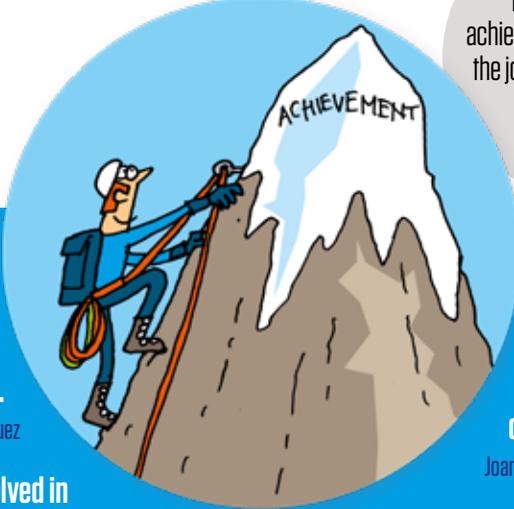
Integrated design will become a buzzword when it is not used as a means, but as a goal in itself.

Joannes Visser, civil engineer

“There are many terms such as sustainable design, inclusive design, holistic design, and integrated design that appeal to an underlying ambition or desire to incorporate value, but which are also vulnerable to become a buzzword. As part of my research into integrated design I investigated possible definitions and applications of integrated design along the different design faculties of Delft University of Technology.

However, I found that some for example refer to product architecture, some to values, and others to disciplines.

This can create difficulties when operating collaboratively. Therefore, the goal of integration should be clear in the first place, before defining and discussing how to reach that goal through design. Integrated design is a non-normative term and integration is relevant when independently defined solutions conflict or lack opportunities for value incorporation. In that context, integrated design becomes relevant as a means and overcomes the buzzword.”



Happiness is not found in enjoying achievements, but enjoying the journey towards these achievements.

Nils van der Blij

The field experience and knowledge of locals are equal or more valuable than any geographical information system or data repository available.

César Jiménez-Rodríguez

Concepts such as waste, nature, overpopulation and disabled are the result of a distinction that is defined by how something is designed.

Joannes Leendert Visser

PhD candidates should be involved in the valorisation of their research in order to increase their added value for industry.

Laura-Lynn Fockaert

The best metric for the effectiveness of a naval ship (and other defence material) is the number of shots not fired.

Agnieta Habben Jansen

Data science should never become a separate discipline.

Tessa Dekkers

With your bachelor's degree you think you know everything, with your master's degree you recognize you know nothing and with your PhD degree you realise no one really knows anything.

Nils van der Blij

Pure research must primarily address social issues and later meet industrial needs.

Luca Pascarella

Sustainable consumption is an oxymoron.

Vivian Tunn

Catalysis under pressure

The chemical industry is under pressure to develop new processes for the production of plastics and fuels. This requires other catalysts. The Industrial Catalysis Lab is specially designed for work with extreme pressures.

See the drawing on the following pages.

“Catalysis is like a magic stone,” says Professor Atsushi Urakawa. A catalyst, as we learned in chemistry, is a substance that suddenly makes an unruly chemical reaction possible without itself being converted. That sounds like magic, and that impression is reinforced by the involvement of exotic metals such as platinum. But ‘magic’ is no longer good enough. The decline of fossil raw materials has put the chemical industry under pressure to develop new processes for the production of plastics, fuels and fertilisers. New processes require other catalysts that are also less dependent on rare metals. It is Urakawa’s mission to significantly shorten the lead time from laboratory to industry. “Given the speed at which the climate is changing, 20-30 years of lead time is no longer an option. We cannot afford to wait that long to make our key chemicals more sustainable.” This calls for labs where catalysis is developed under industrial pressure and temperature. “A higher temperature means more aggressive collisions between molecules, and high pressure

means a higher chance of hitting them.” His hands collide as an illustration. “This is the only way to achieve high conversions.” Working pressures of up to 500 bar require a special building. HappelCorelissenVerhoeven architects designed the Industrial

‘We cannot afford to wait that long to make our key chemicals more sustainable’

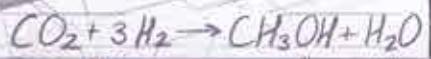
Catalysis Lab specially for work with extreme pressures. Experiments take place in one of the eight cells with 50 cm thick walls of extra reinforced concrete, closed by steel ship doors. The rooms are explosion-proof; overpressure is discharged through a special hatch in the roof. The experiment is controlled from outside the cell by a self-designed control system. In box 3, an experiment is running in which hydrogen and CO₂ are converted to methanol and water.

The catalyst is located in a small space between two blocks as big as a brick. Despite the enormous pressure, the tubes are only a few millimetres in diameter. In box 4, on the other side, a set-up for batch conversion is running, as is usual in the pharmaceutical industry. While the solution is stirred in the reactor, a Raman spectrometer records surface structures and an infrared spectrometer records molecular vibrations. “You can see the chemicals forming on the surface,” Urakawa explains. The ‘next generation’ catalyst, which is being developed here, is in his conception made up of ordinary metals such as copper, nickel and iron. Composed in alloys or nanostructures and tested at industrial temperatures and pressures. Urakawa is convinced that the ‘magic’ of the catalyst is ultimately nothing more than the right combination of materials and conditions. Discovering these is the mission of this small black laboratory at the southwest corner of the campus.

See the drawing on page 32-33

INDUSTRIAL CATALYSIS LAB

BOX 3



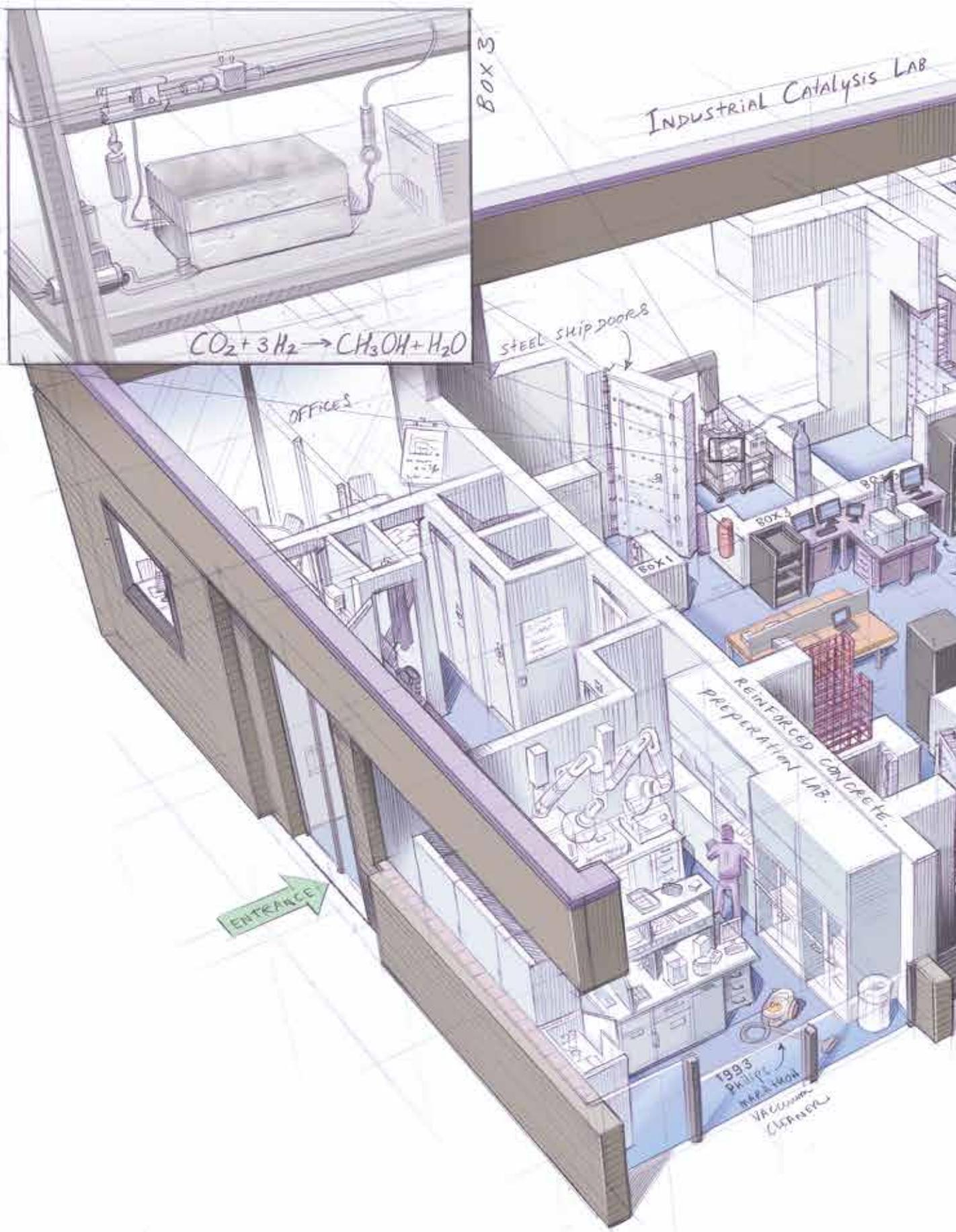
STEEL SHIP DOORS

OFFICES

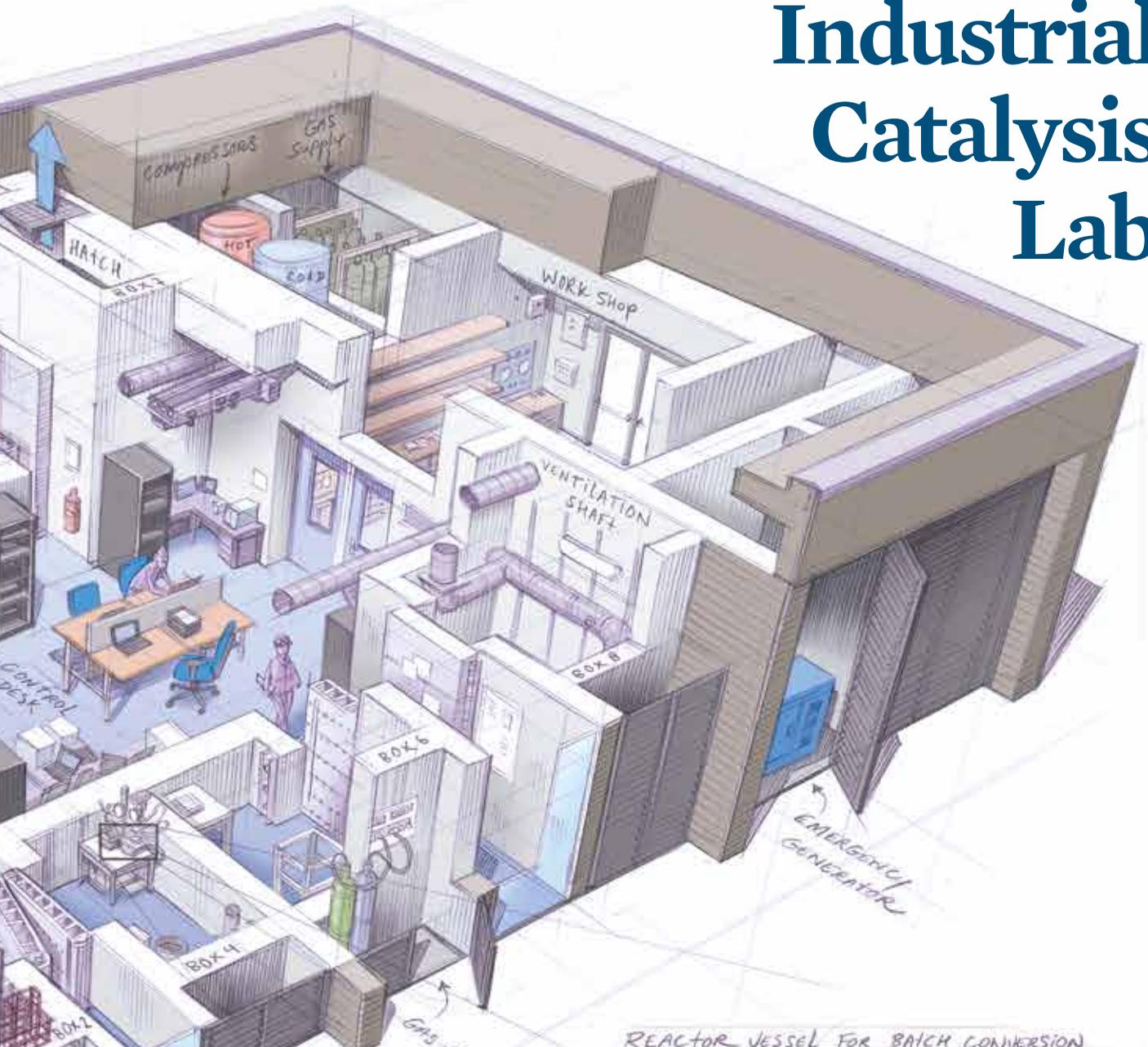
REINFORCED CONCRETE
PREPARATION LAB.

ENTRANCE

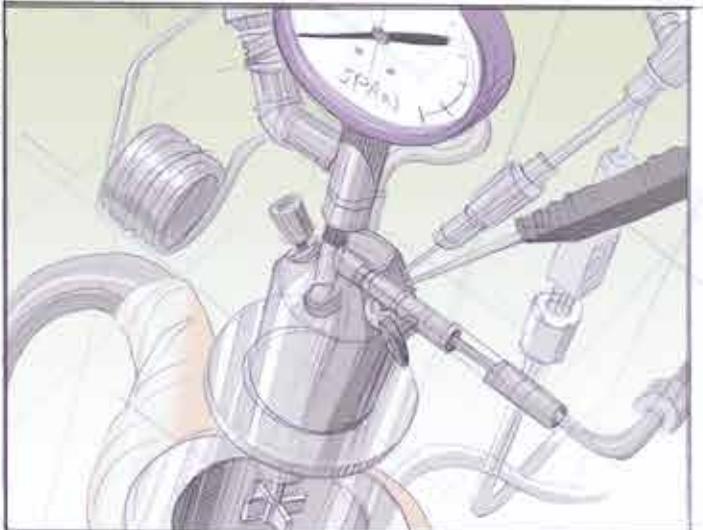
1993
PRIME
REPAIR WORK
VACUUM
CLEANER



Industrial Catalysis Lab



REACTOR VESSEL FOR BATCH CONVERSION



Sturwee '21

‘Contributing has a huge impact’

In the Netherlands, we may be willing to donate to good causes or museums, but not yet to our alma mater. This culture of donation needs to develop, argue alumni Menno Antal and Michiel Westermann. As the initiators of the TU Delft Excellence Fund, they put their money where their mouth is.



Michiel Westermann: “Technology has become part of our daily life, which makes it incredibly socially relevant.”

Michiel Westermann studied Mining Engineering and co-founded the IT company Pink Elephant while still a student; he was later one of the brains behind the ICT incubator Twinning. He is now on the board of medical technology company DIH.



Menno Antal: “If we want Delft to be a world leader, we need top-level academics.”

Menno Antal studied Electrical Engineering. He has worked at Heineken and the private equity company 3i. Currently, he is an informal investor and a member of the supervisory board of Action, Egeria and SOS Kinderdorpen.

me how a business works”, says Antal. While working at 3i, Antal was often in Silicon Valley. “I saw the success of the collaboration between universities, students and alumni and found it very inspiring. I wondered if we could do something similar in the Netherlands.” Since then, a lot has changed in Delft: “When you look at RoboValley, YesDelft or QuTech now, there’s a world of difference. When I see all the possibilities offered to my son, a third-year Physics student, I’m almost jealous.” But there is still something missing: a culture of donation like that in the Anglo-Saxon world, where such universities as those of Oxford, Cambridge or Yale raise billions in donations from alumni. Westermann: “Here, many people feel that funding education and research is purely the government’s job. But innovation really matters to ‘the Netherlands plc’ and so to all of us. As a business or individual, you have an obligation to contribute if you can.”

Top-level academics required

Under the leadership of Rector Magnificus/President Tim van der Hagen, a lot of work is being done in Delft to develop a Silicon-Valley style innovation ecosystem, but the main problem is attracting talent. “If we want Delft to be a world leader, we need top-level academics, because they in turn attract talented students, researchers, grants and international

Both have fond memories of their time in Delft as students and study association members. But something was missing. “At TU Delft, I learnt analytical thinking and had a lot of fun as an active DSC member. But the degree programme was so

technical that I considered also doing Law in order to widen my perspective”, says Michiel Westermann. Antal agrees: “In my day, the programme was also very academic and dry, which can be boring if you have a commercial disposition.” That is why both of them topped off their engineering degrees with MBAs. “That taught

companies. That's the only way that kind of ecosystem will work, and the same applies to the quality of start-ups. Sadly, there is insufficient money to attract such people, because government funding is not keeping pace with increasing student numbers", Antal says. Westermann: "Top-level academics can justifiably set their own requirements. It's not about personal gain, but about equipment, labs and doctoral candidates, the preconditions for top-level research. In other countries, it's totally normal for them to get some kind of starting capital for that."

Donations

To make that possible at TU Delft, the TU Delft Excellence Fund was established. It happened in a typically Delft way: "Normally, you start by building up a relationship – but we asked for a hefty donation from the get-go", says Antal. The strategy proved successful: the first three professors have been recruited thanks to donations from the 38 founders of the fund. "They're an amazing group of alumni with their

own special dynamism. Together, we also organised several fun events, such as 'Meet the Scientist' or 'Meet the Start-ups'. We're still in the pioneering phase and hope to double the number of founders this year", says Antal. "TU Delft is among the world's best in several research areas and we want more from these fields. We're happy to

'Delft is a world player in the development of technology'

invest our energy in them."

The aim is for it to become totally normal for alumni to donate to their alma mater: "All alumni should give something as thanks for what you gained in Delft, because you benefit from that for the rest of your life. Even if it's initially just 25 or 50 euro per year", Antal says. Westermann: "Four out of five alumni that I speak

to only have contact through their study or student association. I'd advise everyone to take a closer look at what's really happening at TU Delft. Technology has become part of our daily life, which makes it incredibly socially relevant. Delft is a world player in the development of that. If you donate money to that, it has huge impact." <<

TU Delft Excellence Fund Founders

Menno Antal, Gert Jan van der Hoeven, Tijo Colloot d'Escury, Marc Schuurung, Richard Kraaijeveld van Hemert en Paul Nederlof; VandeGrijp Holding, Hans van Ierland, Folkert Schukken en KOO Siu-Ling, Serge Kremer, Chris de Ruyter van Steveninck en Marlene Sybrandy, Frans Haafkens, Gijs Dullaert en Estelle Loyson, Michiel Westermann en Jomien Westermann-Buithuis, Jeroen Hegge, Michiel Kottling, Bas Meeuwissen, Daan van Helsdingen, Mickey Huibregtsen, Kristiaan Nieuwenburg, Godfried van Lanschot, Michael Wisbrun, Gert Jan Hubers, Richard Blickman, Joost Pâques; Paques Technology, Brian Joseph, Sven Smit, Harry Dolman, Maikel Lobbezoo, Hugo van der Goes, Benno van Dongen, Freek de Bruijne, Wieger Wiegersma, Otto Staleman, Joris Heerkens, Bastiaan Soeteman, Peter Spaans, Frederik Nieuwenhuys, Ed van Dijk, Stepan Breedveld and Annika Breedveld-Hofman.

Team up with Excellence

The TU Delft Excellence Fund supports the TU Delft excellence strategy based on the three pillars of Research, Education and Valorisation, which together form the TU Delft ecosystem. In this first phase, the Excellence Fund is focusing on alumni and friends of TU Delft who are considering a substantial donation. Donors become members of the Delft Leaders Programme, which focuses on knowledge, experience and community. We are working together to make an impact for a better society, with Delft technology as an important engine of the Dutch economy. For more information:

universiteitsfondsdelft.nl/excellencefund or
excellencefund@tudelft.nl

‘The main thing is to avoid getting stuck in your own bubble’



Patricia Parlevliet: “Students tell me amazing things about their lives and what matters to them. Those different perspectives are so important.”

Mentor, coach, jury member, guest lecturer – over the years, Patricia Parlevliet has remained involved in TU Delft in all kinds of ways. While this is valuable to the university, she also benefits greatly herself: “My contacts with TU Delft often inspire new ideas for my work. Although they may not all result in concrete projects, there is always plenty of food for thought.”

“A genuinely formative time in your life”, is how Patricia Parlevliet remembers her years at TU Delft. “I was in a fun student house and very active in the study association, Tubalkaïn.” Tubalkaïn represents the interests of students of Material Science, the programme in which Parlevliet graduated in 2003. “During my graduation project, I noticed how much I enjoyed exploring something in depth. I was eager to spend a few more years doing that and becoming an expert in a specific field, which is why I chose to take a PhD.” Her supervisor was Adriaan Beukers, Professor of

Composite Materials and Structures, and her research focused on composites for wind turbine blades.

Blue-sky thinking

She is now a senior project manager at Airbus Blue Sky, the division where the blue-sky thinking happens. “I attempt to translate new insights and technologies from the academic world into potential applications in order to transform aviation over the longer term”, she explains.

In 2019, a joint publication by TU Delft, the University of Antwerp and Hasselt University about bacteria that live on electricity and can also transport it (so-called cable bacteria), caught her eye.

“These bacteria live on the seabed and can grow over a centimetre in length. When I read that, I thought: That’s somewhere close to what we need for certain systems, such as those for electrostatic discharge. If you could use an organic material for that, it would be much lighter than the material we currently use. I

‘Your role as a mentor is to talk to students about potential career moves, how to organise an internship or the problems you encounter as a graduate’

approached the researchers to find out more.” The contact led to a joint project. In 2020, the research into cable bacteria formed the basis for a Joint Interdisciplinary Project (JIP) aimed at Master’s degree students in different faculties. Patricia Parlevliet became their business coach. “What applications can you think up for this and what would they look like? That was the assignment we gave the students. I had to supervise and assist with questions, for example concerning the requirements that might be needed for applications in aircraft”, Parlevliet explains. “I also tried to coach them in a broader sense. ‘This is your chance to talk to someone who’s worked at Airbus for thirteen years, so ask your questions’, I told them. It was really appreciated, especially since contacts are so difficult in these times of coronavirus.”

Mentor Alumni Programme

This was not the only Delft project Parlevliet was involved in last year. For the second time, she was also the mentor for the Mentor Alumni Programme (MAP) run by the Faculty of Aerospace Engineering. “Your

role as a mentor is to talk to students about potential career moves, how to organise an internship or the problems you encounter as a graduate. Especially now, it’s very important for them just to have someone to chat to.” Much of the mentor programme is being done online. This can occasionally prove advantageous. “In a virtual programme, it’s easy to network with other mentors. It was my idea to hold a mid-term meeting to share our experiences. I’d been involved in something similar at the Bundeswehr University here in Munich, where I’m also a mentor.”

Bubble

She is determined to maintain links with Delft: “My contacts with TU Delft often inspire new ideas for my work. Although they may not all result in concrete projects, there is always plenty of food for thought. It’s also easy to keep in touch, because of all the events organised by TU Delft for Life. Or via the AE network in Munich, where you meet people and can share tips and tricks. I enjoy taking part in that.” She is also keen to continue working with students: “I’m now in my forties and have two young children, so I generally have little contact with young adults. Students tell me amazing things about their lives and what matters to them. Those different perspectives are so important. The main thing is to avoid getting stuck in your own bubble.” <<

Patricia Parlevliet works at Airbus Blue Sky, where she translates new insights and technologies from the academic world into potential new applications in order to transform aviation over the longer term.

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](https://alumni.tudelft.com/events)

13 April

Masterclass for Good Friends of Delft University Fund - for invites

28 April

Career Café young alumni

19 May

Award Ceremony Marina van Damme grant

7 - 11 June

TU Delft for Life | Xperience Week
Five days packed with inspiration, five themes in which alumni from different parts of the world meet scientists in a virtual environment.

Watch the recordings of last year and stay up to date with the programme via: alumni.tudelft.nl/xperienceweek.

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.

New human enhancement: a balancing backpack

Falling is a societal challenge. Annually, about one in four elderly people fall. Fortunately, a novel aid technology is on its way.

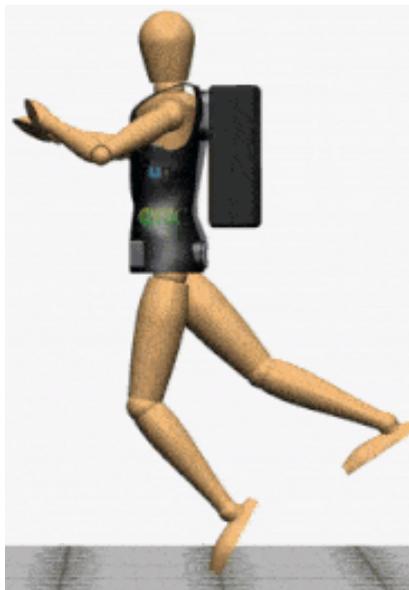
How can science improve the human body with robotic aids? Professor Heike Vallery and her research team from the BioMechanical Engineering department (3mE) are developing a mobility aid that can stabilise balance. Existing mobility aids, such as canes or crutches, tend to alter body posture and limit the hands' movement. Meanwhile, more advanced aids, such as mobile body weight support systems, take up a lot of space and are cumbersome.

Gyroscopic effect

An idea arose to develop a backpack-like aid that is convenient and frees up the hands. Some therapists already use similar inventions in which a cable robot is connected to the backpack.

The trick of making it freely portable is the gyroscopic effect. Enter the fidget spinner, the 2017 toy craze

However, it only works indoors where the cables can be attached to the ceiling. The trick of making it freely



When the person falls, the force sets off the spinning devices to produce the gyroscopic effect, indicated by the red arrow.

portable is the gyroscopic effect. Enter the fidget spinner, the 2017 toy craze. Playing with a fidget spinner is an easy way to observe the gyroscopic effect. "If you spin a fidget spinner quickly, then try to tilt it towards another axis, you will see that it starts to move back and forth. Forcing it to tilt does not work and you will feel torques of forces that affect rotation," she explained. Vallery suggested installing large fidget spinners on the backpack,

where the devices can readjust the balance through the torque or gyroscopic effect triggered when the user falls.

The team conducted experiments involving people walking on a thin beam without touching the ground under three conditions: without a device, wearing an inactive device, and wearing an active device. They tested it with both motor-impaired people from strokes and healthy people. "Everyone – both those who had had strokes and those who had not – was able to balance for a long time," said the Professor.

Challenge

Vallery and her team are now working on a more convenient version of the aid, by making the rotating gyroscopes lighter and smaller. The battery capacity and the user adaptation to the device are also being taken into account.

And what about entering the market? "We hope to work with commercial companies, perhaps a spin-off or a larger company. However, this kind of technology is very different and complicated from 'normal' products, so convincing a company to invest is a bit of a challenge." <<

Tech for Health

Better healthcare thanks to Delft technology

In many countries, such as the Netherlands, high quality healthcare is under pressure due to increasing demand, a shortage of healthcare staff and rising costs. The corona virus crisis has shown us just how fragile our healthcare system is. It's clear that something needs to change. The system needs to become more efficient and more effective, and this is where Delft technology is set to make a major impact. Delft University Fund has launched the Tech for Health campaign to draw attention to healthcare research being done right here at TU Delft, including innovations that lead to faster diagnoses, more effective and rapid treatments, and shorter waiting times.

Integration of academic fields

In these research projects, we are working closely with leading medical institutes such as Erasmus MC in Rotterdam and LUMC in Leiden. The integration of engineering, science, bioscience and humanities is resulting in the emergence of new specialisations. Worldwide, this approach is seen as the best way to resolve complex social issues. We are now using this holistic approach to keep healthcare in the Netherlands at its very high level and to ensure that it is accessible and affordable for everyone. Below some examples of projects in the Tech for Health campaign:



Rapid diagnosis using ultrasound

If a mild stroke is recognised early, preventive treatment can prevent serious damage. David Maresca is working on an advanced ultrasound application that will make that possible.



Ethics in innovation

Responsible and sustainable innovation is an important principle in all projects involving medical technology. Samantha Copeland is leading the mission for including ethical and social considerations in every step of the discovery-development-implementation cycle.



Reduced pain from osteoarthritis

It is important that you start the right treatment of your osteoarthritis symptoms as soon as possible. Professor Jaap Harlaar is set to make an important contribution to this from a unique lab that will combine biomechanics and radiography.

► Will you help?

With your financial support, we can expand labs, deploy additional capacity and accelerate research. This allows us to keep our healthcare at its very high level and ensure that it is accessible and affordable for everyone. Check all the projects in this campaign via www.tudelft.nl/techforhealth or scan the QR code and donate directly.



ALL IN THE FAMILY

Family van der Lippe

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



“In our family, no student grant meant no study”, says grandpa Johan van der Lippe (Civil Engineering, 1946-1951). He kept careful note of how he spent his money. “I got 900 guilders a year. Of that, 300 guilders was spent on tuition fees, 60 on examination fees and 10 on enrolment charges.” This led his eldest grandson Tim van der Lippe (Computer Science Engineering, 2013-2018) to conclude that his grandfather’s home was short of money. Grandpa: “In my day, many students came from well-off families – I didn’t. Every day, I travelled from The Hague and back by tram because my bike had no tyres – you couldn’t buy any after the war.”

His son Carel van der Lippe (Electrical Engineering, 1981-1986) was more fortunate. “I didn’t get a supplementary grant, but I had a part-time job cleaning windows. We did a whole house for 15 guilders. Later, when I was graduating, I was appointed at the Dr Neher Lab run by the PTT. Suddenly I was earning 2,500 guilders every month. It was unprecedented!”

Carel’s eldest son Tim was glad to receive the basic student grant. He did not take out a loan, preferring to earn money as a student assistant. His younger brother Stijn van der Lippe (Applied Sciences, 2018) is doing the same, even though he’s not even receiving a grant. “Thanks to my parents, I don’t need to take out a loan.” MvdV

