



**DELFT
OUTLOOK**

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TU Delft

WATER WORKS
**ARE THE NETHERLANDS
STILL SUCCESSFUL?**

**INTERVIEW
PETER VINK**
**'People are strange
creatures'**

**PROSTHETIC
PRIDE**
**Banning
stigmas**

THEME
Movement

Cover photo: Photography is not the best way to record movement but it works with traffic flow. At the Prins Clausplein intersection near The Hague the light of cars and trains leave lines in the photo. A flashing light completes the picture. (Photo: Sam Rentmeester)

EDITORIAL
Frank Nuijens

Movement

Collectively as a nation, last year we travelled almost 200 billion kilometres using passenger transport according to Statistics Netherlands. To do this, we used the nearly 140,000 kilometres of roads and the over 300,000 kilometres of railway tracks in our small country. We travelled mainly by car - the number of kilometres travelled by vehicle has increased by thirty per cent over the past quarter century. And these figures do not include air travel. Dutch airports served over 57 million passengers last year. Thanks to technology, our personal world has become infinitely large. While a hundred years ago, most lives were lived out within a radius of a few dozen kilometres, today's commuters think nothing of a daily round trip from Delft to Amsterdam. In the past, if you were elderly and infirm, you would be confined to

your house. But now technology keeps us mobile into old age. The hope is that the same technology can ensure that we will remain mobile in the future and that our infrastructure does not get clogged up. To do this, mechanical solutions can obviously play a role - such as exoskeletons, a steering aid for elderly cyclists and *dynamic lane guidance*. But we will never achieve this with engineering alone. Changes in behaviour therefore make up the second important aspect of this edition of Delft Outlook with its theme of *movement*. As ergonomics expert Peter Vink says in his interview: As long as [users] can press a button before something happens, they are happy - and otherwise they are not.'

Frank Nuijens,
editor-in-chief

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Theme MOVEMENT



PHOTO: SAM RENTMEESTER



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Cover photo Sam Rentmeester
Editorial staff Frank Nuijens (editor-in-chief),
Dorine van Gorp, Katja Wijnands (managing
editors), Saskia Bongers, Tomas van Dijk,
Sam Rentmeester (image editor),
Connie van Uffelen, Jos Wassink
T +31 (0) 15 2784848,
E-mail delftoutlook@tudelft.nl
Contributing writers Auke Herrema,
Desiree Hoving, Stephan Timmers
Design Jelle Hoogendam
Typesetting Saskia de Been
Printing Quantas Grafimedia
Subscriptions
delftoutlook@tudelft.nl

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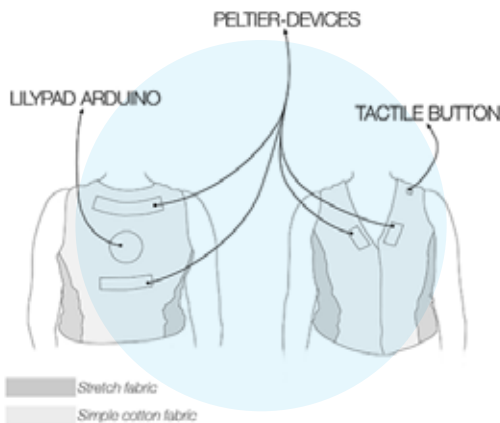
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DELFT IN BRIEF



Cool jacket

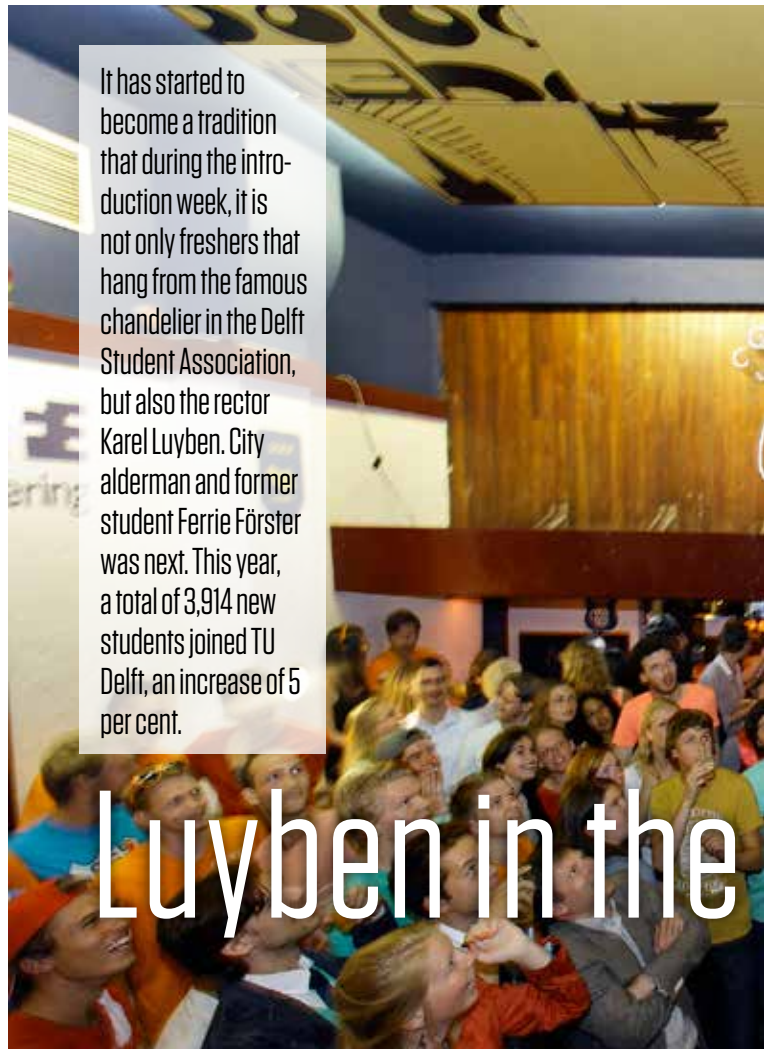
Menopausal women who are suffering from hot flushes may no longer need to reach for the pills in the future. Ir. Geertje Hofstee graduated from the Faculty of Industrial Design Engineering on 5 September with her design for a body-cooling jacket that can automatically detect a hot flush on the skin and will respond by activating cooling elements integrated within the clothing. 'During a hot flush, the skin tempe-

rate can rise by between 1 and 7 degrees, so it is quite easy to detect,' explains Hofstee. The cooling effect is achieved by what are known as Peltier elements. These convert an electric current into a temperature difference between two different metals. As a result, one side of the element (which is almost touching the skin) activates the cooling mechanism.

delta.tudelft.nl/28727

It has started to become a tradition that during the introduction week, it is not only freshers that hang from the famous chandelier in the Delft Student Association, but also the rector Karel Luyben. City alderman and former student Ferrie Förster was next. This year, a total of 3,914 new students joined TU Delft, an increase of 5 per cent.

Luyben in the



Cargo ship with sails

IMAGE: DIJKSTRA.N.A.

Ir. Emiel Mobron studied the economic feasibility of cargo ships with sails for his graduation project in marine engineering (Faculty of 3mE). He made his calculations using Dijkstra Naval Architects's Eco-liner, a 138-metre-long ship with a loading capacity of 8,200 tons, propelled by a combination of diesel engine and four DynaRig masts. His calculations showed that, at a cruising speed of 11 knots (about 20 kilometres per hour), the ship used only half the amount of fuel it would have used without the sails. The ship itself is more expensive, but due to the fuel savings, it can transport cargo 11% more cheaply (in euros per tonne kilometre).

delta.tudelft.nl/28457



chandelier

PHOTO: SAM RENTMEESTER

LAND SURVEY INSTRUMENTS

The historical collection of survey instruments was moved to the tower room at Kanaalweg 4 last summer. This means that the items have returned to where surveying once began. From 1895 onwards the building was the cradle of geodesy in the Netherlands and remained in use as such until 1975. Four volunteers have amassed a collection of spirit levels, theodolites and other instruments here. On 27 August, they opened the doors to the tower room for visitors.

hollandsecirkel.nl

AUTUMN LEAVES

As soon as the leaves start to fall, the problems begin. Rail passengers know all about this. The fallen leaves get pressed into a hard Teflon-like layer between the wheels and the rails, with the result that the stopping distance for a train can double to 800 metres. 'Everything has been tried,' said TU railway professor, Prof. Rolf Dollevoet. 'Brushing, grinding, water jets and now lasers.' After a number of trials using laser trains in the UK, a trial will start this autumn in the Netherlands too. The NS, ProRail and Strukton will carry out the tests.

Dollevoet, together with his Twente colleague Professor Dirk Schipper, has developed a friction meter that measures how long the track stays clean after the laser has passed.

delta.tudelft.nl/28710



SNIFFER BACTERIA

It's not only dogs and rats that can sniff out explosives. Genetically modified *Escherichia coli* bacteria can also do it. At least, that is the belief of the students from TU Delft, Leiden University and Hogeschool Rotterdam who have formed a team to participate in the annual design competition for bacterium, the iGEM (International Genetically Engineered Machine competition) in Boston. The aim of the competition is to modify bacteria such that they can do useful things. The students named their bacterium Ellactrace. The bacterium should light up when it comes into contact with chemicals that seep from old land mines, such as TNT, DNT and DNB.

delta.tudelft.nl/28617

WINNING BLIND

Two Master's students from the Faculty of Architecture have won second prize and €2,500 in the Velux International Design competition. Anneloes de Koff and Iris van den Brink received the award for their blind, The Swipe. The screen consists of four layers, which can be opened and closed individually using a mobile app. This produces a different pattern every time and makes it possible to choose the amount of light one wants to let in.

delta.tudelft.nl/28492



PHOTO: JOS WASSINK

SUSTAINABLE TERRACED HOUSE

TU Delft's entry for the Solar Decathlon, a worldwide competition for energy-neutral construction held in Paris this summer, secured third prize with an extended terraced house with an extended through-room. The house team 'Prêt-à-Loger / Home with a skin' achieved the highest scores for sustainability and

communication with their energy-neutral terraced house. Supervising Professor Andy van den Dobbelsteen (Faculty of Architecture) deliberately chose the renovation of an existing house because according to him, that is where the challenge of the sustainable future lies. After returning to the Netherlands, the house became the first building of the Green Village that was opened by Stef Blok, the Minister for Housing, on 25 August.

delta.tudelft.nl/28748

Glass Bricks

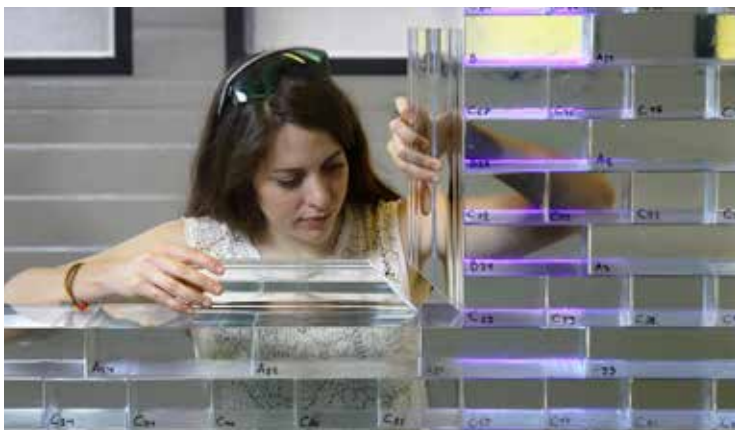


PHOTO: SAM RENTMEESTER

Amsterdam shopping street PC Hooftstraat will become home to a unique new building this autumn. One of its shops is to be given a façade built of glass bricks. 'Interior walls made of glass bricks are quite common,' says Dr Fred Veer, materials researcher at the Faculty of Architecture and the Built Environment. But for a load-bearing wall, the requirements are a lot higher in terms of dimensions and the mortar used. 'This wall could support a herd of elephants,' says Veer, 'and it can withstand an attack with a sledgehammer.' The façade will measure 10 metres by 10 metres when finished and will be 23 centimetres thick - all solid glass. TU Delft is working on this project with architects firm MRVDV from Rotterdam and the Poesia glass factory in Venice.

delta.tudelft.nl/28686

GRAPHENE DRUMS

Scientists from the TU Delft Kavli Institute have been able to make extremely small drums made of graphene. Due to the extremely low weight of graphene, the researchers were able to use small pieces in a way that is similar to the drumhead on a drum. They then 'played' the drum using microwave radiation, listened to the resulting 'nano-sounds' and examined how exactly the graphene layer moved. Thanks to their special mechanical properties, graphene drums could be used as sensors, in cell phones for example, or memory chips in future quantum computers.

delta.tudelft.nl/28645

THEME

movement

ENGINEERING

In Delft, we are busy devising numerous technological solutions to get everything and everyone on the move, and to keep them moving. Robots like Eva and Skel-ex, for example, which help with housework and in the workplace, respectively. Or the bicycle steering aid designed by Arend Schwab that can make cycling safer. Piero Colonna has set his sights higher and is looking at greenhouse gas emissions from air travel. And this is obviously also the right place for an overview of all the 'go-carts' that students have built to move faster or more efficiently.

BEHAVIOUR

But Delft is also working on solutions that seek to influence human behaviour. At CEG they have designed a system that advises people how fast they should be driving and which lane it is best to drive in. That could be good for China, where Ji Lie has discovered that a lack of knowledge of traffic rules leads to major traffic jams. Casper Chorus also believes in giving advice. Thanks to his regret model, travellers are being subtly manipulated in their transportation choices. In Mathieu Gielen's playground, meanwhile, it's more about overt encouragement - he invites children and elderly people to exercise more using toys.

Interaction between man & car

Preventing traffic congestion by modifying driver behaviour: that was what CEG researchers working with Technolution and TomTom came up with. Together they designed a system that advises people how fast they should be driving and in which lane they can do that best. 'The direction I want to move in is that of allowing the car to do more for you.'

Traffic jams. There are more and more of them, and they are getting longer, in spite of all the measures we have devised to alleviate them, from toll booths to rush-hour surcharges, from building new roads and 80 km/h zones, and from promoting public transport to increasing fuel duty. As a driver you have little choice but to travel to the office later in the day, work from home, carshare with someone or just accept that you are going to spend part of your day sitting in a jam. The Faculty of Civil Engineering and Geosciences is taking it in another direction by developing a system that can change your driving style. The new system has the working title of Dynamic Lane Guidance and it advises drivers at which speed to drive and in which lane they can do so most effectively. It was initially intended to combat traffic congestion on the A67, the motorway between Venlo and Eindhoven. Funding for its development came from the Eindhoven Regi-

on, the province of North Brabant and the Ministry of Infrastructure and Environment. Ultimately, of course, the idea is that everyone will be able to use the system. In-car systems are nothing new.

'Take the second exit to the right' or 'Turn around, if possible' are familiar phrases for many drivers. They are spoken by computerized gadgets which, thanks to GPS, know exactly where you are located and will tirelessly advise you which route you should take. More recent are the systems designed to make sure that drivers stay in a certain lane of the road. They warn drivers who are straying from their own half of the road by means of vibrations in the seat or corrective steering. There are also systems that ensure that drivers keep their distance from other cars. Dynamic Lane Guidance is somewhere between all these systems.

DETECTORS

How does it work? 'We use loops along the road to measure how many

cars are using each lane and the average speed at that point on the road,' says Wouter Schakel, who is dedicating his doctoral research to this anti-congestion system. 'The principle is that information is collected from the road and transmitted to a system. That is not new in itself, because detectors are already installed at traffic lights, for example. Based on the information gathered, an advisory speed limit is displayed on matrix boards above the road. What is new is that we now gather this information on a lane-by-lane basis rather than for the whole road, increasing the accuracy significantly.'

However, the real challenge lies not in gathering the information from the road, but analysing it. 'We get our information from the National Data Warehouse, where the data from all roads in the Netherlands is collected. They provide us with the required data three minutes after it has been measured. That data delay is much greater than we had anticipated. This makes it difficult to estimate the cur-

rent traffic situation accurately: where exactly is it busy and how busy is it? In the second module of the system, we pass the anticipated volume of traffic on to an advisor, who in turn gives advice to the drivers. For example, at the end of a traffic jam we invariably advise keeping a short but safe distance from the vehicle in front. The idea behind that is that cars that don't drive in this way will end up stopping and starting, making them react slowly, leaving more time between the the car in front. That is not efficient. It's by keeping such a short but safe distance with the car in front that you will drive through the traffic jam the quickest.'

TRUST

But ultimately it is road users who determine whether a traffic jam occurs. 'Motorists have to trust the system,'

says Bart van Arem, professor of transport models. 'It helps if you motivate people by explaining to them why they should do something. For example, people like to know that the end of the

'The most important thing is for people to just keep driving'

traffic jam is one kilometre away. But the information has to be accurate, because if they are still sitting there after two kilometres, they will stop following the advice you give them. Neither do you want to overload drivers with information all the time, only at very specific moments. The most important thing is that people just keep driving. We have carried out simulations and if

everyone follows the advice, the delay can be reduced by forty to fifty percent.'

Van Arem's ideal is for cars start to understand us more. Just as a horse can feel that his rider is giving him the space to run free, a car should also be able to do more for itself. And I don't just mean accelerating and braking, but also changing lanes. That should feel good for the driver too, because ultimately he or she remains in control. The car can gather information and communicate with the driver, so that there is interplay between people and technology. It would be really wonderful if the car knew what it should do automatically in and around traffic jams.'

When everyone follows the advice, the delay can be reduced by forty to fifty percent.





The rules of the road


The Chinese drive through Changsha like the Dutch ride their bikes through Amsterdam - without any regard for traffic rules.

And that is a recipe for congestion, says Dr Jie Li.

The Chinese traffic researcher Ji Lie recently gained her PhD under the supervision of Professor Henk van Zuylen (CiTG). He had noticed that the flow of traffic through an intersection with traffic lights in China was 20 to 30 per cent lower than the models projected that it should be, and he wondered what was causing this.

The underlying problem, according to Li, is the poor knowledge of traffic rules in China

After four year of research, during which Li conducted surveys of Dutch and Chinese drivers and collected and analysed GPS data from car journeys made by Chinese drivers, she concluded that poor driving leads to delays and accidents. She explored the difference in driving styles between the Netherlands and China and produced some striking figures.

The underlying problem, according to Li, is the poor knowledge of traffic rules in China. Candidates first learn the traffic rules from a book and only then do they get to practise behind the wheel, where the emphasis is mainly on technical skills. Only four of the 35 people in the focus group were correctly able to identify a right of way sign. 

CH vs. NL

DEATHS

per 100.000 vehicles

32

++++
++++
++++
++++
++++
++++
++++
++++

6

++
++++

main cause of accidents

**RIGHT
OF WAY**

DISTANCE

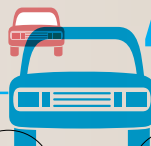
38%

4%

new drivers
in traffic (%)

cars per 1.000 inhabitants

35



461

+27

annual growth
in number of cars (%)

+1

6

average years
of driving
experience

20



Children playing in a lab? That's allowed in the ProFit Fieldlab, which was set up by the City of Delft and TU Delft two years ago with a European Interreg grant to test prototypes for outdoor play equipment.



Memo encourages running and consists of seven posts with touch displays.

As an assistant professor of 'design for children', Dr Mathieu Gielen regularly invites classes of schoolchildren to come and play in playground De Bomenwijk, next to De Bieslandhof care home. This encourages children, and hopefully also elderly residents, to be more active.


Just before the summer, Gielen tested three interactive toy prototypes designed by students. Children could use building blocks that started to vibrate if there was a loud noise, and calmed down again when they were touched. They could also use a glove that measured their heart rhythm to scare each other and 'steal lives'. The third game was

a 'forest of trees', where the kids could attack each other using LED lights, as long as they moved gracefully.

Gielen measured the amount that children were moving using cameras and sensors. 'At the beginning, our ambition was to get elderly people and children to play together, but they did not find that such a logical idea. Now we want to offer children and elderly people activating activities the same location.' For the elderly people in the nursing home, exercise equipment and movable chairs are available. 'The idea is for elderly people and parents to be tempted to get involved in the game and join in.'

The first prototype in the field lab was Memo (memory movement), consisting of seven posts with touch

This encourages children, and elderly residents, to be more active


displays. 'The children run around and play with these - for example: half of the poles are switched on and they have to turn them off by touching them. The first version did not work well. The children did not understand how to choose the games. We solved that problem by using a menu that combined visual and spoken explanations.' 



Cheerful robot


If you take a step to the side, she turns her head to follow you. As soon as she makes contact with you again, her face lights up. It's clear that care robot Eva II enjoys meeting people. 'You shouldn't see her as a person though,' warns IDE Master's student Bram van der Veen, who developed the robot together with fellow students, as an assignment from the university. 'Ultimately she's no more than a glorified washing machine.'

However, she is a machine that is going to have to win the hearts of the elderly. The idea is to circulate Eva II in healthcare institutions to investigate how older people respond to robots.

Her predecessor Eva I, who now stands idle and forlorn in a corner of the lab, was created to distribute drinks in a nursing home and to welcome people and accompany them. However, during an experiment in a nursing home in Heemskerk last year, these duties proved too much for her. Eva I collided with an elderly lady who was using a rollator. The original ambitions had to be scaled back. Eva II has a tray but no movable arms and hands like her predecessor. Her most important task is to give people a good feeling by looking cheerful and surprised. And she can certainly do that like no other. 

roboteva.nl

Painting cyborg

'Do I really need to take my clothes off for the photo?' asks Guarav Genani hesitantly. Moments later, despite his doubts, he is posing for the camera in a large hall at the tech-incubator YesDelft where he has his office. He is half-naked, equipped with the Skel-ex. He developed this device to make it much easier to do repetitive activities such as painting and plastering. It uses an ingenious system of springs, hinges and counterweights. The Indian entrepreneur, who completed a Master's degree in ergonomics at TU Delft, looks like a cyborg. 'This version of the Skel-ex is made mostly of plastic. My previous design was made of steel. Then I really did look like RoboCop,' he laughs. Genani wants to make the Skel-ex even lighter and thinner by printing the components in 3D and using carbon composite. Ultimately he wants to integrate it into work clothes. 

skel-ex.com



Mobility

The government is shifting its focus from facilitating mobility to managing mobility, says Caspar Chorus. His 'regret model' helps predict how your transportation choices will be influenced in the future.

Caspar Chorus: "People make choices to minimise their regret."



through manipulation

‘Until about fifteen years ago, the government believed in building more roads as a solution to the issue of mobility,’ says the newly appointed Antoni van Leeuwenhoek Professor, Caspar Chorus (TPM). ‘Now the question is how many cars and motorways do we really want and how can we use the existing infrastructure as effectively as possible. The government made funding available for travel information, extra rush-hour lanes, and tax incentives. I think that the more the government seeks to influence road users, and the more subtly it does so, the more valuable our regret model becomes.’

Chorus is sitting behind his empty desk in the TPM building. Behind him hangs a 65-year-old academic gown with his name in it. His grandfather wore it when he was a professor of psychology in Leiden. The ‘regret model’ that Chorus Jr. has developed combines psychology with econo-

metrics in the field of mobility, but it seems that it could be applied to all kinds of behaviour, including that of people on dating sites for example. The regret model is an alternative to the utility model, which economists have traditionally used to explain consumer choices. When buying a house for example, someone will look at location, maintenance, neighbourhood, price etc., and will process all this in his head to arrive at a total personal utility value. According to economists, this assessment of utility is independent of any houses for sale down the road.

COMPROMISE

In the late 1950s an alternative idea of behaviour was put forward: people also allow themselves to be guided by what they do not choose, when making their decision. They weigh the price of a lottery ticket against the possible regret of not having bought one. The postcodeloterij makes use of this by dividing its prize money over a whole street – that is, the people in that street who bought a ticket. Who would risk becoming the laughing stock of the neighbourhood? Chorus has translated this idea into an econometric model, and in doing so he has built a bridge between psychologists – who take a mainly qualitative view – and economists – with their penchant for mathematics.

People make choices to minimise their regret, says Chorus. Hence many people end up with a compromise. Maximising utility or minimising regret – it may all sound like much of a muchness, but the essential difference is that the regret model incorporates alternative choices. The introduction of this type of behavioural mechanism

into the model leads to better predictions of mobility decisions, especially when it comes to the type of subtle influence that the *Behavioural Insight Team* (BIT) of the Ministry of Infrastructure and Environment has been eagerly awaiting.

The ‘regret model’ combines psychology with econometrics

The provision of information plays an important role in influencing people. This is already the case when the government and transporters such as the Dutch Railways suggest alternative routes in the event of line closures, also indicating the additional travel time. According to the regret model, certain alternative routes can be made more attractive by mentioning them alongside selected other routes. So when a range of alternatives are presented, it is possible to influence the choices made by passengers. The Regret Model can be used to calculate these effects.

‘The subtle manipulation of traveller might seem very futuristic,’ Chorus says, ‘but experiments are already being done whereby people are provided with very personal and rich travel information, which affects their behaviour in terms of their choice of transport and route.’

Previously, traffic models were static and calculated traffic flow projection over ten years. These days they are online, real-time, and they take account of the changes that they set in motion themselves. Mobility, and with it traveller behaviour, has itself become dynamic. JW



Fossil fuels are not hip. Human muscle power and renewable energy: that's what the TU Delft 'dream teams' are all about.



DUT Racing Formula Student dutracing.nl

It was going to leave everyone behind at the traffic lights. The DUT Racing team's electric racing car can accelerate to 100 km/h in 2.13 seconds. This means that the Delft students hold the world record for acceleration in electric cars. The team has also won the Formula Student at the Hockenheim circuit in Germany five times. The Formula Student is an international design competition for racing cars.



Hydrogen-powered racing car formulazero.tudelft.nl

This may be the fastest hydrogen-powered racing car in the world at this moment. The Forze VI has a top speed of 220 km/hour and a capacity of 190 kilowatts (260hp). The car weighs 880 kilogrammes and can carry three kilogrammes of hydrogen in two tanks - enough to race for 30 minutes at top speed. Seventy students have worked on this vehicle over the last year.



NovaBike novabike.nl

The NovaBike is a one-cylinder motorcycle that runs on bioethanol. At the TT circuit in Assen and the Red Bull Ring in Austria, it reached speeds of around 220 km/hour. 'But we think 250 km/hour is achievable,' says team manager David Meijer. 'The bike has a capacity of 85hp. That's not bad for its weight of 130kg. Most street bikes weigh around 170kg.'

Nuna solar-powered car nuonsolarteam.nl

Driving through the Australian desert as fast as possible using solar power: that is something that the Nuon Solar Team can do like no other. With their solar-powered cars, the students bagged no less than five gold and two silver medals at the bi-annual solar car race, the World Solar Challenge in Australia. This year, for the first time, the team also took part in a race for solar-powered vehicles in South Africa.



Velox recumbent bicycle hptdelft.nl

133.78 km/hour: that is how fast Sebastiaan Bowier cycled through the Nevada desert last year on his Velox. This was a new world record, making him the fastest man on earth in a human-powered vehicle. This year the team also wants to break the women's world record.

Wasub submarine wasub.nl

For the European International Submarine Races in the UK, participants must cycle as fast as possible underwater. Team Wasub won second place in 2013, with a speed of 6.7 knots. This year the Wasub 4 won a fourth place for best design.

Solar Boat deltalloydsolarboat.nl

The TU Delft Solar Boat is a hydrofoil vessel that can reach a top speed of 30 km/h with its 4kW motor. Last July, the team took part in the world championship for solar-powered boats in Friesland and Groningen, the Dong Energy Solar Challenge. For a moment it looked like the boat was going to take second place but the boat capsized just before the finish line.

The Ecorunner ecorunner.nl

The cars in the Shell Eco-marathon may not go particularly fast - around 25 km/hour on average - but the race around the Ahoy arena is always very exciting. To travel as far as possible using the smallest amount of fuel - that is the objective of this race, which involves thousands of students from all across Europe. Any type of fuel is allowed. There are categories for hydrogen, gasoline, diesel, solar and electric battery. Just like last year, the Delft Ecorunner team excelled in the hydrogen-powered category. They finished second, with 396.9 kilometres per kilowatt hour.

ASSISTED STEERING



Ironically, it looks quite scary, this type of sawn-through handlebar on a bicycle. But this steering aid, which is being developed by Biomechanics (3ME), is intended to make cycling safer. And it works too, says bicycle researcher

Dr Arend Schwab. 'Normally a bicycle becomes stable when it is moving at 15 km/hour or faster. With this steering aid, the bicycle becomes stable at just 3 km/hour.'

Schwab developed the steering aid in

response to accident statistics showing that the number of bicycle accidents has increased, particularly among the elderly in accidents involving no other moving traffic. Schwab believes that stability plays a role in this kind of accident.

The steering aid, which consists of a sensor, a small processor and a servo-motor, takes over the job of steering at low speeds and steers in the direction in which the user is likely to fall. It takes some getting used to, but that is the case with any new bicycle, says Schwab.

The prototype may look a little rough around the edges, but eventually it will be possible to incorporate the entire system into the front of the frame, the bicycle researcher reassures us. JW

Making mobility work

Mobility and space, infrastructure planning and urban planning - in the past these were often different worlds. And too often they still are, according to spatial planner Remon Rooij.

Mobility has traditionally been the domain of civil engineers and traffic experts, while the city was that of urban planners. Often they were largely separate worlds. In the past, the city centre was the centre of everything. Now there is no single area that is more important than all the others. In Amsterdam, for example, the Zuidas district is clearly now the economic heart of the city, not the city centre.' To get people to those places, infrastructure and mobility are required. At many

transport nodes, national and regional accessibility is well regulated, but often this is not the case for local accessibility by walkers and

Now there is no single area that is more important than all the others

cyclists, believes Rooij. Many of the graduation projects that he has supervised were about the integration of stations and station areas into the city itself. Slow traffic and local spatial structu-

res often play a crucial role. Noor Scheltema developed a method to evaluate the quality of cycle routes from residential areas to stations. She found a way to measure safety, directness, comfort and attractiveness. 'You might think: surely these things have been considered,' says Rooij. 'But the problem is that no one is responsible for the whole package. The municipality is not in charge of the station, and the rail company has no control over the public areas and access routes. But


integrating the nodes with the city must receive the necessary attention for the urban network to function properly.' CvU

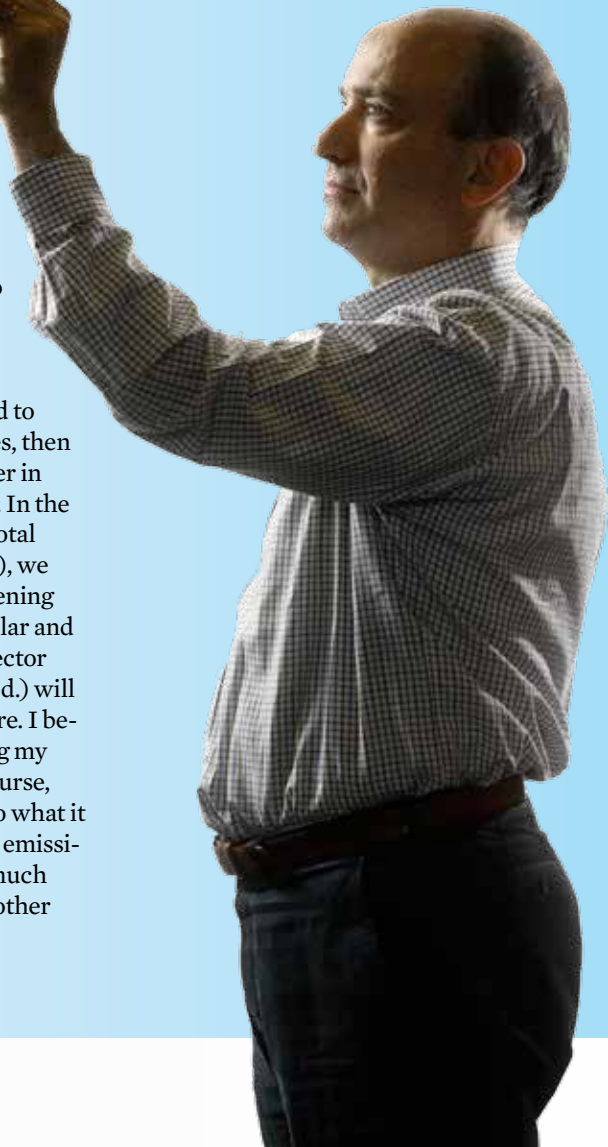


2030

According to projections by the International Civil Aviation Organisation, in fifteen years from now scheduled flights will be doubled. Is it possible to prevent greenhouse gas emissions from aircraft doubling too? Professor of Propulsion (AE) Piero Colonna is looking for solutions in unexpected places.

Let's put things in perspective,' he says over the phone from his temporary home in Stanford. 'The total contribution of aviation to industrial greenhouse gas emissions is two per cent. That's not much, but the emissions take place at high altitudes and we don't know what impact they have. There is a lot that remains unclear about the chemistry of the trails that planes leave behind them in the sky. So aviation has a limited impact on climate change, but a real one. We have to do our best to minimize that impact. And there are geopolitical considerations too. If, for whatever reason, the oil supply is interrupted, all our aircraft will be grounded with serious consequences for the economy. But in the medium term of, say, the next ten to twenty years, aviation will continue to depend on fossil fuels. Their high energy density (a high volume of energy per kilogramme) and ease of storage is unrivalled. In addition, aircraft engines already work extremely efficiently with these fuels - it would hardly be possible to make them any more efficient. One improvement that can be made on medium-range flights is by using turboprops instead of jet engines, as these have higher efficiency.

I also expect gains to be made by reusing the waste heat produced by the engines. Because even in the most efficient jet engine, 50 percent of the energy is lost in the air as heat. By using special fluids and turbines in the organic Rankine cycle, we can convert some of that heat into power. In trucks it is possible to recover up to 10 percent of the energy in this way. If, for some reason, we needed to switch to other energy sources, then I think it would be much easier in other sectors than in aviation. In the energy sector (27 percent of total greenhouse gas emissions ed.), we see that change already happening with an increasing share of solar and wind energy. The transport sector (accounting for 12 per cent - ed.) will use electric power in the future. I became convinced of that during my sabbatical in California. Of course, the air travel industry must do what it can to reduce greenhouse gas emissions too, but even so, there is much less potential for this than in other sectors.' 



IN PERSON



Ir. Ionica Smeets
SCIENCE JOURNALIST

In columns and on television, she can explain scientific subjects in great detail, in August she appeared on VPRO's *Zomergasten*, and in September she published her book 'The Exact Story. Scientific Communication for non-Scientists'. 'Maths girl' and former Delft student Ionica Smeets has written a practical guide for scientists, journalists and anyone else who wants to make complex material accessible to a general audience.



Prof. Nick van de Giesen
WATER MANAGEMENT (CEG)

The Delft University Fund presented the Best Professor Award to the professor in water management because he carries out excellent teaching and research work, has inspired others to follow his example and is inspiring for students and PhD candidates. The prize money of €15,000 is intended to be used for a sabbatical period abroad. Van de Giesen was nominated by the Dean and the study association for his faculty.



Prof. Huub Savenije
WATER MANAGEMENT (CEG)

This professor of water may now call himself a Fellow of the American Geophysical Union (AGU). He was nominated for the Union for his pioneering contributions to the understanding of hydrological processes at the macro level. He is the second Dutch hydrologist to be awarded a fellowship of the AGU.



Filippo Maria Doria
STUDENT IN ARCHITECTURE

This new graduate won the Archiprix 2014 for his plan for a library for blind people in the Villa Borghese Park in Rome. According to the jury, the 'extremely original plan' was unusually rich in fundamental architecture-related ideas. The Archiprix evaluates scenarios for a changing society and is awarded to the best graduation projects of the Dutch design schools.

VENI grants

Daniele Cavallo and Atilla Geresdi were awarded a VENI grant by the NWO. The two researchers from Delft were both awarded up to €250,000 euros for their research over the next three years. The Dutch Organisation for Scientific Research (NWO) awards these VENI grants annually to talented scientists who have gained their doctorate within the last three years. This year, 152 researchers were awarded VENI grants of up to €250,000. Daniele Cavallo researches the generation of terahertz waves with microchips at the Faculty of Electrical Engineering, Mathematics and Com-

puter Science. He wants to investigate whether the microchips that we know from mobile phones and computers can be used to produce terahertz waves.

Atilla Geresdi is carrying out research into the whispering of the Majorana particle at the Faculty of Applied Sciences. Topological quantum calculations based on Majorana particles can provide unrivalled protection against the loss of quantum information through interaction with the environment, according to Geresdi. He wants to build an 'on-chip radiation detector' in order to

detect the quantum noise (or whispering) of the mysterious Majorana particle. He also wants to demonstrate the feasibility of topological quantum bits.



THE FIRM

Rowing - a sport for everyone. That is not the case yet, but former Delft student Lenneke de Voogd is working hard with her company Volans Rowing to make it possible.


It is the ultimate dream of every industrial designer, Lenneke tells us: designing your own product and then bringing it onto the market. Not working for somebody else's company, but with your own business. De Voogd knows the difference. After graduating in Industrial Design in 1997, she worked at TNO for twelve years. She spent a lot of time in sports innovation - for example, she worked on the new cooling rowing suits that were used at the Olympics in Athens in 2004. De Voogd made a move TU Delft in 2009, where she was sports innovation coordinator at the valorisation centre. The idea for Volans Rowing emerged after discussions with the Eindhoven student rowing club, who were keen to promote their sport. Together with her business partner Cees van Bladel, who was working at Stichting Sports & Technology, she started thinking: why do so few people row in the Netherlands? Despite the thousands of new students who join the sport each year, and despite the tens of thousands who use a rowing machine at the gym, the Dutch Rowing Federation never seems to grow beyond 33,000 members. One problem is that rowing seems very focused on competitive sports, and the type of scull that is used for competitions - seven metres long and very unstable - is difficult for beginners to row in. They are also expensive, bulky and difficult to transport. With the help of IDE students and in collaboration with DSM and the Dutch Rowing Federation, De Voogd and Van Bladel star-




ted developing a new type of rowing boat, the Volans2. It is small, compact, user-friendly and about €4,000 cheaper than the sculls used in competitive rowing. Its hull is a little wider and instead of the rower sliding back and forth on a seat, it is the slider rigger, the part with the oars, that does so. This boosts stability and speed, in spite of its short length. The first boat was launched in June 2011, and since June 2012 Volans Rowing has been located at the tech-incubator YesDelft. But De Voogd quit her job at TU Delft without knowing what the future would bring. Now, in 2014, she does not regret that decision, even though she and her partner have to do project management and consultancy work to supplement their income. 'I have

confidence in the steps we are making,' the IDE alumna says. 'We have now sold over a hundred boats in the Netherlands, Germany, Sweden, Denmark and America. We have one dealer in the Netherlands and one in Germany. The next step will be to look for dealers in other countries. Then we can start scaling up. It also helps to promote the boat at events with famous athletes. In August we introduced the Volans-Kids model and we also have plans for a sea-going rowing boat. In about two or three years we should reach the point of breaking even.' The pair were advised to stick to just one boat for the time being, but they have chosen to ignore that advice. Yes, product development, negotiations with factories, marketing, networking and sales are now all mixed up together, and they are doing almost everything themselves, but De Voogd would not want it any other way. 'What drives us is developing and expanding the sport of rowing, starting with young people. Our mission is to make rowing a sport for everyone, regardless of background. So we didn't want to wait too long to introduce our kids boat.' **SB**

Name: Lenneke de Voogd
Degree: industrial design engineering
Company: Volans Rowing
Established in: 2011
Sells: rowing boats
Mission: de roeisport populariseren
In five years' time: Volans dealers in different countries



‘People
want
to
press
the button
themselves’

A black and white close-up portrait of Professor Peter Vink. He is an older man with grey hair, a mustache, and glasses. He is looking slightly to the left of the camera with a thoughtful expression. The background is dark and out of focus.

People can be strange creatures, as ergonomics expert Professor Peter Vink (Industrial Design Engineering) knows. They will sit in tight and uncomfortable seating to save money, complain about it in surveys and then do it all over again. These are the enigmas of environmental ergonomics.

TEXT JOS WASSINK PHOTOS SAM RENTMEESTER

CV

Peter Vink (1953) has worked on interior design for offices, production halls, aircraft and vehicles. With his interior design group at TNO, he worked with companies including Boeing, BMW, Ahrend, Gispens and SNCF (train interiors). He is seen as one of the pioneers of participatory ergonomics, in which the future user plays a role in designing his/her own environment. From 1998 to 2004, Vink was chairman of the Netherlands Association for Ergonomics. With Klaus Brauer, he co-authored the book 'Aircraft Interior Comfort and Design' (2011). In 2011, he was presented with the American Hal Hendrick Distinguished International Colleague Award. Vink worked for TU Delft as a part-time professor from 2001. In June of last year, he opted to devote himself fully to the development of knowledge rather than management. On 4 June 2014, he will give his inaugural address: 'The sweetness of discomfort'.

As an ergonomist, you should know all about designing your office, but your workstation looks pretty standard.

"I have not been at this desk very long. But I do have a good chair, an Axia from BMA ergonomics, which my colleague Richard Goossens helped design. What makes it so special is that if you put the backrest down, the back part of the seat tilts with it, preventing you from slipping out of the chair. And my computer monitor is perpendicular to the window, minimising negative effects of external light and reflections. But my workplace at home is better."

You have been a part-time professor since 2001, but full-time since June of last year. Why the change?

"For years, I was in charge of the interior design department at TNO, working on the design of offices, factories, aircraft and vehicles. I worked one day a week at TU Delft to forge links between it and TNO. That worked well: TNO was able to recruit students easily and I could bring in people from TNO to do their PhDs at TU Delft."

So why did you make the move?

"My department at TNO just kept growing and I wanted a smaller group to leave me with some time for research. That was difficult to achieve at TNO, and it got me thinking. Then an advertisement appeared for a chair in environmental ergonomics, so I applied for it."

In office design, you emphasise the role played by the user, but how can the user contribute to the design of an aircraft or car?

"A new chair for BMW is a good example. This chair needs to distribute the pressure under your body and be as adjustable as possible. We worked on it for seven years. But when we started testing it with people, they all looked worried, thinking 'what on earth is happening?'. Although they said they found it an improvement, you could tell from the looks on their faces that they were not relaxed. Then we added a button saying 'ideal seat'. The result is: people sit down, press the button and you can see them thinking that it feels comfortable. The most important difference is that you are giving people control. As long as they can press a button before something happens, they are happy and otherwise not. Actually, the same applies for flexible working, 'het nieuwe werken' in Dutch. If suddenly all kinds of things start being introduced and you have no control over any of them, people

become distrustful. At TNO, aspects of flexible working were always phased in in a small department first, leaving the rest of the organisation unchanged. We then conducted evaluations. When, after that, you want to introduce the changes more widely, you will have much more support within the organisation. Simply by enabling people to become used to the idea and testing out the changes on a small scale first."

Is it possible also to give people in an aircraft a feeling of control?

"Definitely. If you book a ticket with KLM, you can book yourself a little extra legroom in comfort class for EUR 2.50. Even people who have less legroom are now more satisfied than they were before because they have themselves opted to sit in tight seating. People want to have control, they want to know what they can expect. We conducted a study among more than 1,000 air passengers that revealed that there is no significant difference between the comfort score for economy and business class. This is not because there is no difference, but when you book, you set a scale in your head and you use that scale to calibrate your comfort score. Your booking is what determines your expectation and your expectation determines the score."

What should be done with passengers who are too wide for the seat?

"Many airlines solve this problem by removing the middle armrest. This makes it possible to book two seats, and this is also indicated in the small print from the airlines. The shape of the seat created in this way is not ideal, however. You should make the seats flatter, but this makes them more uncomfortable for people using them in the standard way. Actually, the trend is towards narrower seats. When I was involved in the design of the Boeing 777, the original plan was to have three rows of three seats. But Emirates wanted three-four-three. That meant slightly narrower aisles, but an additional seat in each row. People did not complain and now Emirates is thinking of switching to four-three-four because people continue to book the seats. It would seem that the width is not so important. People complain more about legroom."

Are Emirates passengers less wide on average?

"Not at all. Using anthropometric data (average



human dimensions), you can calculate that 95% of people will fit in the seat and 5% will not. The latter sit in an aisle seat with the armrest up. If you end up sitting between two people like that it is just bad luck.”

Is there still room for further development of aircraft seats?

“Yes, because in the past there was only business and economy class. Then first class was added and now you have premium economy. Below economy you also have low budget now. The manufacturer may secure a major order from a low-cost airline but it is not proud of the end product because the seat has been stripped down to nothing but the backrest, seat and a bit of foam.”

Are people happy with that?

“There is no significant difference in the experience of comfort between low-cost and economy and yet low-cost tickets are 50 to 100 euros cheaper.”

And people do not complain?

“That’s the funny thing about it: about 40% of passengers complain about the lack of legroom, but they still buy the tickets. In my view, you could make the seating even tighter and people would still continue to book. Ultimately it’s the price that is decisive. People decide to do without legroom but then complain about it in their trip report. They sometimes say that they will not book again, but still do it anyway.”

You came to TU Delft inspired by a desire for knowledge and greater depth. What lines of research will you be pursuing in the years ahead?

“My dream is to build an interior of a blended wing body aircraft here at TU Delft. I think there are many more possibilities for feeling more refreshed and comfortable in a small space and on a long flight. For BMW, we developed a game

for the rear seat that you operate by pushing your shoulders against the seat. You activate a whole range of muscles that way. This game is much more refreshing for passengers than reading a book and the idea can also be applied in aircraft. A blended wing aircraft, which will not start flying until 2050, offers more options than the tube-shaped aircraft we have today. On the outer edge, you can allow people to lie down and sleep in a type of oblong container. Even more than is currently the case, booking will take place via social media, enabling you to form groups even before the flight. In the middle of the aircraft, you can go in search of sociability and entertainment, with relaxation on the periphery. I would like to build this kind of interior and then investigate whether you can achieve a greater variation in positions and activities with the same density.

‘We prefer to have the discomfort first followed by the comfort’

One of my PhD students discovered that if you start from a hard seat, a softer seat feels much softer. You can take advantage of this by having people sit on harder materials at the gate so that the aircraft seating feels better. Our sensors do not work in terms of absolute values, but relative values.”

Perhaps comfort is a question of variation?

“Yes, and that is what I would like to explore. If you make the whole journey as comfortable as possible, you do not experience very much. But if you have to go without it now and again, you enjoy the comfort more. People are strange creatures. We prefer to have the discomfort first followed by the comfort.

I thought that ergonomics had already discovered everything, but you have a whole world still to explore!

“Yes, and that is what is so great about working with students. They can be so ingenious at times. I currently have a student who is working on an aircraft seat with a hole in it that enables you to sleep sideways. I really like these kinds of wild ideas.

Ditching the Dutch?

Wherever there are problems with flooding defences, broken levees or other water-related threats, often one of the things you'll hear is the call to 'bring in the Dutch'. But are we still as successful as all that? Many of those in the water construction sector think not.

TEXT TOMAS VAN DIJK PHOTOS SAM RENTMEESTER

Dutch “water expertise” can be found all around the world’. These were the opening lines of the current affairs television programme *Nieuwsuur* in May when it looked at the international success of Dutch engineering firms in the field of water management. The broadcast featured Henk Ovink of the Ministry of Infrastructure and the Environment, who has been posted to New York to advise on water management there in the aftermath of Hurricane Sandy. Another interviewee was the director of dredging company Van Oord, Pieter van Oord, who talked about the international success of his company. Dutch maritime pride was given an extra boost when the winners were announced of a contest organised in New York by Ovink to make the city better able to withstand hurricanes. Prizes were awarded to, among others, the Rotterdam firm of architects OMA (Office for Metropolitan Architecture) and Royal HaskoningDHV for their strategy to protect the town of Hoboken against floods using dams, water storage areas and pumps. Another winning team from the engineering firm Arcadis plans to construct a U-shaped flood defence around

Lower Manhattan and an earth wall in Battery Park facing the Statue of Liberty. ‘Wherever there is flooding, the Dutch spring into action’, concluded presenter Twan Huys in his broadcast.

SERIOUS CONCERNS

However, that is only part of the story. Many water engineers are very concerned about the international competitiveness of the Dutch water construction sector.

Arie Mol, director of engineering firm LievenseCSO has a very strong opinion on this. ‘We think we’re very good, but actually we’re not,’ he told the *Metro* newspaper on 23 April. ‘When it comes to building harbours, breakwaters, quay walls or tunnels around the world, we are barely involved at all. [...] In terms of engineering, the Netherlands is losing out to others on all fronts.’

Tjitte Nauta, from the Deltares research institute, agrees with Arie Mol’s statements. According to him, one of the problems is that Asian engineering firms are able to secure loans on more favourable terms. ‘They are able to get state backing for their loans. And their way of working is fundamentally different. Asian engineering

firms usually get to work straight away and they find out what works or doesn’t work through trial and error. We, on the other hand, do all kinds of studies before we start work on a major water project.’

‘Our competitive position is getting more difficult. There was a good reason why the Dutch government launched the DRR Fund (Dutch Risk Reduction Team) recently,’ concludes Nauta.

GOVERNMENT SUPPORT

The DRR Fund, which contains six million euro, is meant to help Dutch companies to secure contracts. With the help of this support from the Dutch government, engineering firms can offer ‘free’ advice to foreign governments. When countries start to build flood defence systems, the hope is that they will award the contract to the Dutch engineering firms who have already been advising them. Last year a DRR project began in Myanmar. Tjitte Nauta and some of his colleagues from Deltares were involved in this project, as well as some Dutch engineering firms and TU Delft (indirectly) (see ‘Paradise for engineers’ in *Delft Outlook* 2). With the help of a government grant, the



The Americans came to look at our Delta Works after Hurricane Katrina but designed the new coastal defences themselves.

consortium is working on an advisory report on integrated water management in Myanmar. The DRR fund is part of the policy

‘Many water engineers are concerned about the international competitiveness of the Dutch water construction sector’

that began with the Global Water programme of the Ministries of Infrastructure and the Environment, Foreign Affairs, Economic Affairs,

Agriculture and Innovation several years ago. The objective of that programme is to initiate long-term relationships with developing countries in delta regions in order to promote cooperation in the field of water management. The programme combines development aid and trading interests, in the form of the export of Dutch water expertise. That is the idea, in any case.

FREEBIES

According to Han Vrijling, Professor Emeritus of Hydraulic Engineering at TU Delft, this policy is still not bearing much fruit for the Netherlands. One of the countries where Dutch engineers have been working intensively for years as part of the Global Water

programme is Vietnam. Vrijling says: ‘Dutch companies have created a blueprint plan for the Mekong Delta. But we still don’t know if the Vietnamese will sign contracts with Dutch companies. So far, these are freebies that the Netherlands is giving away.’ Vrijling takes a hard-headed approach. ‘The countries that this policy focuses on are poor countries. In addition, the World Bank demands that if they make money available for a project in one of those countries, the country itself should be involved in the construction work.’

‘Dutch dredging companies are doing well internationally,’ Vrijling continues (see box, ‘The global water sector’). ‘They have good equipment. But selling engineering services, which >>

everyone has such high hopes for, is more difficult. Engineering firms are paid by the hour. Dutch hours are a lot more expensive than Vietnamese hours. So you need to be really excellent in order for them to hire you. These days they know about construction themselves.'

The Netherlands has lost out in the United States, too, according to the professor. 'The Americans redesigned and rebuilt the whole system of coastal defences around New Orleans after Hurricane Katrina. I think we could have done it much better, but, well, that's another story. The Americans came to look at our Delta Works and delegations from the Netherlands also went over there, including Mathijs van Ledden of TU Delft and Royal HaskoningDHV, but the Americans designed the new coastal defences themselves. The Netherlands contributed nothing, or almost nothing.'

NO MORE TRADEMARK PROJECTS

So what is going on? Because of rising sea levels, the world has a growing need for water defence projects, es-

NEW DELTA PLAN

According to Minister Schultz van Haegen (Infrastructure and the Environment), our struggle against water will never be over. This is why this year, on Prinsjesdag (the opening of the new session of parliament), the Cabinet presented a new delta plan. The plan provides an overview of what needs to be done to protect the Netherlands against flooding between now and 2050. The plan will cost approximately €20 billion. The decisions follow the recommendations on which Delta Commission member Wim Kuijken has been working since 2010. The programme sets out strategies relating to the areas of water security, fresh water supplies, spatial planning, the Rhine-Meuse delta and the IJsselmeer area. The Delta Plan includes different scenarios, which the ministry says will make it possible to continue to adapt to unexpected developments, new measurements and insights.

pecially in river delta areas, where there are often rising levels of urbanisation too. But the Netherlands does not really seem to be making the most of this. According to Vrijling, there is more to it than the fact that the Netherlands is relatively expensive. We do not have any eye-catching projects any more, no distinctive trademarks. Our standing in the world

seems to have suffered because of that. And because of this, water engineers in the Netherlands are not as well trained as they used to be either. 'When we built the Eastern Scheldt storm surge barrier in the Netherlands, we also trained a whole raft of engineers (including himself – Ed.). Then came the Second Maasvlakte, the extension to the Port of Rotterdam in an area

The Netherlands has been well-protected against water for years now.



reclaimed from the sea, which was also pretty complex. But since then we have not built anything comparable.' Tjitte Nauta of Deltares is less pessimistic. He thinks the Dutch water sector can reinvent itself. 'While others concentrate solely on one specific aspect of water management, such as reservoirs or irrigation channels, we focus on integrated water management,' he says. 'Using integrated water management, we can develop an excellent new revenue model.' Nauta hopes to demonstrate this approach for the first time in Myanmar.

Nauta does not share Vrijling's opinion that the Netherlands no longer has any distinctive trademark projects at home. 'That remark is often made. But the Netherlands has been well-protected against water for years now. In addition, we have interesting new projects, such as Room for the River and the Sand Motor - a large-scale sand replenishment scheme on the North Sea coast at Kijkduin. So we have a lot of techniques that we can sell.'

CENTRE STAGE

Piet Dircke, global mater management director at Arcadis, agrees that it is difficult to get a foothold abroad. Arcadis is involved in several projects organised by the Ministry of Infrastructure and the Environment, including projects in Vietnam (Mekong Delta), Myanmar, Bangladesh and Indonesia. 'Making the step from knowledge to doing business - actually getting a return on your investment - is difficult,' says Dircke about these projects. 'Perhaps it would be more sensible to avoid these delta areas where the Ministry has taken the lead, and look to other areas instead.' Harrie Laboyrie of Royal HaskoningDHV (who holds the position of Global Director for Rivers, Deltas & Coasts) also says that 'it's difficult to make these global water programmes pay.' And he also sees that developing countries are increasingly keeping the construction of flood defences in their own hands. 'But because we are doing consultation work in these areas, we are positioning ourselves for other customers, financiers and sectors.'

'Climate change means many countries with river delta areas need to develop new growth scenarios. They are focusing on the Netherlands. We have developed our own effective strategy to deal with rising sea levels in the form of the Delta Plan, and that is famous around the world.'

'After the Second Maasvlakte we have not built anything comparable'

Laboyrie points out that Royal HaskoningDHV also has projects underway in Africa and South America. 'Some of these countries are funding these themselves nowadays. Other projects are paid for by donors such as the World Bank and the Asian Development Bank.' He does not want to say which countries exactly. 'That is confidential information.'

Laboyrie also believes that Dutch engineering firms are deliberately ignoring a section of the market. 'That's the part that is going to Chinese companies, for example. China is investing hundreds of millions in infrastructure (such as roads) in Africa. It is Chinese companies who then win the contracts there. That is their business model. The Dutch water engineering sector does not work that way. In addition, sustainability is a key concept for Dutch companies. We don't get involved in projects if we think they will not contribute to the responsible development of a country and of the people who live there.'

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THE GLOBAL WATER CONSTRUCTION SECTOR

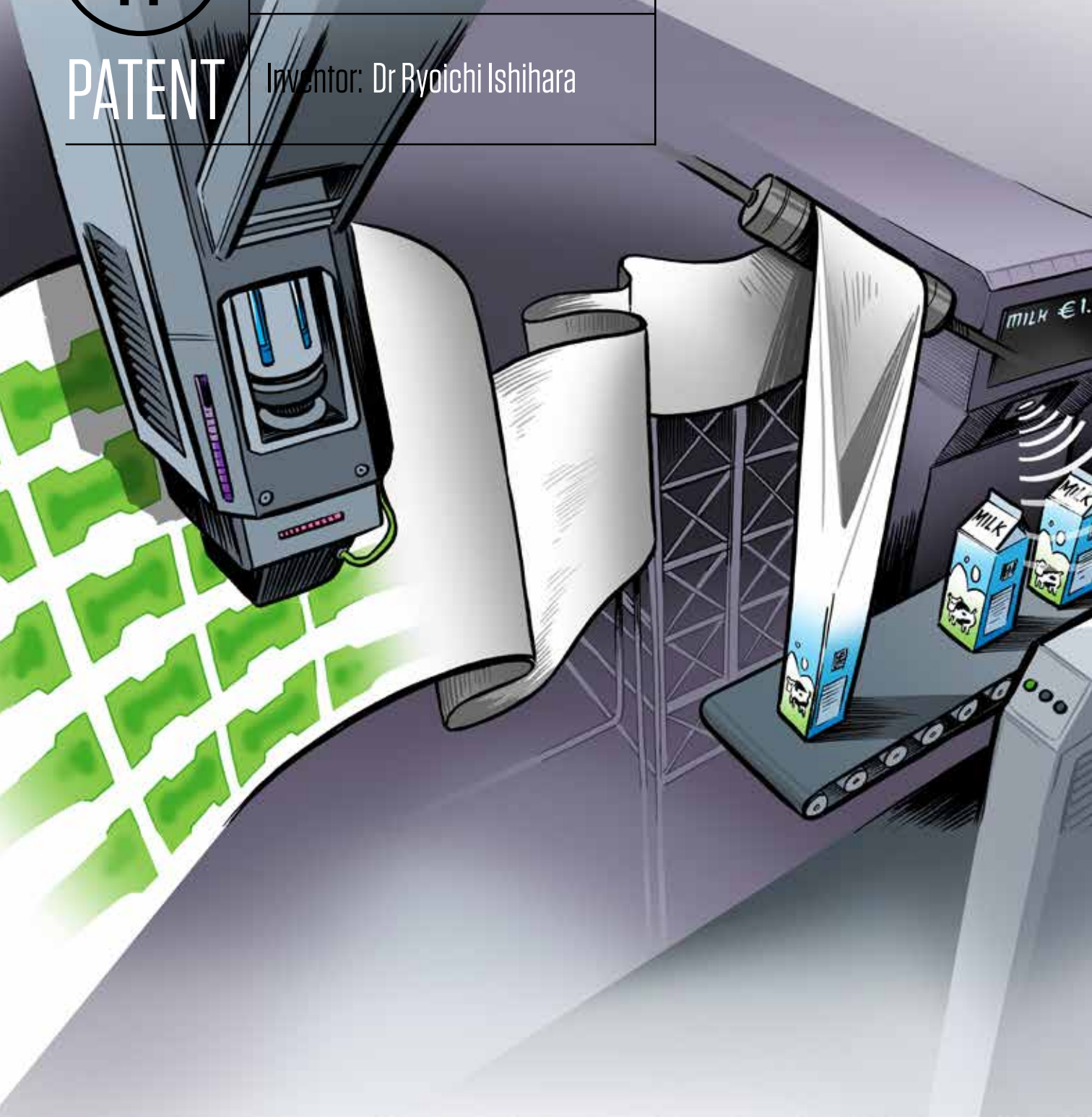
How much money is involved in the water engineering sector worldwide, and what share of that is going to Dutch companies, is difficult to say. Even so, the Netherlands Water Partnership (NWP), an advocacy group for the Dutch water sector, has tried to give an estimate for this in its future vision for the Dutch water sector (Water 2020). The NWP states that each year €120 billion is converted into delta technology worldwide. That is based on figures from 2008. Delta technology includes things like the construction of flood defences, such as harbours and breakwaters, but also the management of water infrastructure in delta areas. With business worth €7.5 billion, Dutch firms take about 6 percent of the world market for delta technology. Of that €7.5 billion, €4 billion comes from projects abroad. The vast majority of that foreign turnover (80 percent) comes from the two major Dutch dredging companies: Van Oord and Boskalis.

R


PATENT

OCT-11-033: Fast and inexpensive
roll-to-roll manufacturing of silicon
transistors on plastic films

Inventor: Dr Ryoichi Ishihara



Now

Silicon transistors printed onto plastic or paper are paving the way for tablets and paper e-readers that you can fold up and put in your pocket. In 1996 Dr Ryoichi Ishihara came to Delft from the Tokyo Institute of Technology to set up a new research project focusing on thin transistors. The result was a thin layer of electronics and semiconductors on a glass surface. We use these every day in our tablets and smartphones. 'That research has now been commercialised,' said Ishihara. Building on this work, in 2008 he shifted his attention to silicon transistors printed on a plastic surface. The benefits of this would be enormous - after all, plastic can be folded and rolled. This means a tablet with a foldable display and a fast and reliable electronics circuit could fit into your trouser pocket. In addition, the materials are less expensive and the production process would no longer involve huge machinery. The transistors are printed onto a plastic surface using the technique invented by Ishihara. This can also be done on a much smaller scale - eventually even at home. That would make it possible to design your own displays. But the big surprise, according to Ishihara, is that the printing technique can also be used on paper. 'You could print a display a print on a milk carton with information about the milk. Or you could make a paper e-reader that you could also write on.' What sounds even more like science fiction is Ishihara's idea for transistors on paper for medical applications. 'Paper and silicon are not harmful to the human body. You could swallow the electronic paper in order to take measurements inside the body.' This is not science fiction, says the researcher, but it really could be possible using this technology. 

While I was on holiday I bumped into a student from Delft. Her: twenty years old, studying at TPM, living on the Jacoba van Beierenlaan. Me: 36, studied at AE, also once lived on the Jacoba van Beierenlaan.

'So, these mobiles phones...' I began. 'We didn't have those in my day. So I'm a bit curious: when you're at the clubhouse of the student association with your friends, do you all stand around playing with your phones, chatting and calling?' She smiled in the same way that she probably smiles at her ninety-year-old granddad when he asks daft questions about young people today. 'Oh, no. 'The use of phones is prohibited there, just as it is in the dining room. Anyone who uses their phone gets a glass of beer poured over it.' What a great vision, I thought: a high-tech university city like Delft, full of teens and twenty-somethings who have decided to create a mobile-free oasis. So you can you still sometimes speak to each other without having one eye on Facebook or Google at the same time.

The conversation continued and I became more enthusiastic about my old university town, and especially the generation currently studying there. In the study circles that I once moved in, a job at a multinational company was practically the highest achievement you could hope for. Think of Shell, Airbus, important consultancy work. That ambition is now less widespread, she assured me. Starting your own business with your own great idea is a prospect that she and her friends find at least as attractive these days. She told me about what is happening at YesDelft, where students prepare

themselves to start up their own companies. They really think of everything, from cheap office space to help with redeeming patents.

'You know the storm umbrella?' she asked. 'That umbrella that you can use even in the middle of a force-ten gale? That all started at YesDelft.'

Yes, I did know the storm umbrella. The inventors of that umbrella must be millionaires by now, and no doubt all at the expense of some cumbersome umbrella multinational which saw no real need to innovate.

As we said goodbye, she told me about her plans for the coming academic year. She was going to Amsterdam for six months to study how intelligence services operate. She thought it would be good to go and study something totally different outside Delft for a while. Different people, different culture, different ideas.

'And the credits that you get in Amsterdam...' I started to ask, expecting her to launch into some lament about how different universities refuse to recognise each other's study credits and other Kafkaesque woes. But she had already finished my sentence for me: '...they count towards my minor in Delft. No problem at all.' She waved goodbye and off she went. I sat there thinking of all those newspaper columns written about students and studying in the year 2014. Everything

was better in our day is usually the gist of them. But nothing could be further from the truth, it seems. The best time to be a student is now.



Tonie Mudde is the Head of Domestic News at de Volkskrant. He studied Aerospace Engineering between 1996 and 2003.

HORA EST

'Strong car brands need not worry about their image when they add an electric car to their product line.'

Ingrid Moons, Psychologist and Industrial Designer

'Car makers are concerned that their image will change if they produce electric cars. But they need not worry. In my research, I used four car brands that evoke different emotions: BMW (which promises a pleasurable driving experience), Alfa Romeo (a highly emotional car), Toyota (evokes few emotions), and Volvo (for a responsible driving experience). I then supposed that there was a new car that was a mixture of these four brands. I also added either more rational or more emotional characteristics

to this. I told drivers of the four makes, plus people who drive some other make of car, that one of these two designs was the electric car that one of the four companies were about to add to their product line. I then asked them whether this would change their perception of the car brand. That turned out not to be the case. The brands maintained their own image even with the new car in their product line.'

The doctoral propositions should be limited to 140 characters and should be tested against the interest of social media before being printed.

Ekim Tan
architect

Finding out why we want something is more important than finding out what we want.

Congli Dong
civil engineer

Living abroad can make Italians capable of forming an orderly queue.

Riccardo Fagiani

Research in The Netherlands is too heavily placed in PhD projects.

Thijs van Leest
physics engineer

A PhD track has the same phases as a mud flat crossing by foot.

Paula van den Brink,
physics engineer

Positive discrimination should be avoided since it results in policies in which desirability prevails over quality.

Pieter E.B. Vaissier,
physics engineer

If a four kilometre high mountain range would be built from Morocco to Guinea, this would eventually turn the Sahara into a green paradise.

Rudi Johannes van der Ent
hydro engineer



After Delft

At the age of fourteen, Gerald Schotman (53) already knew that he wanted to study civil engineering. He was completely fascinated by the work of the Dutch engineer Cornelis Lely. ‘Reclaiming land from the sea, making sure people had dry feet, conquering the elements, all those macho ideas made a great impression on me.’

Now, as Research and Development Director and Chief Technology Officer at Shell, he sometimes wonders how he could have been so confident. ‘I just love the world of engineering, it’s so much fun. In my job, I feel like a child in a toy shop. The future is not a matter of luck, but it’s all about the choices you make. That way of seeing things is deeply engrained in me and it’s a goof fit with civil engineering.’


At Shell, Schotman is responsible for all the technological choices. Those choices may relate to drilling deeper wells more cheaply or making fluids flow through pipelines more easily, but also to the role of solar energy, wind energy and biofuels. His budget for this is \$1.3 billion. But he did not learn about finance in civil engineering: he followed some courses in economics in Rotterdam and developed his knowledge over the years. In fact, the combination of pure engineering and economics has been a unifying theme throughout Schotman’s career: three of his ten jobs at Shell have had an economic aspect. Not that Schotman had ever given any thought to working for Shell. The multinational approached him shortly after he graduated in soil mechanics. ‘At that time, I calculated that it should be possible to install piles for the North-South line in Amsterdam without causing structural damage to the city’s famous



PHOTO: SAM RENTMEESTER

Name: Gerald Schotman
Place of Residence: Oegstgeest
Marital Status: married, three sons
Studied: Civil Engineering (1979-1984)
Association: Delftse Studenten Bond

facades. I was working on the phenomenon of dike deformation for the Deltadienst, when Shell was looking for someone with my expertise.’ Schotman did lab work looking at the foundations of platforms in the North Sea and then, in Brunei, he worked on the movement and design of platforms. While in Brunei, he also solved business problems: it was his first strategic position. The next was in Aberdeen in 1995, where he was project manager for a North Sea platform. Six years later he travelled to Oman, where he was head of strategy and planning and was part of the management team. After fifteen years abroad, he returned to The Hague as

head of global strategy for identifying and extracting oil. ‘And my current job is the best job there is at Shell.’ When he meets his old student friends for a drink, they sometimes reminisce about the project-based teaching of which they were some of the first recipients at TU Delft. ‘I found it all a bit vague. What does that mean, “thinking out-of-the-box”? First you had to formulate your goals and parameters. I always did my best, but to be honest if I’d had the choice, I wouldn’t have bothered with it. But what we didn’t understand as eighteen-year-olds was that it would stand us in very good stead after our time Delft.’ 

Prosthetic pride

An artificial leg, a hearing aid, a dust mask: there is a fair degree of stigma attached to some products. How do you deal with that as a designer? Kristof Vaes completed his doctorate on this subject in a joint study by the University of Antwerp and TU Delft.

TEXT CONNIE VAN UFFELEN PHOTOS GERT, AGE SIMULATION SUIT - WOLFGANG MOLL



Wolfgang Moll designed suits which simulate old age.

‘An asthmatic child who has to wear a dust mask to filter out fine dust particles doesn’t want to look ill or weak. That was the starting point for Flemish product designer and lecturer Kristof Vaes when he was asked to design just such a mask in 2008. How can you make a mask like that not only acceptable, but pleasant or even fun to use?’

Vaes found this such a fascinating assignment that he chose it for his doctoral research into product-related stigma: social disapproval associated with a particular product. People’s experience of all kinds of protective equipment and medical products can be unpleasant or uncomfortable. And many of them are not well-designed either, says Vaes. ‘They have been developed by a medical team, for whom ergonomic and physiological considerations are paramount,’ he says. ‘It needs to function properly in a technical sense, but scant attention is given to the emotional side of the story. Although for some products, that is now happening - wheelchairs for example.’

CONFRONTATIONAL

How can you help designers in creating products and ensuring that they are appreciated as much as they are needed? In studying this, Vaes’s initial focus was not on the users, but on bystanders or passers-by. They can cause feelings of unease by making comments, staring, or keeping a greater distance than normal when they pass by. ‘That can be very confrontational, even if the user feels fine with the product,’ says Vaes. He says that the cultural context also plays an important role. ‘In the West,

we associate a white dust mask with the fear of contamination, while in Japan people actually wear such a mask out of respect, in order not to infect others. Or let’s take the walking stick: for us it’s a symbol of old age and disability, but in African countries it’s a sign of wisdom. As a designer, you need to know about cultural differences like these before you start designing.’ Sometimes it is not so much the product itself, but using it that can be the cause of social stigma. ‘If I had to inject myself with insulin in a public space, I would have to bare my arm and stick a needle into it. As a designer, you can play on how other people might react to that.’ For example, when people see someone with a severe deformity, according to Vaes they often have an instinctive, gut reaction: they are scared or surprised. ‘It is difficult to suppress this reaction; it happens in the first few milliseconds. After that, people may be extra friendly, or they might smile at the person: this is a more conscious and deliberate response. These are the two phases when people encounter someone with a stigma-related product. ‘

‘As a designer, you can play on how other people might react to that’

According to Vaes, designers can work on that initial shock moment, so that it definitely will not occur. And they can ensure that during the second (conscious) phase of the reaction, people see a more positive image, for example by adding big sporty tyres or attractive wheel rims to a wheelchair. Or by designing it without handles,



Design of a pressuremask by Gert van Laar.

which removes the suggestion that the wheelchair user needs to be pushed.

EXPERIMENTING

To measure product-related stigma, Vaes conducted a range of experiments. First he gauged the gut reaction of the test subjects by showing them pictures of people with and without various types of masks. But that method turned out to be too far removed from reality.

So he sent sixty Master’s students out into the streets of Antwerp for three days wearing a mouth mask. They had to get a friend to shadow them, take photos and report what they experienced. They found among other things that people in buses would sit further away from them. Vaes then set out to measure what is known as the interpersonal distance - a parameter from social psychology.

‘Using cameras, we looked at how people reacted when they encountered someone with a mouth mask in a controlled space, how they walked past them and if they looked at that person. If the passer-by walked past the mask wearer, we measured how

much distance there was between them. For people without masks, the average was 110 centimetres. For people wearing a white dust mask the distance was fifty centimetres further.' We found that the white dust masks caused the most extreme reactions, people kept a greater distance with those. People reacted less to neoprene masks in bright colours. Prototype masks with a transparent mouthpiece were found to be less off-putting, while a mask incorporated into a bandana (a 'shawl mask') was often do not even recognised by people as a mask at all.

PYRAMID

Vaes devised two design tools to help designers to develop the right products. The first was an estimation model for stigma products: the Product Appraisal Model for Stigma (PAMS). This is a checklist of 27 questions for designers in order to help them explore the context in advance. The idea is that designers can use this

model to identify the main sensitivities relating to stigmas.

He presented this questionnaire in the form of a cardboard pyramid with nine questions on each side, relating to the perception and use of the product. 'How do people notice the product? How does that correspond to the goals of the user, the by-standers or the culture? Are there conflicts between these aspects? Are there confrontational moments when using the product? If I shake hands with someone who has a flesh-coloured artificial hand, what surprises me is not so much the visual aspect but the fact that the hand is cold. These are sensitivities that designers can discover in advance.'

CAMOUFLAGE

The second design tool that Vaes devised was a set of cards with seventeen possible design strategies: the Product Intervention Model for Stigma (PIMS). 'These approaches or strategies are meant specifically to inspire

designers to reduce stigma,' says Vaes. He developed the set of cards after studying 200 to 250 examples of well-designed products. 'I looked at how they had done it, briefly describing each strategy and giving one or two clear examples of existing products.'

The cards can be divided into three sets: The first set of thirteen encourages the designer to keep the product free of negative associations. This can be done through de-identification, for example. If a user does not wish to identify with the product, the designer can make use of camouflage, flesh-colouring or transparency. People's attention can also be diverted towards something else.

Of course, distracting attention from their own products does not come naturally to designers. Another strategy is to personalise the product. 'We want users to feel proud. For example, you can allow someone to choose from two hundred snowboard helmets with different prints, or you can design a prosthesis on the basis of a personal interview. This ensures the user feels good about the product, and it reinforces the character of the user.'

Another product strategy involves the avoidance of confronting elements during use. As an example, Vaes holds up one of the cards showing an insulin syringe that is concealed inside a pen, but designers might also be able to make sure that users have to use the product as little as possible. 'Let's suppose we could make a dust mask with a built-in sensor that measures when the concentration of dust is very high, so that you need to wear the mask only when it is really necessary. This is also really nice - two Swedish designers built this cycling helmet into a kind of scarf. It's actually an airbag that inflates over your head in the event of a fall.'



Courtesy of 3D-systems

An artificial leg can be made from lighter and stronger materials.



"We found that the white dust masks caused the most extreme reactions, people kept a greater distance with those."

Materials and new technologies can also be put to good use. An artificial leg can be made from lighter and stronger materials, for example, and a hearing aid can appear smaller if it is transparent. Finally, a designer can align the product with an accepted existing product. A familiar example is a hearing aid that is integrated into the frames of glasses or a helmet that is almost invisible under a hat.

SOCIAL BEHAVIOUR

A second set is based on the principle of 'user empowerment'. Here, designers make use of extra features that other users might be jealous of, like the blades of the bladerunner. 'One student designed a mask where the filter was built into a toy figure that you could attach to the shoulder of a child, to their backpack for example. There is no additional functionality, but it makes the child feel stronger. Or you could add a pair of lips onto the

mask. That kind of humorous, disarming touch can really help. The third and final set of cards relates to cultural aspects. Vaes talks about how to launch a product, for example.

'A mask with a pair of lips or one with a filter built in a toy figure: a humorous, disarming touch can really help'

'You can use famous cyclists to promote cycle helmets. You could also promote social integration. If you are designing a park bench, include a place that someone can put their wheeled walker or wheelchair under. Then they can actually participate in a conversation without people's attention constantly being drawn to their wheelchair.'

Vaes is convinced that these design tools can help to reduce product-related stigma. Thinking back to his original design brief - a dust mask for asthmatic children - he would make the mask transparent. 'That makes it more friendly, because then other children can see when their friend is smiling or laughing.'

Vaes would not incorporate the filter into the mask itself, so the mask does not get too heavy. 'We can use a transparent tube passing over the shoulder to connect the mask to the filter unit, which is very compact, about the size of a Coke can. You can then put the filter unit inside a backpack, like a water bottle on a bike. You can also incorporate it in a fun way.'

Alumni News

Launch of TU Delft Sports Engineering Institute - with alumni lecture

What do top-level sports and technology have to do with each other? Everything!

Top-level sport is extremely demanding, and not just in physical terms. In order to keep on improving their performances, top-level athletes need to look beyond just their physical capacities; they need to think about clothing and equipment, materials and design. For this reason the TU Delft Sports Engineering Institute was opened on Wednesday 17 September. The afternoon consisted of a brief plenary programme led by Studio

Sport presenter Tom Egbers, including a presentation by Prof. Frans van der Helm about the ambitions of the Sports Engineering Institute.

Representatives from the business sector, academic institutions and the world of top-class sport were present to share their vision and experience. The plenary programme was followed by an informal networking drinks party on Innovation Square, where the latest TU Delft innovation projects relating to top-class sport and amateur sport was on show.



Lecture

The theme of this edition of Delft Outlook is 'movement'. The Alumni Relations department will organise a lecture for alumni that reflects this

theme. This time, we will do this in cooperation with the recently launched Sports Engineering Institute. They will organise an alumni lecture

in November. You will receive more information about this by e-mail, or you can visit the alumni website: alumni.tudelft.nl

Student visits China

Merel Oostveen (25) is completing her Master's degree in Chemical Engineering. Her graduation research concerns the rehydration of powders. The research, which she has recently completed, was done in collaboration with DSM Delft and focuses on powders in food. This kind of research ensures that the ingredients in products like powdered milk or Cup-a-Soup will dissolve more easily.

Using a microCT scanner, she was able to study the process of rehydration in detail. She noticed that the process has not yet been accurately described by an existing model and made recommendations to improve this model. Oostveen was given the opportunity to present her research findings at the World Congress on Particle Technology in China. The Delft University Fund supported her financially for this visit. 'It was really exciting to give this presentation to a group of experienced scientists. I had to be very concise with my story and afterwards there were a few challenging questions from the audience.'

The Delft University Fund is able to assist with visits to conferences like this one thanks to the involvement of alumni.



Eleven new free TU MOOCs

Around 60 students have already registered for the free online courses (MOOCs or Massive Open Online Courses), which will start this autumn.

The successful MOOC on 'Solar Energy' will be repeated and the 'Introduction to Aeronautical Engineering' and 'Introduction to Drinking Water Treatment' can also be followed again. In addition, eight new MOOCs will follow:

- Introduction to Water and Climate
- Introduction to Functional Programming
- Technology for Biobased Products
- Next Generation Infrastructures 2
- Delft Design Approach
- Responsible Innovation
- Solving Complex Problems
- Introduction to The Treatment of Urban Sewage

TU Delft offered its first two MOOCs a year ago. These were followed by three more last spring. The number of participants successfully completing these MOOCs was many times greater than the number of 'on-campus students' in any given year.

'Meanwhile, 150 thousand people worldwide have participated'

Meanwhile, some 150 thousand people worldwide have now participated in TU Delft's online courses. The best students from the first MOOCs were put in the spotlight this summer by TU Delft. 'Solar Energy', for example, invited four

students to attend a laboratory course week in TU Delft's PV Solar Lab, while the best participants of 'Introduction to Aeronautical Engineering' were given the opportunity to fly in the faculty's aircraft or the flight simulator. Other students with outstanding results were able to follow the online versions of regular TU Delft courses and in this way gain ECTS credits. The MOOCs provide free online access to the knowledge of TU Delft to everyone, anywhere in the world. Participants watch video material, read, complete assignments and take part in discussions on the forum. They are given homework assignments and can complete the course with a certificate of participation.

edx.org

**Become
a friend of
TU Delft**

TU Delft is among the world's foremost universities in the field of technology and engineering. Many great discoveries have emerged from the university's pool of developing talent.

You were once a student at Delft, too. You gained knowledge and fed your curiosity there, and you went on to use these for the rest of your life. Would you like to experience TU Delft's characteristic thirst for progress once again and help to pass it on to others?

The Delft University Fund is an independent organisation that supports new talent at TU Delft. The Delft University Fund would like to give you, a former student, the opportunity to help contribute to

the opportunities and new developments of today.

As a former student, you can make a donation to your Alma Mater via the University Fund and thus become a 'Friend of TU Delft'. The Delft University Fund depends on donations from individuals and businesses to fund its operations. With the support of companies and of people like you, Delft University Fund can continue to expand its activities. You will be helping to foster talent across the whole breadth of TU Delft, support

entrepreneurship, and continue to contribute to engineering a more sustainable world. Every Friend of TU Delft can attend the Alumni Event free of charge. The minimum annual donation is €100 per year, and for this you will receive invitations to all our awards events and our annual report. For friends who donate €500 or more annually, we organise the 'Good Friends Dinner', where you can find out first-hand about new developments at a unique location within TU Delft.

You can find more information at universiteitsfonds.tudelft.nl

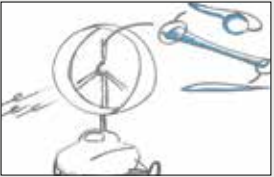
Alumni Chapters in the USA

In November, TU Delft will visit its alumni in Boston, New York, San Francisco and Houston during a tour of the United States. A small event will be held in these cities including speakers and updates on the developments at TU Delft. It is expected that independent chapters will form after the events and meet on a regular basis. Meetings for alumni are organised

all over the world by the university itself or by active, enthusiastic alumni. They give our alumni the opportunity to keep abreast of what is happening at TU Delft and provide an opportunity to make contact with fellow engineers.

[Would you like to attend an alumni event? Then please register via \[alumni.tudelft.nl\]\(http://alumni.tudelft.nl\)](#)

TU Delft exhibition event DIG-it!



On 11 November, TU Delft will show over eighty innovative research projects to the business community and provide leading researchers with a range of master classes. This is part of TU Delft's efforts to bring new knowledge and technology to the market and society and to encourage cooperation with the business community. The event will enable participants to find out more about the latest scientific and technological developments. The event will take place in the TU Delft Library. An overview of selected projects: the use of mathematical numerical analysis to optimise industrial processes; a wind-powered car that uses wind to move forward even when it is moving against the wind; smart fixed wings: making optimum use of memory metal; Geobee: using a drone to create 3D maps of difficult terrain quickly and in situ; the Bill Gates toilet: combining different technologies to enable the production of a safe and sustainable toilet in developing countries; genetic analysis of tumours: enabling better predictions of the development of tumours by looking at the genotype of the tumour.

[For further information, and to register, please visit \[tudelft.nl/dig-it\]\(http://tudelft.nl/dig-it\)](#)

Activity calendar

October

Alumni Chapter,
Toulouse

9 October

Reception IDEA League
Zurich, Switzerland

4 November

Alumni Chapter,
Bandung Indonesia

6-9 November

Alumni Chapter,
Jakarta Indonesia

11 November

Alumni Chapter,
Surabaya Indonesia

12 November

Alumni Chapter,
Paris

13-22 November

USA tour (Boston, NY, San Francisco,
Houston and Seattle)

November

Sport Innovation lecture

9 January

New Year's reception for Mathematics
and Computer Science, TU Delft

CONTACT

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

ALUMNI PORTAL

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

LINKEDIN

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

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OAPS

Willem van der Poel

Like other employees, professors retire when they turn 65. But there are exceptions. One of them is computer pioneer and puzzle creator Prof. Willem van der Poel (87).


I'm there every Tuesday morning,' Van der Poel said. 'I just stop by.' The emeritus professor shares a room in the EWI tower. Ten stories below, there are computers that he built over sixty years ago. The relay computer Testudo, dating from 1952, is in the basement - or at least parts of it are. It counted at a rate two times slower than a human, but it remained in use for twelve years. The Zebra (1956) is also part of the study collection, proudly displaying 498 tubes and 509 transistors.

Today he is writing an entry for the Nieuw Archief, the magazine of the Royal Mathematical Society. The magazine published a puzzle (Is there a number, n , such that the numbers $2n, 3n, 4n, 5n, 6n, 7n, 8n$ and $9n$ start with 2,3,4,5,6,7,8,9?), to which, after a few weeks of working, he has found the answer: no. Van der Poel says that the main difference compared to his activities before retirement is the fact that the supervision of assignments, and the help of the students

involved in that, no longer feature in his work. Instead, he now gives readings, for which he is invited about ten times a year by, among others, the KNAW and the HCC (Hobby Computer Club). He is also an active member of an international puzzle

Padlock One - a padlock with no lock or opening. He has two thousand puzzles at home and he pulls a whole range of them out of his bag. He's also rekindled his interest in computers. He started at the Technical University in 1962 as Professor of the

However, the new, affordably priced microcomputers that are now appearing on the market have reawakened his interest in technology. A plastic box the size of a packet of cigarettes contains an ARM computer costing €35. It runs on Linux. Van der Poel types something into the keyboard and the computer calculates pi. The screen starts to fill up with numbers. The little thing can even simulate the old Zebra.

Puzzles, software and computers - Van der Poel is insatiable when it comes to logical challenges. However, there has also been a second career in the background: music. He learned to play the piano when he was five years old and he never gave it up. Later he learned the flute and the bassoon. He played with the student orchestra Krashna Musica for seventeen years. But he is glad he chose the TH and not the conservatoire. 'For music you have to really be at the top of your game,' he says with irony. And his motto? 'Keep searching' - but not intended in any religious sense. 



club, whose three hundred members devise, make and try to solve mechanical puzzles. 'If I get my hands on a puzzle, it may take me three months, but I have to find a solution.' That is what happened with Rainer Popp's

Theory and Construction of Computers (applied logic). In the 1980s, his attention shifted from hardware to software, because of the rapid developments and considerable investments involved in constructing the former.

CONTINUATION P.39

Willem van der Poel (born 2 December 1926 in The Hague) enrolled at TU Delft's predecessor, the Technische Hogeschool (TH) after World War II, from which he graduated in 1950, and started work at the Dr. Neher Lab at the General Post Office. In 1956 he completed his doctorate on the design of the Zebra computer with Professor Van Wijngaarden at the University of Amsterdam. In 1962 he was appointed as a part-time lecturer at TU Delft, going full-time in 1967. In 1971 he became a member of the Royal Netherlands Academy of Arts and Sciences (KNAW). On his retirement in 1991, Van der Poel was appointed a Knight of the Order of the Netherlands Lion.



The new, affordably priced microcomputers that are now appearing on the market have reawakened his interest in technology