DELFT OUTLOOK
NO.1 APRIL 2014 YEAR 31
TU Delft

THEME LIGHT

JAN VAN DEN BERG

‘The days of a happy-go-lucky attitude on the Internet are in the past’

70,800

participants in online MOOCs

Big in small things

10 YEARS KAVLI INSTITUTE

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EDITORIAL
Frank Nuijens

Light

Delft research varies in scale, nature, topic, applicability, perspective and a number of other variables. However, they do have some things in common: TU research falls under the three research pillars: design, engineering or science. And it is integrated in society, just as our new logo on the cover is integrated with the background. From now on, in Delft Outlook we want to put more emphasis and shed more light on this enormous diversity. Therefore, in this updated Delft Outlook, besides the usual background and news you will also find a selection of notable research projects about this topic. For this first issue we chose a topic that goes well with the season: light.

Naturally, there are several ways one could choose to classify Delft research involving light. We have opted to focus in on light as a source of energy, light as an instrument and light as an experience. That results in other solutions, such as sustainable solar gas, a lamp that brightens the dark African nights and an optical needle that facilitates the detection of tumours.

From now on we will be coming to your postbox four times a year. If you would prefer to read Delft Outlook online, subscribe to our newsletter through the website.

Frank Nuijens, editor-in-chief

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Theme LIGHT

PHOTO: SAM RENTMEESTER

01

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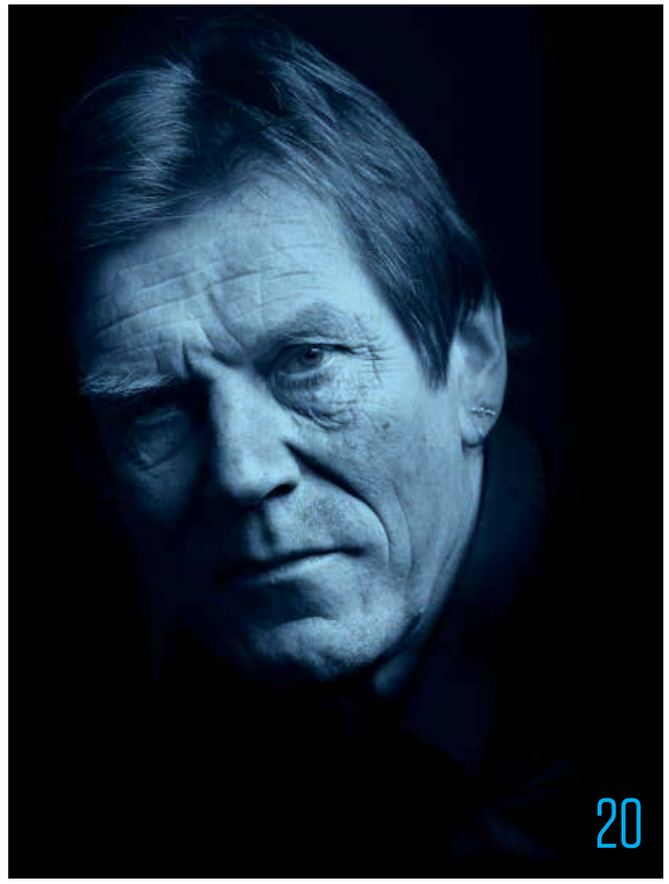


DELFT IN BRIEF

Synthetic graphene

Very fast electronic circuits and flexible display screens; the promises of graphene are plenty. This material, which consists of a single layer of carbon atoms, is one of the fastest semiconductors. Since graphene was discovered in 2004, scientists have been looking frantically for ways to produce it as purely as possible. Only in its purest form can electrons move freely through the atomic lattice, a phenomenon called ballistic transport. In January researchers from the MMME and AS faculties described in Applied Physics Letters how they were able for the first time to demonstrate ballistic transport in synthetic graphene which they fabricated by chemical vapor deposition.
delta.tudelft.nl/27803

PHOTO: TOMAS VAN DIJK

Ir. Shou-En Zhu with his chemical vapor deposition machine.

Cloud computing

Clouds that grow all the way up to the tropopause at ten kilometres height or more can cause extreme summer storms. The atmospheric processes that lie at the basis of these so-called cumulonimbus can now be studied in more detail thanks to the PhD research of Steven Böing of CEG faculty, which he defended on January 27. He improved a programme called the Dutch Atmospheric Large Eddy Simulation software. Earlier versions of this programme calculated clouds to the height of some kilometres. Böing was the first to lift the cloud ceiling to twenty kilometres, which is basically the weather's limit.
delta.tudelft.nl/27716

← Cumulonimbus dominating a US village

PHOTO: JIM W. LEE, NATIONAL WEATHER SERVICE

CLOGGED ARTERIES

A new mathematical model might one day help point out which people, on the basis of a CT-scan, are most at risk of atherosclerotic plaque formation. Or such is the hope of Dr. Sasa Kenjeres (Transport Phenomena Section at AS faculty) and M.Sc. student Alexander de Loor (Burgers Centre for Fluid Dynamics) who developed a model that shows where exactly cholesterol will accumulate in a carotid artery. The researchers calculated the blood flow patterns through the carotid based on a 3D reconstruction of CT-scans and on the ultrasound blood flow measurements of a healthy person.
delta.tudelft.nl/27547

Cyberzoo

Robots are undoubtedly getting smarter. But they're at their smartest when they work as a team. Researchers can now study how they move in groups in the very latest TU Delft lab: the Cyberzoo. This 'zoo' is an initiative of the Delft Robotics Institute. It is situated at the AE faculty in the aeroplane hall. It will soon be the home of hovering, crawling and rolling robots. "We used to think that intelligence could be best accomplished in one large robot. But we're now moving towards the idea that a group of smaller, simpler robots is actually much smarter", says one of the initiators, Dr. Chris Verhoeven.
delta.tudelft.nl/27835

PHOTO: SAM RENTMEESTER

RHINE SAMPLES

Delft Scientists have been the first to link the presence of pharmaceutical residues in the Rhine to the demographic characteristics of people living along this river. This knowledge could be used to develop a better way of dealing with the contamination of drinking water. Professor Nick van de Giesen and Dr. Rolf Hut of CEG faculty and Corine Houtman from the Water Laboratory published their findings in December in Environmental Research Letters. "Young people and the elderly use very different pharmaceuticals in different quantities. Pharmaceutical usage also varies by nationality. These differences are so great that we were indeed able to detect most of these pharmaceuticals in the river water", explains Hut.
delta.tudelft.nl/27646

NO MORE SQUINTING

By modelling the soft tissue biomechanics and the suspension of the human eye Dr. Sander Schutte, who recently defended his thesis on this topic at the MMME faculty, believes surgery to correct strabismus, or cross eyes, can be improved.
Strabismus is usually corrected surgically by relocating the insertion of one eye muscle on the eye a few millimetres backwards. "It is a very straightforward operation requiring no more than a ruler, a pair of scissors and thread and a needle. And the procedure has hardly changed since it was first devised in the nineteenth century", says Schutte. Unfortunately about twenty percent of all patients need a reoperation because their strabismus was over or under corrected. One cause of this error is the fact that the anatomy and physiological properties of the eye, the muscles and the orbital fat vary greatly between patients.
delta.tudelft.nl/27573

DELFI-N3XT

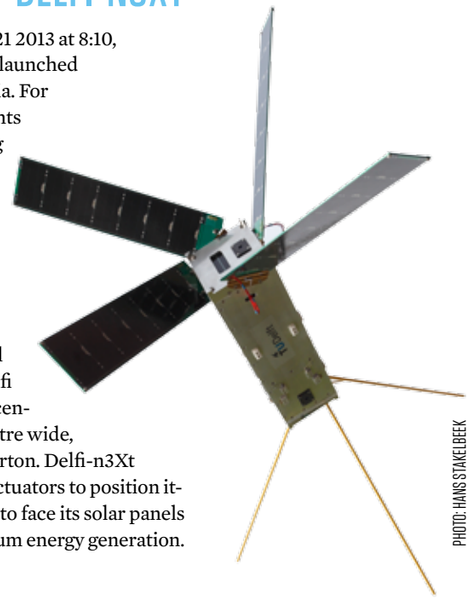


PHOTO: HANS STAKELBEEK

On the morning of November 21 2013 at 8:10, the Delfi-n3Xt satellite was launched from a base in Yasny, Russia. For almost five years TU students and staff have been working on the Delfi-n3Xt, the second satellite to be built by a Dutch university. Delfi-n3Xt is the successor to the first Delft satellite, Delfi-C3, which was launched in April 2008. Although it was designed to last a year, this satellite is still functioning today. The Delfi satellites are only thirty-four centimetre high and ten centimetre wide, not much larger than a milk carton. Delfi-n3Xt uses a system of sensors and actuators to position itself. This enables the satellite to face its solar panels towards the sun for optimum energy generation.

FINAL RESULTS

A simulator to train sailing skills, drones, 3D-printed jewellery and of course robots that hand over drinks, on January 30 the central hall was filled with the final results of industrial design minor students. The presentations attracted a great deal of attention, including that of national TV show Hart van Nederland and Omroep West.

+ 700.000 TAGS

PHOTO: RIJKSMUSEUM

One of the 700 thousand prints to be annotated.

Like an iceberg, the vast majority of the Rijksmuseum's collection is hidden. But not for much longer. The museum now runs a program to digitize artworks and put the objects online. To help the curators annotate the items Delft researchers develop methods to harvest expertise from the crowd. PhD student Jasper Oosterman (EEMCS) has recently done a first trial run with eighty-six prints of birds and plants. He develops strategies and software to identify potential contributors and to assemble them into a working crowd. This is one of over forty research projects that were presented on Delft Data Science New Year Event, held at the EEMCS building on January 13.
delta.tudelft.nl/27782

SURFING LIKE A BOSS

Given the right waves, everyone can learn how to surf. Or so says Dr. Steven Schmied, who works on a surf pool and who recently defended his thesis on this topic at the MMME faculty. Schmied wants to make annular wave pools in which pressure sources dragged through the water create waves that propagate inwards. A sloping bathymetry (beach) triggers these waves to break. Waves suitable for beginners to experts can be produced this way. Talks are to make such a pool in Zoetermeer.
delta.tudelft.nl/27765

Artist's impression: Webberwavepool.com

THEME

light

ENERGY

Sustainable gas from light and water; the Ndassie lamp that brightens Africans nights: Tvlight that makes intelligent lamp posts; and Miro Zeman on the future of solar panels.

INSTRUMENT

An optical needle that detects tumours; an optical microscope with super-resolution; a tiny connection linking optical chips; and water treatment using sunlight.

EXPERIENCE

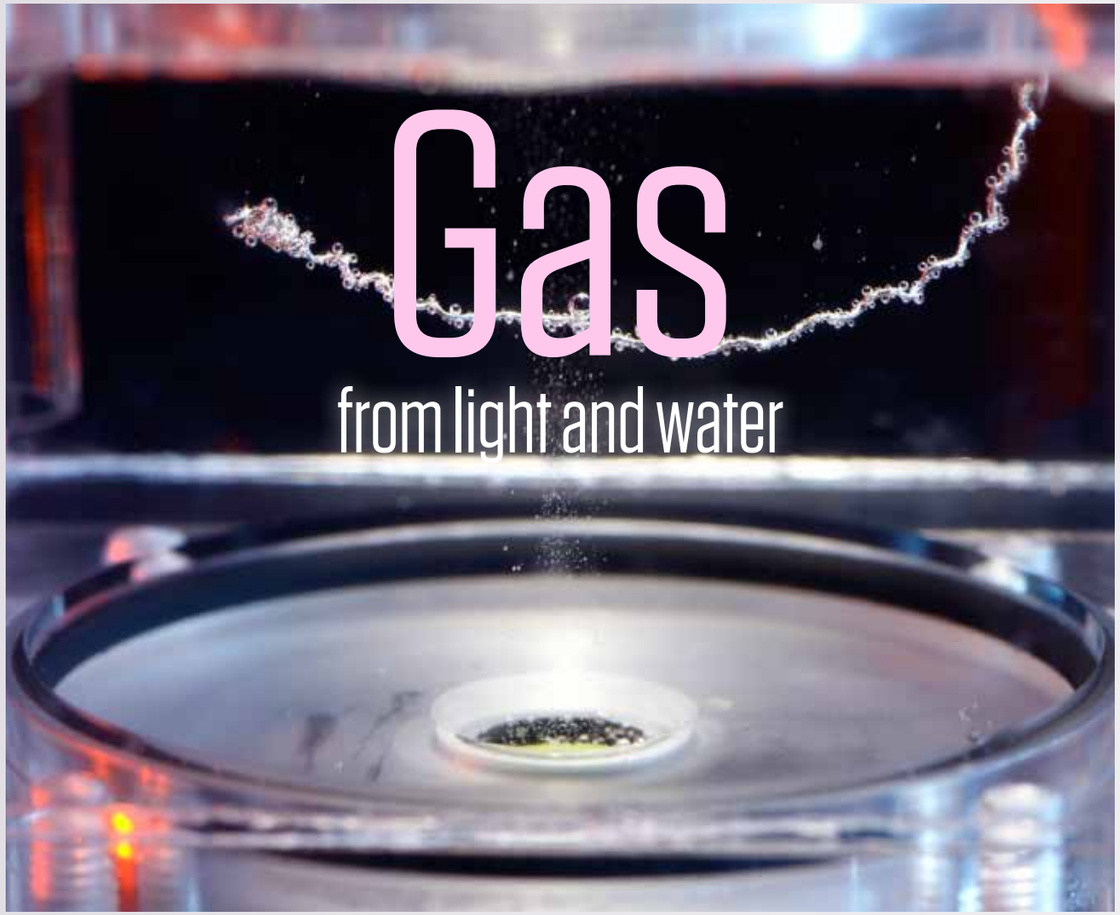
The relation between daylight and outlook; and an interactive light installation for children with cancer.

LECTURES ABOUT LIGHT

Thursday 15 May, starting at 19.00, researchers will give a lecture on the subject of light. Arno Smets will elucidate the article 'Gas from water and light', and Jenny Dankelman will talk about needles with optical fibres that can accurately detect tumours. More information: www.alumni.tudelft.nl

PHOTO: NIELS DE VRIES TVLIGHT

TEXT: JOS WASSINK
PHOTOS: SAM RENTMEESTER



Gas from light and water

The government is looking for techniques for producing new fuels from CO_2, light and water. Late last year, the Foundation for Fundamental Research on Matter (FOM), the Netherlands Organisation for Scientific Research (NWO) and Shell allocated € 5 million to this purpose. One of the seven proposals to be funded was from TU Delft.

More and stronger earthquakes in Groningen and a majority in the Netherlands House of Representatives for reducing the gas-exploration activities in the area – these developments signal the end of an era in which natural gas was an obvious source of energy and income for the state. In the meantime, the Netherlands has acquired a unique infrastructure of gas pipelines, and it would be a shame not to use it.

The research programme entitled 'CO_2-neutral fuels', which was launched in the spring of 2013 by FOM, NWO and Shell, has made € 5 million available for the clean production of CO_2-neutral fuels from water and carbon dioxide. The objective is illustrated in a cheerful video: electricity from solar panels supplies a factory in which water and carbon dioxide (CO_2) are converted into methane (CH_4). The gas flows through pipes to reach the farthest corners of our country. As natural gas – in this case, more specifically, solar gas – is burned, carbon dioxide and water are released, thereby closing the circle. In this way, we can live happily ever after.

STORAGE

Storage is another matter to consider with regard to the advance of solar energy, according to Dr Arno Smets (EEMCS). Although solar energy currently accounts for only a small share (1%), what will happen when this share reaches 10% or 20%? "Storage will become a bottleneck", predicts Smets. "We have to be able to dump energy through a chemical conversion." One way to do this would be to generate hydrogen through electrolysis (i.e. using electricity to split H_2O into H_2 and O_2) and converting it into methane (CH_4) using CO_2. Unlike hydrogen, methane lends itself well to storage, if necessary in the gas fields of Groningen, which would then be empty.

A video* on the research conducted by Lihao Han (EEMCS) and Fatwa Abdi (Applied Sciences) on a solar cell that produces hydrogen provides a glimpse of the future: we see a simple, square plexiglass box. The box stands alone – there are no wires attached. Then, a spotlight flashes on the cell. The camera zooms in and, lo and behold, small bubbles are rising from a screen in the middle of the cell: hydrogen from light.

According to Abdi, a capacity of 10% should ultimately be feasible: "We have now reached about half of this goal. If we achieve a capacity of 10% with large-scale installations, we can bid farewell to fossil fuels." Then we will cover our roofs with combination cells that generate hydrogen, which we will use to fill our hydrogen cars – free, and without taxes.

APPEL

With the funds they have received from FOM and other sources (€ 750 thousand), two new PhD students will start working on a revised model, for which the researchers have high expectations. In their proposal to NWO/FOM, the researchers even refer to the prospect of a total capacity (solar to hydrogen) of 15%.

"Now that we know how the cell works, we also know where the problems lie", explains Abdi's supervisor Prof. Dr Bernard Dam. He is thinking of improving the charge separation (e.g. by preventing the loss of electron-hole pairs due to receding of electrons), improving the absorption of light and optimising the mobility of the charge carriers (allowing greater formation on the electrodes).

The design used by the applicants Arno Smets and Dr Wilson Smith (from Dam's group) in their proposal, entitled APPEL,[2] is quite different from that developed by Abdi and Han. They actually reverse the entire design: in their design, hydrogen is formed on a semi-conducting photo-cathode with a catalytic layer.

The two PhD students will continue to develop the new design in the coming years, under the supervision of Smets and Smith. For example, they will be considering ways of protecting the semi-conductor against corrosion due to water. The idea is to develop a 'passivation layer' that separates the semi-conductor and the water, while allowing the electrons to pass, thus producing hydrogen on the cathode.

THE LONG RUN

It will also be necessary to develop new oxygen-generating catalysts to replace the usual platinum. Ideally, the anode should also continue to absorb a portion of the light. To this end, the yellowish bismuth vanadate of the cell's surface must be replaced by a different, darker oxide, which will absorb a greater portion of the spectrum. It is hoped that this will generate a stronger current, which is expected to increase the production of hydrogen. It is obviously crucial for the solar cells in the background to be able to generate as much or more electricity with less light.

Dam acknowledges, "This is research for the long run." Therefore Dam would like to have research support of a more structural nature. "The production of hydrogen from sunlight is a topic that is essential to a sustainable society", asserts Dam, who would like to see funding for applied research focus more on new industries than on existing ones.

[1] *Fatwa F. Abdi, Lihao Han, Arno H. M. Smets, Miro Zeman, Bernard Dam & Roel van de Krol, Efficient solar water splitting by enhanced charge separation in a bismuth vanadate-silicon tandem photoelectrode, Nature, 29 July 2013.*

[2] *Earth Abundant Materials based Monolithic Photovoltaic-Photo Electrochemical Device toward 15% Solar-to-Hydrogen Conversion Efficiencies – Acroniem: APPEL*

[3] *www.fom.nl/co2*

* You Tube

Waterspliting TU Delft
http://youtu.be/U2qU0Z18TkE

Why this is important

The gas-exploration in the Netherlands is on question. Clean and cheap alternative is solar gas, in which water and carbon dioxide is converted into methane.

7 roads to solar gas

The NWO/FOM/Shell programme for CO_2 neutral fuels[3] is providing support for seven studies, selected from 32 submitted proposals. The proposal from TU Delft focuses on the production of hydrogen, while the others concern the production of fuels from CO_2 and hydrogen. The funders are calling upon the researchers to look for connections between the various projects.

PHOTO: HOLLANDSE HOOGTE/CORBIS

Light for Africa

Illuminating the dark nights in Africa safely, while fighting poverty: that is what alumnus Jean Seraphin Kepguep hopes to achieve with his solar Ndassie lamps.

Jean Seraphin Kepguep received a warm welcome during a visit to his native Cameroon. The people in his village were happy to see him, and his grandmother cooked his favourite meal. Because Kepguep arrived in the dark, however, the meal had to be prepared in the light of a kerosene lamp. He was eagerly looking forward to the food, but unfortunately the feast did not happen. The kerosene seeped out of the lamp and onto his favourite dish.

As in many other countries around the equator, it is pitch dark there as soon as the sun goes down. The night is illuminated with kerosene lamps, and that can cause major problems. The lamps do not always close correctly. Children burn themselves with the oil, and houses catch fire. "I wanted to find a solution for this", explains Kepguep. Based on his studies (Applied Earth Sciences) and his African background, Kepguep knew which alternatives to the kerosene lamp would and would not work. "It would have to be a lamp that would benefit the entire community, and not only one family. It would also have to be durable, inexpensive, easy to repair, and more than simply a source of light." Fireflies formed a source of inspiration for his Ndassie lamp. "As a child, I tried to catch them and put them in a jar, so that I would always have light. That obviously did not work. But even then I was an engineer, intensely involved with light." Because the sun shines all day long in Cameroon, he wanted to create a light source based on solar energy. A large solar panel now graces his grandmother's house. It is connected to a bright green in-home charging station with five shelves. On each shelf, twenty lamps can be charged at one time. "That's not all: you can also charge a mobile phone on the lamp. In Africa, this is almost as important as light." Kepguep emphasises that this system makes light available to almost everyone. "Someone with a lamp could also ask for money in exchange for charging someone else's mobile phone." In addition to generating light, the Ndassie lamp also reduces poverty. His ageing grandmother is benefiting from it as well. "Because the charging station is in her house, people are always coming to charge their lamps. I therefore know that people are keeping an eye on her and caring for her." Even if the durable system should break, locally trained people would be able to repair it. The Ndassie lamp has already won several prizes. The idea grew into an actual product without external funding, but with considerable help from students and researchers at TU Delft, as well as from coaches and supporters. "The first shipment of lamps and charging stations is now ready for use. Not just in Africa, but also in other parts of the world without electricity, in Asia and South America for example."

Delft Social Impact

Ndassie Engineering will be collaborating with Delft Social Impact, a platform where students and scientists can share their projects for developing countries. Although there is considerable activity in this area at TU Delft, the projects are not centrally coordinated, and people are thus not aware of what others are doing. Delft Social Impact is a central desk to which alumni, interested parties, students and scientists can turn with questions about projects and for help with promoting the various projects. MZ

www.ndassie.com
www.socialimpact.tudelft.nl en
socialimpact@tudelft.nl

TU Delft conducts many social projects for developing countries. One example is the Ndassie lamp, a light source based on solar energy.

Smart street lighting

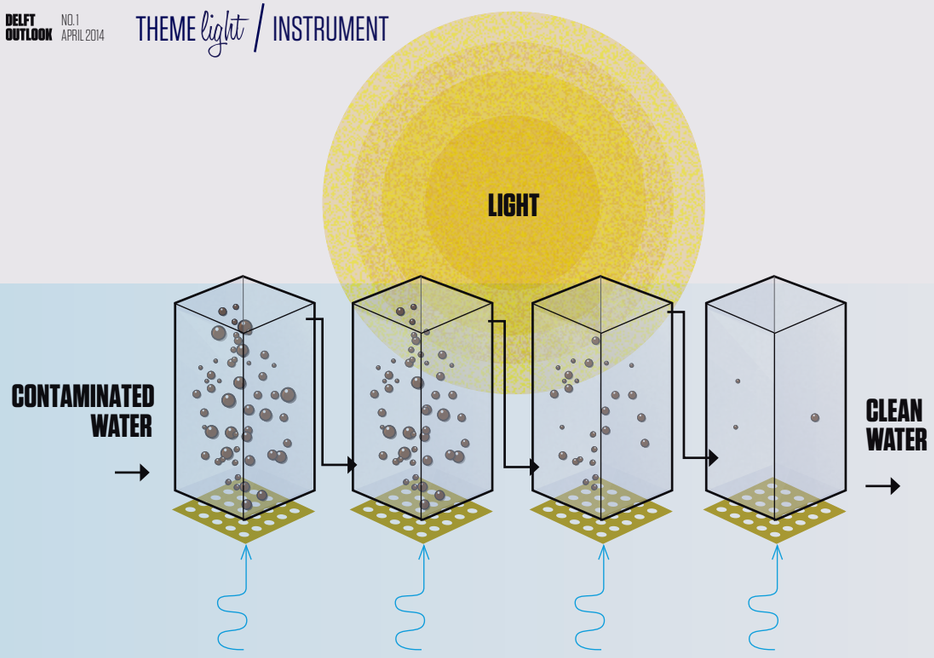
PHOTO: NIELS DE VRIES TVILIGHT

MULTIPLE LAMP POSTS COMMUNICATE WITH EACH OTHER.

When nobody is in the area, street lamps do not need to shine very brightly. This is harmful to the environment, and it wastes considerable energy and money. The company Tvilight, owned by alumnus Chintan Shah, is therefore working to develop smart street lighting, in which multiple lamp posts communicate with each other. "Sensors detect road users, in addition to distinguishing between pedestrians, cyclists and automobiles. They also detect cats, dogs and birds", Shah points out.

Tvilight ensures adequate lighting that continually travels along with road users. "Road users therefore do not notice anything. When nobody is in the area, the lamps are dimmed". This application will allow energy savings of up to 80%, and it will cut maintenance costs in half. It can be applied to both new and existing lamp posts.

Shah started his company as a hobby in 2010. It now employs twenty people, and the technology is being used around the world. For example in Groningen, Assen and Nuenen and in various train stations, as well as in Ireland, Germany, Australia and, soon, the United States and Canada. RV



PURIFIED BY SUNLIGHT

Sunlight can be used to purify water. This process is not yet in common use, however, because it requires large, expensive installations. Researchers at ChemE would like to make photocatalysis more attractive by increasing its efficiency.

Our ancestors were already aware of the purifying power of sunlight. They bleached their sheets by laying them on the grass. The first industrial applications of solar purification took place 30–40 years ago. These applications involved water purification. Little has changed, observes Dr Ruud van Ommen of ChemE, in the Faculty of Applied Sciences. Together with Dr Michiel Kreutzer, he supervised the Iranian-Dutch PhD candidate Dr Mahsa Motegh in her study into the design of photocatalytic reactors.

According to Kreutzer, this type of reactor can be calculated with ray-tracing. In this procedure, a computer calculates countless paths that photons can take through the reactor. Photons are reflected, bent, absorbed and occasionally used for photocatalytic transformation. This usually takes place through finely separated titanium dioxide (the material that makes paint and toothpaste white). The calculation of all sorts of light paths is highly complex. Motegh developed an alternative, in the form of several design rules for photocatalytic reactors. Her calculations predict efficiency within a margin of 20%, estimates Kreutzer.

More importantly, engineers can use the guidelines developed by Motegh to optimise photoreactors during the design process.

In general, the efficiency of photoreactors is quite low. For example, if one in every 500 photons results in a chemical transformation, this would translate into an efficiency of 0.2%.

“The challenge is to improve this efficiency”, proposes Kreutzer. “I’m not talking about 80%; even 2% would represent a tenfold improvement. Then we could reduce the surface of the reactors, and thus the investments as well. Ultimately, there are only three or four matters that designers must take into account.”

Van Ommen adds that the use of guidelines in the design of ordinary catalytic reactors has long been common practice. It is now possible for photocatalytic reactors as well. JW

Detecting tumours

Light will soon play an important role in minimally invasive surgery (keyhole operations), in which medical instruments are inserted through an opening that is as small as possible. It is used to take a biopsy with a needle, for example. In this procedure, tissue is collected in order to determine whether a person has cancer.

“It is important to take tissue that is suspected of being a tumour. Last-minute adjustments are sometimes necessary. Needles with optical fibres and sensors make this possible”, explains Prof. Jenny Dankelman, head of the department of Biomedical Engineering (3mE). The optical fibres are extremely thin. The needle has a diameter of two millimetres. The fibres have a diameter of two tenths of a millimetre, resting in grooves that have been etched into the needle. The shape of the needle is determined with sensors in these fibres.

The optical fibres are suited for use in MRI scanners. “Because of the magnetic field, metals cause problems in a scanner, but optical fibres do not. Therefore optical sensors do not cause interference in the MRI image”, explains Kirsten Henken.

The researchers are already thinking one step further. They are trying to develop steerable optical fibres that can characterise tissue, in addition to treating it. “One puncture would then suffice for both the diagnosis and the treatment. The fibre-containing instrument uses light to determine the type of tissue. If it is suspicious, we would want to heat it, thus destroying the unhealthy cells”, Dr John van den Dobbelsteen tells us.

This is something for the future, however, as the technology must undergo further testing and development in the coming years. RV

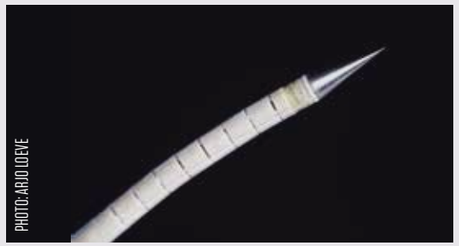


PHOTO: ARJO LOEVE

Exact fit

0,1 micrometer

WHY THIS IS IMPORTANT

The sharp increase in data traffic (internet) is approaching the limits of the current broadband technology. Although glass fibres are able to transport large volumes of optical data, the intersections where the optical data must be transformed into electronic information pose a problem.

The bundle of light passing through a glass fibre is as thin as one tenth of a human hair. The connections between optical chips and laser diodes must therefore be very precise. Micro-engineer Dr Marcel Tichem (3mE) has achieved a precision of 0.1 micrometre (700x thinner than a human hair). In 2008, one of his doctoral candidates produced a ‘box’ (opto-electronic package), in which the core of a glass fibre is aligned precisely with a laser diode. This is done with a micro-electromechanical system (MEMS) that can move the thin end of the glass fibre in two directions (horizontal and vertical).

Tichem is now working on the next challenge: connecting the light signals of a photonic chip. This involves four minuscule streams of light (‘wave guides’), each with a diameter of 3 micrometres, which are emitted from a photonic chip at a distance of 25 micrometres from each other. Connecting glass fibres to them, however, requires an intermediate chip (an ‘interposer’), which broadens the light streams and their distance from each other. Even when this interposer chip, with its studs and grooves (a bit like Lego) is in place, it is impossible to achieve a precision smaller than 0.5 micrometre, although 0.1 is required.

Tichem resolves this problem by incorporating MEMS functions in the interposer. After the photonic chips have been installed, he can use the microelectromechanical system to manoeuvre the streams of light precisely into place. The system also allows him to achieve optical connections for several light streams at once. JW

Supersharp

The super-resolution technology shows objects ten times sharper than a regular light microscope

Light waves cannot represent objects that are smaller than a half wavelength (approx. 0.25 micrometre). That is what we learned about light microscopes in secondary school. Dr Bernd Rieger and Dr Sjoerd Stallinga of the department of Imaging Physics (Applied Sciences) know better. With their super-resolution technology, they can go as far as 1/20 of the length of the light wave – this is 10 times sharper. Their technology is particularly attractive for studying biological structures.
It is based on fluorescence microscopy, which was developed in the mid-1990s. In this technique, a fluorescent molecule with a smart tail is attached to an interesting cell structure. A light pulse is then used to bring the 'fluorophore' into a charged state. When it reverts, it emits light of another colour. This makes it possible to distinguish between incoming and outgoing light. The light source is a molecule that is quite a bit smaller than half the length of a light wave. The light source is positioned in the calculated centre of the light patch. Rieger compares it to taking a night-time photograph of a city in the distance, in which the lights in individual houses are turned on and off in order to achieve maximum resolution.
In this technology, it is essential to avoid illuminating all of the fluorophores at once. Initially this was achieved through the successive activation of some of the molecules with UV light, fading them out with an overdose of light after activation. This worked, but it was sometimes a lengthy process, with lighting times up to 24 hours for 100,000 frames with 1,000–10,000 light points. The lighting time has since been reduced to around five minutes.
According to Rieger and Stallinga, future developments will include: shorter registration times, clearer fluorophores and 3D registrations for dynamic systems. This would make this advanced form of light microscopy more broadly applicable in molecular biology. JW

BERND RIEGER (LEFT) AND SJOERD STALLINGA SHOW THEIR SUPER-RESOLUTION TECHNOLOGY. PHOTO: SAM RENTMEESTER

A closer look at views

1:5 SCALE MODEL

From a blind wall to a wide landscape; views can differ considerably. And yet very little attention is paid to the topic within the field of architecture. Dr Hester Hellinga has discovered that people who are satisfied with their views are often also satisfied with the amount of daylight in their workplaces.

Hellinga developed a tool for assessing views, so that architects can now pay more attention to lines of sight and the use of landscaping when positioning a building on a plot. She asked office workers in various buildings to assess the quality of their workplaces in terms of their offices, the lighting and the view. She then developed a method for analysing daylight and view, including a system for assessing the quality of the view. In the system, scores are assigned to various aspects. In the examples from Hellinga's thesis, the scores for daylight and view range from two points for a view of a gray concrete surface to eleven points for a view of a green slope along a river on the edge of a wood. Less variation was found in the subjective ratings assigned by the respondents (2.0–8.3), although they follow the same general trend.
In the film adaptation of 'A Room with a View', based on a novel of the same title by E.M. Forster, a certain Mr Emerson states, "Men don't need views." In contrast to women, he means. "Our vision is within," he continues. Although Hellinga does not rule out the possibility that men and women might rate views in different ways, she focused on the average ratings, without making any further distinctions based on sex, age or cultural background. These results were largely consistent with her rating system.
Hellinga also investigated the impact of the window (size, height, proportions) on the assessment of the view. To this end, she had the respondents look outside from within a scale model (1:5) of an office. By changing the facade of the model, she was able to examine the influence of different windows and views of the visual quality of the office space.
Results from this second study reveal that people prefer a window that takes up at least a quarter of the wall, but not a wall entirely made of glass. The shape of the window is less important, but a 'landscape' window is deemed preferable to a 'portrait' orientation. The proportion of sky in the view is a relatively good indicator of the amount of daylight. JW

Illuminated footprints

Children with cancer feel often lonely when they are in hospital. In order to cheer them up, nine students in the Interactive Environments minor designed the interactive light installation Seina, which can be used to make light tracks on the floor. The lamps in Seina use sensors to react to movement. Young patients can make their own light tracks, but they can also see where nurses, friends and family members have walked. This makes them feel less alone, both literally and figuratively, because the light tracks remain visible everywhere. Seina is being installed in the Princess Máxima Institute for Paediatric Oncology, which is scheduled to open in 2016. www.seina.nl MZ

2030

In 2030, solar energy will be the least expensive form of all, predicts Prof. Miro Zeman of Photovoltaic materials and Devices in the Faculty of Electrical Engineering, Mathematics and Computer Science.

"What we see as light is electro-magnetic radiation between 380 and 780 nanometres. However, solar radiation comprises much more than that. Our solar cells can also transform the invisible radiation into electricity. For example, silicon solar cells are sensitive to infrared radiation up to 1200 nanometres. Germanium goes even further, to 1900 nanometres. We are investigating ways of transforming as much of the solar spectrum into electricity as possible. One good example involves the expensive solar cells with which the first Nuna solar cars were equipped. They consisted of three stacked solar cells of different materials, each of which was sensitive to a different part of the spectrum. This allowed them to achieve an efficiency of 35%. Silicon solar cells achieve up to 25%. We have just submitted a publication on a new type of thin-film solar cell with four different silicon-based materials, with which we have established a new efficiency record. I think that such multi-junction solar cells will be able to achieve an efficiency of over 50% within a few years. Just compare this to a coal-fired power station that produces electricity with an efficiency of 30%–40%. In 2030, an efficiency of 40% will be quite normal for solar panels.

The production volume of solar cells has grown immensely. In China, there are factories that produce PV panels for 5 gigawatts per year. There is also no shortage of silicon. The price of solar energy will therefore continue to decline. In 2030, solar energy will be the least expensive form of all. In Germany, this is already the case in some instances. Companies are shutting down coal-fired power stations, because they cannot compete.

The challenge for 2030 will be to determine how we can fit inexpensive solar energy into the existing electrical facilities. In addition to PV cells and transformers, this will require research and investments in the storage of electrical energy.

Although the research being conducted in our department is at the highest international level, no industries in the Netherlands are currently making use of this knowledge. If a company with new technology for solar panels wanted to build a factory, they might achieve 5–10 megawatts per year for a niche market. One Chinese factory is producing a thousand times more than this. It would be impossible to set a price that could compete with that. We like to collaborate with Hyet in Arnhem, which would like to produce flexible thin-film solar cells for applications in the built environment. In the future, however, I think that we will also have to talk with people from Japan and China. At the end of the day you do want your research results to be applied". JW

PHOTO: SAM RENTMEESTER

ALUMNI EVENT 2014

'The university of the future'

The annual Alumni Event will take place on 6 June 2014 from 15.30 to 22.00. Experience the university of the future during the main programme, network with friends, acquaintances and current students over afternoon drinks and at dinner and discover our promising, innovative ideas during the evening programme.

More information: www.tudelft.nl/alumnievent

THE FIRM

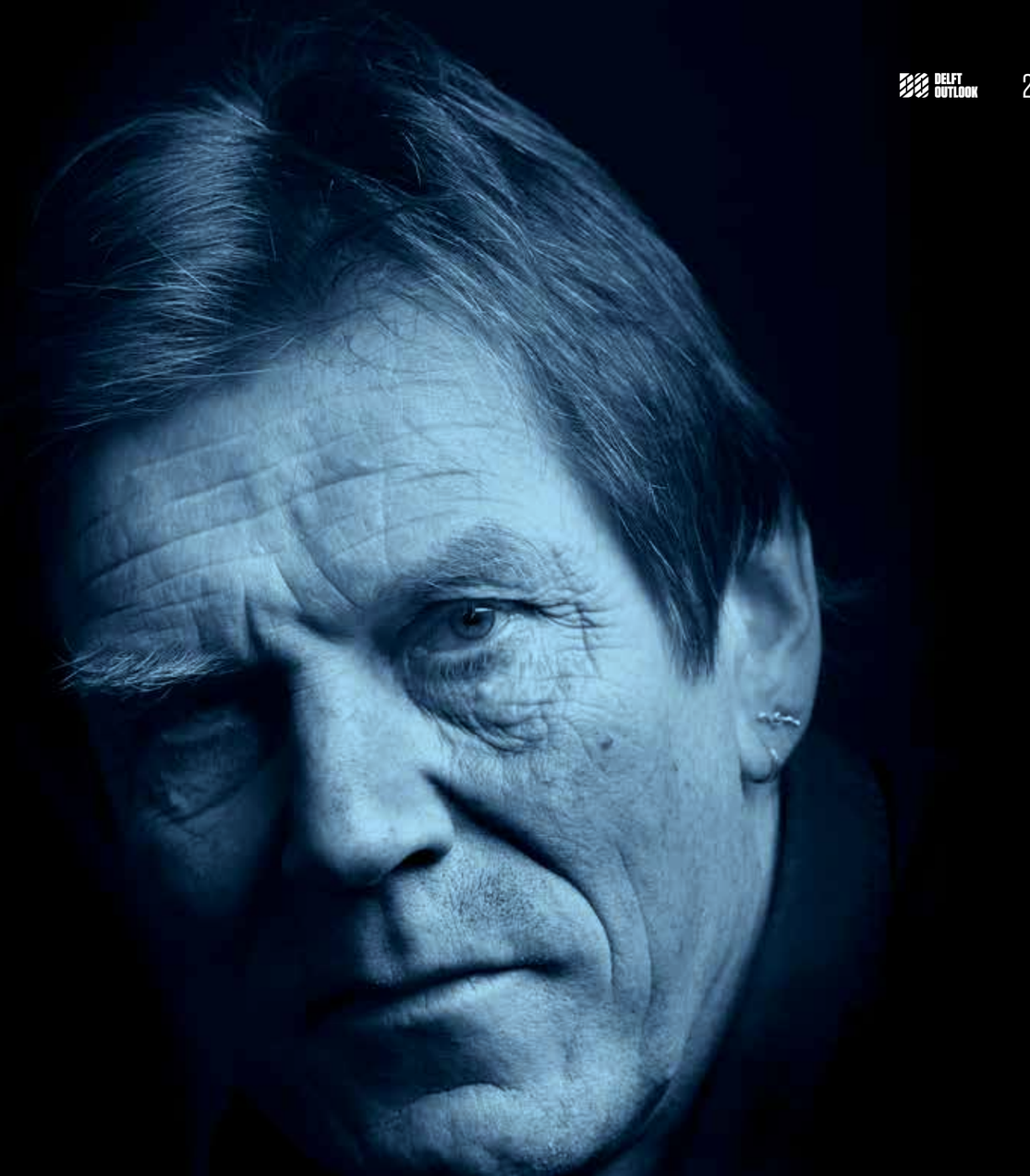
The income of Indian salt farmers is absurdly low, argues TU Delft alumnus Nick van der Velde. "They earn € 120–€ 180 per year for producing tons of salt. They need to work hard for that." Since last August, he has been living in Ahmedabad, India, and selling salt in a modern way with his company Chakri Originals.

Nick van der Velde was studying strategic product design at the Faculty of Industrial Design Engineering when he went to India with three fellow students in 2010. A non-governmental organisation (NGO) had asked the students to help in the development of a metal windmill to replace the unsafe and inefficient bamboo windmills. They were happy to do so, and there are now fifty of them in India.
At € 900, however, the metal windmills are expensive for the farmers, and the price of salt is low. Buyers take away a mountain of salt weighing 10 000 kilo for just € 30–€ 40.
The students discovered that packaged salt sells for 150 times more. They created a streamlined packaging design, targeted towards the rising Indian middle class. This, combined with natural and fair-trade certifications, would help farmers increase their income, or so the students expected. They had a lorry full of salt washed and packaged in a trendy, reclosable bag. Together with the farmers, they sold these bags at a food expo for consumers. They were sold out within three days.
After this success, the students had to return to Delft. Nevertheless, the salt farmers remained on Van der Velde's mind. In 2012 he founded Chakri Originals in 2012 and, having graduated, in August 2013 he left for India to develop his company, with assistance from the incubator Enviu. He ordered a new packaging design, hired two employees, opened his company to Indian interns and started work in earnest. The salt of Chakri Originals is now being sold on a trial basis in 20 stores; after this expansion is planned into Mumbai, Bangalore, Delhi and the Netherlands. This will require the sale of thousands to hundreds of thousands of bags and salt grinders. Van der Velde is still looking for investors.
In the meantime, he is also focusing on pepper sales. Other herbs, spices, coffee, tea and sugar should follow in the future. All will be natural and fair trade, and all will be aimed at improving the income of the farmers.
If everything goes according to plan, Chakri Originals will be "the established name in organic and fair trade products in India" within five years. His company is currently operating at a loss. According to Van der Velde, however, the goal is not to turn a high profit within five years. First he hopes to increase the income of the farmers to three to five times what they earn now. At the same time, he would like to continue to improve his products.
"For as long as necessary," he will remain in India, a country that is not at all similar to the Netherlands in terms of enterprise. "Bureaucracy, corruption and an unstructured environment make the work a challenge. I am enjoying myself - I'm not the type to get homesick." SB

PHOTO: NICK VD VELDE

Name:	Nick van der Velde
Study:	Strategic product design (IO)
Company:	Chakri Originals
Established in:	2012
Sells:	Salt
Mission:	Increase the income of Indian farmers
In 5 years:	The established name in organic and fair trade products in India

Mandatory inspection for every PC



"How safe are we really?" was the question posed at TU Delft's 172th Dies Natalis celebration. New technologies offer opportunities, but they also pose threats. This is certainly true with regard to internet safety, Cyber-Security Professor Jan van den Berg (EEMC/TPM) tells us. "The days of a happy-go-lucky attitude are in the past".

TEXT JOS WASSINK PHOTO SAM RENTMEESTER

YOU GRADUATED IN 1977, LONG BEFORE THE RISE OF THE INTERNET. HOW DID YOU END UP IN THE FIELD OF INTERNET SAFETY?

"For me, the breakthrough came in the late 1990s, with the advent of Web 2.0. We already had Web 1.0, which emerged in the mid-1990s. That was passive. Although there were websites, individual users – lay people – had no influence, because it was too complicated. With Web 2.0, however, it became very easy for users to post content to the web themselves. Companies started to engage in e-commerce with dynamic content on their own websites. Social network sites emerged rapidly as well. End users began to notice that they could do something on the web. Sometime in the past 14 years, since about 2000, criminal activity started to creep in."

'We have built a highly complex society in which we no longer know exactly what is going on'

LAST YEAR WAS AN ACTIVE YEAR FOR LESS PLEASANT INTERNET ACTIVITIES. EXAMPLES INCLUDE THE HACKING OF KPN, DDOS ATTACKS AND THE NSA REVELATIONS. IS IT JUST SELECTIVE OBSERVATION, OR ARE MORE INCIDENTS OCCURRING ON THE INTERNET EACH YEAR?

"I think that more is going on, and I don't think that it's going to stop. In the late 1990s, nobody was talking about cyber-security. At that time, we were only talking about information security. It was all about information. Cyberspace as we know it today had not yet been created. In the space of fifteen years, we have made ourselves completely dependent on IT. We have made a world in which three billion people are permanently connected to each other and in which they engage in all kinds of activities with each other. In addition to exchanging information, which was how it all started, they can conduct financial transactions, find friends and, in some cases, partners. Companies work with them. You name it. Everything that we do in reality, we have also placed in the virtual world, which has made it a world with real effects, where the same things happen that take place in the ordinary world: theft, deception, robberies, bullying - you name it. Don't forget: real criminal organisations are behind this: the internet mafia and dark markets. Truly shocking accounts have been written of these practices."

CAN YOU NAME AN EXAMPLE?

"Well, people who are paid to do these things. You can get a botnet[i] to carry out a DDoS[ii] attack. For a certain price you can rent these for a few hours or a few days. You are even told how to carry out the financial transaction in such a way that you cannot be traced. You can do that via an anonymous server, where you can then purchase zero-days[iii]."

SO ARE THERE A BUNCH OF SMART GUYS FIGURING ALL OF THIS OUT FOR DUBIOUS BOSSES?

"Yes. They are paid to do this. It is a very smart network of people who do not know each other. This obviously involves complex relationships of trust. They communicate with each other anonymously, but once you order something and pay to have it delivered, this obviously creates a network you can work with. In the real-world mafia, the boss is also unknown to the people on the ground. I'm no expert, but I know that's approximately how it works. Our dependence on IT is only increasing, and my greatest fear is that the major infrastructures will become increasingly tied to each other: electricity, highways, ports, water works and industries. We have built a highly complex society in which we no longer know exactly what is going on."

IT IS APPARENTLY ALSO NOT SUCH A GOOD IDEA TO CONNECT ALL OF THE ELECTRONICS IN YOUR HOME TO THE INTERNET, INCLUDING YOUR THERMOSTAT, YOUR SECURITY SYSTEM AND YOUR REFRIGERATOR.

"Vulnerability is increasing, and problems of responsibility are emerging. I recently paid a visit to an internet service provider. They tell us, 'In the past, our responsibility extended to the first box in the home'. That was connected to a TV, a PC and maybe a laptop. Now there are likely to be 10–15 appliances connected to it. Any of those systems could become infected with malware[iv] and start to behave inappropriately. The provider would actually prefer to disconnect that one device, but the privacy watchdogs will not allow this. This is an interesting dilemma, and we have not actually determined where the responsibilities lie. The user says, 'Yeah, right. Security. I bought a PC. It should be able to keep itself free of viruses. I'm not going to pay for that'. Why not, actually? We are also required to have our cars inspected periodically. Everyone now considers it perfectly normal to contribute to the overall safety of the highways. This realisation has yet to dawn within the digital realm. Farmers have to clean their ditches every autumn in order to maintain proper water management for the common good."

WHAT TYPE OF USER RESPONSIBILITY ARE YOU TALKING ABOUT?

"The general idea is that, next to highways, water, air and space, the internet is a new domain in which all kinds of traffic rules apply. This is already quite different from the former happy-go-lucky attitude. It could mean that software or the use of devices could be subject to responsibilities. For example, annual PC inspections could become required. Why not?"

IN YOUR INAUGURAL ADDRESS, YOU SAID THAT THERE IS NO SUCH THING AS 100% SECURITY, AND THAT IT IS UP TO POLITICIANS TO DECIDE ACCEPTABLE LEVELS OF RISK. BUT WHAT DO POLITICIANS KNOW ABOUT THIS?

"If you formulate the problem in that way, it's difficult to solve, because it's too big. My proposal would be to chart internet dependency within each domain and establish risk levels based on this information."

WHICH DOMAINS ARE YOU THINKING OF?

"Through its 'top-sector policy', the Netherlands has defined nine top sectors[v]. They are important to the country, and they have all been made dependent on information technology. We could start there. Chart the IT risks for these sectors and use this information to develop policy and design measures. This could serve a preventative as well as a detective purpose – the latter being my own discipline. I would like for us to be much more precise in monitoring what happens on the internet. In effect, we should be doing what the NSA is doing, but with a clear, transparent objective."

SHOULD WE ARRANGE A TYPE OF TRAFFIC-CONTROL ROOM?

"Yes, actually. A cyber-security control centre should ultimately be able to function in such a way that it would have an overview of what is going on. What the NCSC (National Cyber-Security Centre) currently does is to present an annual overview of cyber-security. If I ask them, 'What is the situation in cyberspace now?', they wouldn't have any answers for me. At most, they could say something about the financial sector. In this sector companies like Fox-IT monitor all financial transactions in real time. They try to single out unusual patterns. If they have a feeling that something is not right – in most cases, they do not know exactly what is wrong; that would require domain-specific knowledge – they alert the bank and advise them to investigate. The banking world is perhaps the first to take an active approach to 'cyber situation awareness', as it is called.

DO YOU THINK THAT ANYONE WOULD SUPPORT SUCH A MONITORING PROGRAMME IN THE WAKE OF THE NSA SCANDAL?

"When I heard about it, I thought, 'The most serious consequence will be mistrust of governments regarding this subject'. We all trust the government when it is transparent. This should be just as applicable to the internet as it is to the actions of the police. We should figure out how to develop a level of transparency for the new domains. But if we aren't monitoring what is happening on the internet, we're fighting a losing battle in terms of cyber-crime. We will always be behind the times. I don't think there's any way around it. If we want to have this digital world, and we all do, we must accept the consequences. If we wish to operate safely in this world, we must be able to monitor it. This is my message: We must learn how to cope with the new fifth domain. We did this with the other domains when the first plane took to the air and the first automobiles took to the roads. We suddenly had to start driving on the right. Hey! Can't I drive wherever I like? I still remember when we had to start wearing safety belts. You should have heard all the protests! Or wearing a helmet. Now it's just second nature."

CV

Jan van den Berg (1951) studied mathematics and physics at TU Delft and was active in the national student movement. He graduated in 1977 and went to teach (mathematics, physics and IT) at schools of higher professional education. During this period he also spent two years teaching in Mozambique. In 1989, he joined the Econometric Institute at Erasmus University Rotterdam, teaching and conducting research in the areas of data analysis, complex systems, economics (and econometrics) and information security. He completed his PhD in 1996. Ten years later, he joined TU Delft, where he was appointed Professor of Cyber-Security in the Faculty of Electrical Engineering, Mathematics and Computer Science and the Faculty of Technology, Policy and Management in July 2013. On 13 December 2013, he held his inaugural address, which included a simulated hack.

i botnet - a collection of software robots (hacked computers) or bots, which operate automatically and independently.
ii DDos – distributed denial of service – an attack in which a server becomes inaccessible when many hacked computers try to contact it at the same time.
iii zero days – attacks that exploit vulnerabilities in operating systems that are not yet known and against which even the most current virus scanners thus offer no protection.
iv malware - collective term for malignant and/or harmful software
v The top sectors are as follows: Agriculture & Food; Chemicals; Creative Industries; Energy; High-tech; Logistics; Life Sciences & Health; Horticulture, and Water.

Big in nano

TEXT JOS WASSINK PHOTO SAM RENTMEESTER

The Kavli Institute of Nanoscience Delft celebrated its tenth anniversary on 10 March. In terms of money, the Kavli Foundation's annual contribution is only approximately one per cent of the budget, but the name is of inestimable value.

MUCH OF THE RESEARCH FOR QUANTUM NANOSCIENCE WILL FOCUS ON THE QUANTUM COMPUTER IN THE NEXT TEN YEARS.

Delft, 17 July 2003 In the summer of 2003, Professor Hans Mooij (quantum transport, Faculty of Applied Sciences) receives a strange e-mail. A certain 'Kavli Foundation' claims that its goal is to promote research in nanoscience, astronomy and neuroscience by sponsoring three or four institutes for each field. It also wants to know if TU Delft would be interested in establishing such an institute.

"I had never heard of Kavli," recalls Mooij. True, he had seen Norwegian cookies with that name while on vacation. But it was unlikely the foundation was connected with those.

Meanwhile, Nigerian spam is everywhere, offering fantastic sums of money in exchange for a small deposit. Mooij is therefore on his guard. A Google search reveals that Fred Kavli is an industrialist from Norway who made a fortune out of supplying sensors for aeronautic, aerospace, automotive and industrial applications. In 2000, Kavli sold his company Kavlico and subsequently dedicated himself to philanthropy. He chose three fundamental scientific fields for his philanthropic work: one concerning the very small (nanoscience), one concerning the very large (cosmology) and one concerning the highly complex (neuroscience). He assembles a management team consisting of university heavyweights to find the best research groups in the world. Eventually they come across the department of Mooij in Delft.

Santa Barbara, 12 December 2003 Mooij and Professor Cees Dekker meet with Kavli and the management of the Kavli Foundation. Kavli himself is exceptionally friendly and soft-spoken, but remains in the background. The conversation is conducted by the members of the Board - all famous names from American universities. They ask Dekker and Mooij about their research, about the support and their goals. Dekker gets the feeling that he is being screened. "It was really a job interview." Eventually, Kavli speaks. "Do you want to be the director?" he asks Mooij. Mooij answers that he does.

Delft city hall, 5 February 2004 Mysterious decision-making turns out to be typical of the Kavli Foundation. During a reception of the Kavli management board in the Delft city hall, Kavli says something that Mooij can only interpret as an admission that TU Delft has been selected. Even so, he decides to ask for confirmation. The Kavli Foundation will deposit 7.5 million dollars in five annual instalments as capital, with the institute receiving the interest. Kavli, suddenly a businessman, wants to know what the Executive Board will offer in return. The board decides to counter the offer and promises a comparable amount. The documents are signed in New York on 10 March 2004. The sister institutes of Cornell University and CalTech also sign. "The financial contribution is not what is most important," says the current director, Dekker. The contribution is only two to three hundred thousand euros a year in interest earnings – roughly one per cent of the departmental budget. "What really matters is that they designated us, together with CalTech and Cornell, as the top 3 in nanoscience, after a worldwide search. That provides us with considerable prestige. We were later joined by Harvard and Berkeley. Five leading institutes: ours and four located in the US. We are very proud of that."

Ilulissat, Greenland, 11-15 June 2007 Seventeen renowned scientists take part in the Kavli Futures Symposium on bionanotechnology. Dekker is on the list, which also includes Stephen Chu (1997 Nobel Prize laureate and former Secretary of Energy under President Obama) and Freeman Dyson (legendary physicist from Princeton). This is one of those events that could never have been organised from Delft, but which the Kavli Foundation is able to organise. Dekker organised the symposium with Paul McEuen (Cornell University) in order to bring together a group of great minds and give them the chance to think about >>

'What really matters is that they designated us, together with CalTech and Cornell, as the top 3 in nanoscience worldwide'

the distant future of nanotechnology and biology, and about the fusion of biology and nanotechnology into artificial cyborg cells. Philip Ball, editor of the journal Nature, reports on the symposium. In their final report, the researchers state that nanotechnology is now mainly being used to study living cells. However, nanotechnology might eventually play a role within cells. A literal fusion of biology and nanotechnology will occur. 'In fifty years, synthetic biology will be just as widespread as electronics is now,' the final document states. 'And just as with electronics, the impact of this development cannot be predicted. Nevertheless, the decisions we make today will have significant consequences for the future.'

Ayers Rock, Zoetermeer, 16 September 2010 Mooij hangs from a rope and descends majestically along the climbing wall. Dozens of employees of the Kavli Institute see a small orange flag sticking out of his trouser pocket. Dekker climbs up from below. Somewhere below the middle point, he encounters Mooij. Mooij takes the little flag out of his pocket and hands it to Dekker. The 68-year old emeritus has passed the baton and Dekker is now the new director of the Kavli Institute of Nanoscience Delft. Since 2010, the institute has consisted of two departments: Quantum Nanoscience and Bionanoscience. The Delft institute is the first one to receive a second grant (of five million dollars) from the Kavli Foundation, mainly due to the development of bionanoscience. The little orange flag now has a place in Dekker's bookcase.

'The best way to truly understand a living cell is by creating one'

Boston, 28 February 2012 Professor Leo Kouwenhoven has news for the congress of the American Physical Society. It has been exactly two years since he decided that Majoranas were an interesting object of study. Due to persistent rumours, the room is crowded.

PHOTOS: HANS STAKELBEEK

LEFT: PROFESSOR HANS DE MOOIJ, FORMER DIRECTOR OF KAVLI INSTITUTE
RIGHT: PROFESSOR CEES DEKKER, CURRENT DIRECTOR OF KAVLI INSTITUTE

Kouwenhoven presents the measurement results of the previous month, which show a remarkably stable peak in the conductance. "Have we seen Majorana fermions?" he asks at the conclusion of his presentation. "I'd say it's a cautious yes." Nature immediately writes 'Quest for quirky quantum particles may have struck gold', which leads to Kouwenhoven and Majoranas becoming international news. On 23 March 2012, the publication reaches Science, which immediately has the piece reviewed. On 12 April 2012, the following article is published: 'Signatures of Majorana Fermions in Hybrid Superconductor-Semiconductor Nanowire Devices.'

Delft, 6 February 2014 Ten years ago, we presented ourselves as an institute for nanoscience, because we believed that nanotechnology was not a hype, but rather the fundamental scale on which matter is arranged, from quantum interactions to the building blocks of living matter", says Dekker. Much of the research for Quantum Nanoscience will focus on the quantum computer in the next ten years. Gaining an understanding of cell molecules is essential in Bionanoscience. I even have ideas about creating a living cell or parts of one myself. When Richard Feyman died, he left a quote on his blackboard: 'What I cannot create, I do not understand.' And he was right; the best way to truly understand a living cell is by creating one." <<

Life after Delft

Alumnus Frits Brouwer has been the director of KNMI (the Royal Netherlands Meteorological Institute) for ten years. On 1 February he made a move to NDW, the National Data Warehouse for Traffic Information. When geodesy plays a role, Brouwer feels at home.

"Weather and traffic are the two most common topics during birthdays and similar gatherings. I'm lucky in that regard: until recently I focused on weather, and now I deal with information on traffic congestion. These are partly affected by the same issues. One example is the role of open data. Another is the division of tasks between the government and market players. For example, KNMI issues weather alerts, while Buienradar (rainfall radar) makes pictures for your mobile phone. It's the same at NDW: the government takes charge of the overall traffic management when disruptions occur due to collisions or snow, while companies provide advice to individual motorists.

'The joys of management kept calling'

Working at NDW is attractive for a geodesist. I chose geodesy in 1972, because I was looking for a programme with plenty of applied mathematics and physics. I was the president of the study association Snellius for one year, during which I became familiar with the professional field of geodesy in the Netherlands. I also learned quite a bit in terms of management: holding meetings, negotiating and making deals.

After completing my PhD, I combined a part-time job as an assistant professor at TU Delft with two days of GPS research per week at Kadaster (the Netherlands' Cadastre, Land Registry and Mapping Agency). Four years later, I decided to leave academia behind. The joys of management kept calling. I transferred to Geometric Services at Rijkswaterstaat, and I became head of a department that conducted research into soil movement. I later became the adjunct director for all geodesic research in that organisation.

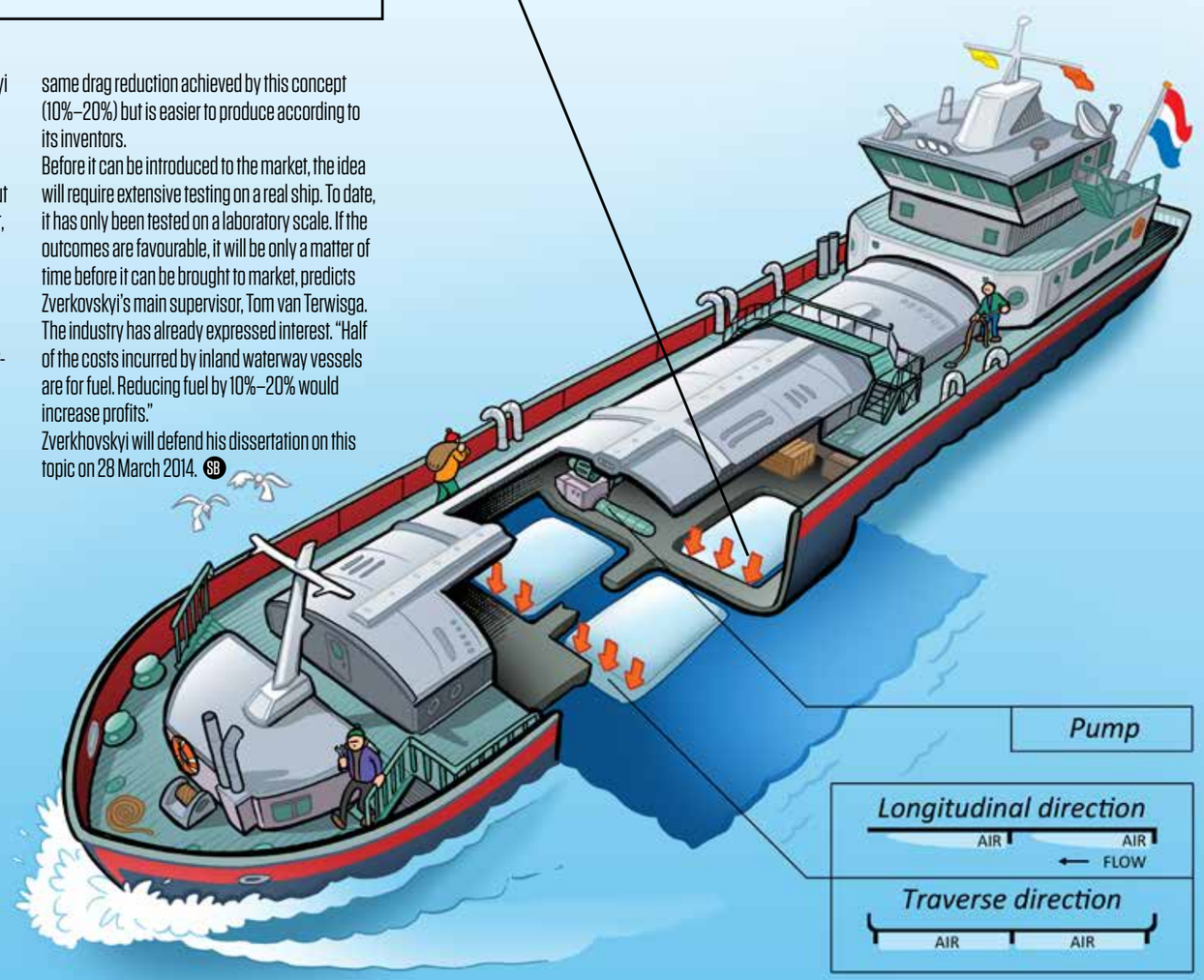
Although I left TU Delft as an employer, you can see in all my positions that I have kept in contact with the university. At the Kadaster, this contact concerned GPS, and at Rijkswaterstaat, it involved soil movement and remote sensing. I had less contact as the Water Director at Rijkswaterstaat Noord-Holland, but it intensified again when I was at KNMI. A climate centre was established at TU Delft, where KNMI employees also work part-time. A centre of expertise for Open Data has also been started at OTB. I was involved with it through KNMI and it is also relevant to what we do at NDW. Therefore, in one way or another, my training in geodesy and my relationship with TU Delft have always played a role in my career." GvU

THE PATENT

OCT-13-079: The air cavities system for vessel drag reduction

Inventors: Ir. Oleksandr Zverkovskyi
Prof. Tom van Terwisga
Prof. Jerry Westerweel

PhD candidate Oleksandr Zverkovskyi is from the Ukraine, and this has its advantages. Russian science remains largely closed to anyone who cannot speak the language, but Zverkovskyi can. This is convenient, because Russia is one of the four countries where considerable research is being conducted on air lubrication. This is a technique in which air is used in various ways to reduce the resistance between the underside of a ship and the water, thus saving fuel.
The Dutch company Damen Shipyards holds a patent for a concept based on air chambers on the underside of a ship. Zverkovskyi's idea of small thresholds on the underside achieves the same drag reduction achieved by this concept (10%–20%) but is easier to produce according to its inventors.
Before it can be introduced to the market, the idea will require extensive testing on a real ship. To date, it has only been tested on a laboratory scale. If the outcomes are favourable, it will be only a matter of time before it can be brought to market, predicts Zverkovskyi's main supervisor, Tom van Terwisga. The industry has already expressed interest. "Half of the costs incurred by inland waterway vessels are for fuel. Reducing fuel by 10%–20% would increase profits."
Zverkhovskyi will defend his dissertation on this topic on 28 March 2014. SB



Cycling zombie

My aunt takes care of elderly people with dementia. She recently told me about a new facility in her nursing home: a home trainer with a video screen. On this screen, residents can take virtual cycling tours through Dutch cities and villages.
As is often the case with technological innovations, my first reaction was a conservative reflex; wasn't this just a budget reduction in disguise? It probably just costs less to have elderly people use home trainers like a kind of cycling zombies than it would be to supervise them so that they could cycle outdoors.
The next day, I asked a colleague whose mother has dementia what he thought of the idea. "Ingenious," he replied immediately, and told me how problematic his mother's daily walk was with her carer.
"The carer simply walks too quickly. She takes my mother by the arm and says, 'Come on, Ma'am'."
A home trainer seemed preferable to that, in his view. It would allow her to cycle at one kilometre per hour without it bothering anyone.
I did not truly start to change my opinion, however, until I asked my aunt how often the residents used the home trainer. She answered, "All day long. That thing is unbelievably popular."
That evening, I was playing squash in a gym in Amsterdam. The next hall is always filled with people in their 30s, 40s and 50s on home trainers, looking at screens. They are usually playing music or watching a National Geographic documentary on sharks. As I looked at them, my admiration for the bicycle idea in the nursing home grew. Wouldn't it be much nicer to see something on the screen that has at least has some relation with cycling? Why not let people take their virtual bikes up Mont Ventoux and compare their times with those of friends and celebrities? Such elements would probably make fitness much more addictive, and members would come more often.
Speaking of addiction, I suddenly thought back to my student days, when I would sometimes come upon a television channel late at night where you could watch the view from a car driving rough the Netherlands for hours at a time.
Did anything unusual ever happen? Never. Did I keep watching? Yes. Perhaps it was the hope that something remarkable would happen after all: a collision with a man in a gorilla suit, or a half-naked woman dancing on a zebra crossing. Or perhaps it was something else that made those images so addictive; the idea of how inconceivably big the world would be if you were actually to drive the full length of every road. The notion is that there will always be a next turn, another unknown place where life goes on.
Another fifty years or so; then I'll be ready for the nursing home. If you'd like to visit me then, go to the basement and look for an old man sweating on a home trainer in front of a video screen. Don't be fooled; that man is intensely happy.

Tonie Mudde is the Head of Domestic News for de Volkskrant. He graduated from TU Delft in 2003 in the Faculty of Aerospace Engineering.

Cleanroom
Entering the cleanroom where the Photovoltaic Materials and Devices (PVMD) group does their research is a tedious process. Overalls, hoods, mouth covers, latex gloves and boots must all be donned before entering the sensitive area of manufacturing and scientific research. Amongst several cubicles stands an imposing machine, Amigo, a plasma enhanced chemical vapour depositor. PhD candidates Pavel Babal and Martijn van Sebille use it to fabricate solar cells. The cleanroom, found in the Dimes building, is the only lab in the Netherlands with the ability to make silicon-based solar cells from start to finish. "The future of solar cells is in more diverse products, such as wearable, flexible and portable solar cells," says van Sebille. "And solar energy could provide a substantial amount of energy for the world. In the future, up to one third," adds Babal. (KD)

'You should avoid snap judgements'

Last summer, the former Shell chief Jeroen van der Veer was appointed as the new chair of the Supervisory Board. Van der Veer graduated from TU Delft in 1971 with a degree in mechanical engineering. He replaced Gert-Jan Kramer, who served as chair for two terms. TEXT TOMAS VAN DIJK PHOTO SAM RENTMEESTER

How does it feel to return to your Alma Mater?
"It feels great. I am honoured to be able to give something back to this university, which I have always valued highly."

What is your vision for TU Delft? Is the university moving in the right direction?
"I'm not going to state my opinion of TU Delft in the newspaper. I prefer to work in the background. That is my role. Moreover, at Shell, I learned that you should avoid snap judgements. You need to first understand what is happening and investigate where your personal doubts are. That's the phase I am in at the moment. What I can say is that, when I was working for Shell, TU Delft graduates were thought of very highly there. And that is still the case. We shouldn't do anything to change this."

You prefer to work in the background. Should we assume that we're not going to hear much from you in the coming years?
"I won't be providing much copy."

Unless something goes wrong at TU Delft; then the minister would call you to account.
"Yes, in extreme cases, I could become the mouthpiece for the university. But you shouldn't aspire to be the university's face to the outside world."

Your predecessor, Gert-Jan Kramer, had to explain the high salaries and expense claims of several supervisors. Such discussions flare up periodically. What do you think of that?
"We must realise that we are a state university. The government is a shareholder, and they are entitled to make demands. I do think that the level of compensation has an effect on the talent that you are able to attract. One should be able to see both sides of a story."

TU Delft is focusing on emerging economies, including China, which is making major investments in research. Do you see any other developments that the university should use to its advantage?
"It is good to look at geographic changes, but there are also changes taking place right here. For example, a new manufacturing industry is emerging, due to robotisation, developments in 3-D printing and the advancing automation of machines. Producing products in small series is becoming possible again here in Europe. The built environment also offers many other opportunities for improving the way we deal with energy. In ten years, construction will look very different to today. This is also a source of opportunities for TU Delft.
Developments in medical technology are another interesting area to focus on. I am excited about the idea of collaborating with the universities of Leiden and Rotterdam."

IN PERSON

Ir. Eric Wiebes
STATE SECRETARY OF FINANCE
From 1981 until 1986, Wiebes studied mechanical engineering at TU Delft. His graduation project involved research on the integration of sustainable energy and cogeneration in the electricity network. He subsequently worked for Shell and McKinsey. He later became the deputy secretary-general of the Ministry of Economic Affairs (2007-2010) and Alderman for Traffic, Transport and Infrastructure in Amsterdam. Wiebes succeeded another member of his party (VVD), Frans Weekers, who resigned due to failings within the Tax and Customs Administration.

Dr. Aad Correljé
MEMBER OF THE MINING COUNCIL
Political scientist Aad Correljé (Economics of Infrastructures research group at TPM and researcher in the Clingendael Institute's international energy programme CIEP) has replaced Prof Margot Weijnen as a member of the Mining Council. Weijnen left the position to accept an appointment to the Scientific Council for Government Policy. The Mining Council advises the Minister of Economic Affairs with regard to mining permits for companies wishing to extract minerals, as well as on policies concern mining activities.

Dr.ir. Gabrielle Tuijthof
ASSOCIATE PROFESSOR
Tuijthof (Biomedical Engineering, 3mE) has been awarded € 200 thousand by the NWO for her research on minimally invasive technologies for orthopaedic procedures. This Aspasia grant is designed to support women researchers. Tuijthof would like to focus on technologies that use sound waves to detect cartilage damage. She will use the money to hire a female PhD candidate. She is also working with Delft Women in Science to organise a series of lectures by successful women professors in the field of medical technology.

Prof.dr.ir. Rob Fastenau
DEAN OF OPEN & ONLINE EDUCATION
EEMC dean Rob Fastenau will be collaborating with Prof. Ernst ten Heuvelhof (TPM) on an innovation programme involving the further development of open and online education at TU Delft. Within two years, they would like to realise an extensions school, in which this type of education will be offered to students from all around world. TU Delft has been active with open courseware since 2006. There are now 130 courses that have been put online completely, lectures are available through i-TunesU and the MOOCs TU Delft is offering are a succes.

Honorary Doctorates

During the 172th Dies Natalis celebration on 10 January, TU Delft awarded an honorary doctorate to the American safety expert Deborah Hersman and to the German sociologist Dirk Helbing. Hersman has been working for the National Transportation Safety Board since 2004. She has chaired this American agency, which investigates accidents, since 2009. Hersman holds an MSc degree in conflict analysis and resolution from George Mason University.

Helbing
Prof. Dirk Helbing has been a professor of sociology at ETH Zurich since 2007. He is a co-founder of the ETH Risk Center. Before this, he was the director of the Institute of Transport and Economics at Dresden University of Technology. Helbing's sociology group focuses on complex social networks. Their work includes simulating the behaviour of crowds when panic breaks out. Helbing studied physics and mathematics at the University of Göttingen. He then completed a doctorate at the University of Stuttgart, focusing on social interactions, complex systems and game theory.

PROPOSITIONS

A collectivistic culture generates less scientific innovation than an individualistic one.
Hannes Bernien, physics engineer

Nuclear power plants will not be built without governmental financial support; wind farms will.
Eeke Mast, mathematical engineer

Dutch treat is not copied in China.
Dong Juan Xiao, industrial design engineer

The end of an experiment is unfortunately defined by the deadlines.
Sai Rama Krishna Malladi, materials engineer

When science enters the media the content shrinks, while at the same time it grows in suggested importance.
Hendrik Lude Hortensius, physics engineer

Spreading news about violence leads to spreading of violent behavior.
Samur Araujo, computer science engineer

Italians are too much epicurean to be seriously concerned about their own country on a long term run.
Francesco Vitale, mathematical engineer

HORA EST

Proposition

Technology is not a means for solving problems. It replaces them with another complex problem that will need to be solved in the future.

Maruti Hegde, chemist

Defence

"Technology leads to environmental problems. And I don't see how technology can solve these problems again. Take my own research. It's about manufacturing plastics into which graphene and carbon nano-tubes have been incorporated. It's fairly basic research. Should it eventually result in stronger, lighter plastics that might lead to lighter aircraft that consume less fuel. That isn't necessarily good. It might lead to even more air travel, resulting in even more pollution. I don't know what the goal of technology is. It's confusing."

Grandparents are an invaluable source of knowledge and inspiration for sustainable designers.

Lenneke Kuijer, industrial design engineer

Making MOOCs

The first two Massive Open Online Courses (MOOCs) were completed late last year, and the sequel is undergoing intensive preparation. The pioneers look back. “To meet the deadlines, we even made recordings at midnight.”

TEXT CONNIE VAN UFFELEN PHOTOS HANS STAKELBEEK

When Professor Jules van Lier was asked in January if he would like to create a MOOC, he had no idea what that was. He did have experience with open courseware – his lectures have been online for years – but that was just a matter of ‘sending’. The demands for the MOOC ‘Introduction to Water Treatment’ were higher. “We wanted to create a professional course”, recounts Van Lier. “We wanted to do it right, or not at all.”

Van Lier and his team reduced 24 double lectures from a third-year Bachelor’s course on wastewater purification to around 40 YouTube knowledge videos of 8–10 minutes in length. This involved writing out the condensed lectures verbatim and indicating where the director should move to a PowerPoint slide, an animation clip or a close up. This took about 20 hours for each video, according to Van Lier’s estimate. A lot of time, as Arno Smets also experienced. Last year, he developed his own MOOC entitled ‘Solar Energy’. “Whereas colleagues at MIT and Harvard take 18 months to prepare, we had four months: day and night, seven days a week”, recalls Smets. “To meet the deadlines, we even made recordings at midnight.”

FORUM

The professors had to do more than simply make the lecture videos. Van Lier also prepared questions to follow each video, as well as a digital textbook containing questions and an automatic verification of the answers. Participants also had homework. To help them, Van Lier and his team made tutorial videos, in which a student assistant showed how an assignment could be tackled. Course participants were very pleased with these videos. Exam questions were needed as well, along with an online forum in which students could hold discussions with each other.

Both Van Lier and Smets underestimated such a forum. Students wanted information and asked for feedback. “The first week we received 200 messages per hour”, Smets tells us. “It was like trying to empty the ocean with a thimble.” On the first day the server was down for a while, due to the many downloads. The creators of the MOOCs received complaints about the fact that they did not answer any questions. “That would be impossible if a thousand people started chattering”, notes Van Lier. “It was our own inexperience. You just hope that another student helps out, and in fact that did happen.” That was great to see, found Smets. “If students give a wrong explanation, other students correct them. There is so much mutual interaction that the learning process is largely owned by the students themselves.” True contact with students does not occur while the MOOC is online. Smets saw his students for the first time when he asked them to make YouTube videos of their own solar-cell systems. “It was primarily students from countries outside the West who >>

Assistent professor Mark Voskuijl recording the MOOC introduction to aeronautical engineering which started on 3 March.

made the videos. It's then that you realise the impact of such a MOOC: we now have the largest collection of videos and photos of installations. They come from Iran, Africa..." Van Lier also received a treasure trove of information when he asked students in the forum to describe how water purification took place where they lived.

TOP TALENT

Teaching a MOOC is completely different from teaching a group. "Everything is pre-digested; every word has been thought through", explains Van Lier. "There's no interaction, and you're not fed with questions. But based on experience you know roughly what students will find difficult". Course materials can be explained differently using animations. "In the classroom, I can spend 1,000 words on something. That's no longer necessary", says Smets. In fact he and Van Lier are both planning to incorporate the MOOCs in their campus-based teaching. Since February, Van Lier has been presenting his MOOC to his on-campus students as a SPOC (Specific Personal Online Course). They view the MOOC online and thus have fewer lectures. Classes are now intended to discuss questions and assignments. As Smets explains, "The most important advantage is that they are spending more time on they materials than they might think, because the homework consists of following lectures." "There's more time to go deeper into the material." Apart from a way of saving time, Van Lier also sees this as an impulse for regular on-campus education.

'There's no interaction, and you're not fed with questions. But based on experience you know roughly what students will find difficult'

In addition, the MOOC is a marketing instrument for attracting and selecting high-level talent. For example, the two best participants in the solar MOOC received the opportunity to conduct a week of research in a lab at TU Delft, and the ten best participants in the water MOOC can now take the online Master's course Fundamentals of Water Treatment free of charge, in the hope that they will also take other paid courses online.

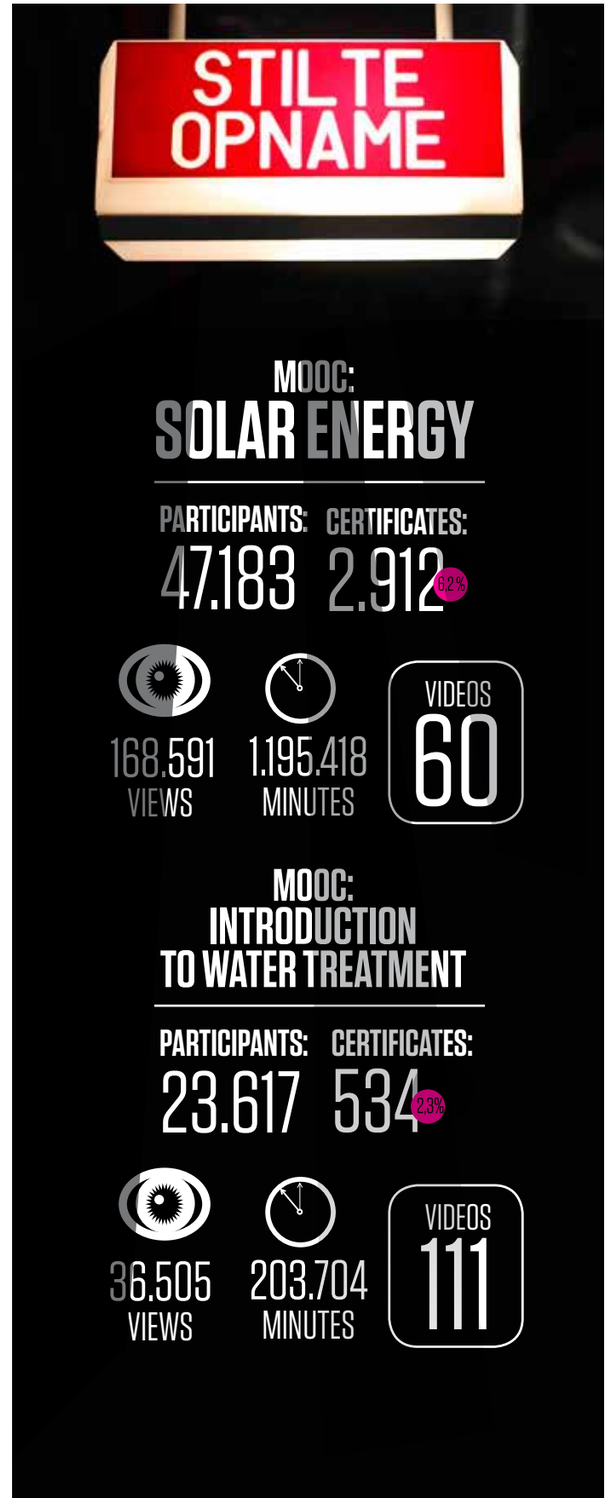
IDEALISM

Another important element in the creation of the MOOC was idealism: making knowledge accessible to everyone. In the opinion of Van Lier, "The world will progress a step further if we all have the same basic level." Smets says that he was lucky to be able to attend university. "Not everyone has the opportunity. If I can inspire just one person to go further, I will have accomplished enough."
Smets' MOOC, which cost TU Delft about € 100,000, drew 56,000 interested viewers, 21,000 of whom ultimately started the course and just under 3000 of whom earned the certificate. "If you consider that, in recent years, an average of fifty students pass the exam at TU Delft, this means that I just did sixty years of work in one go", observes Smets, grinning from ear to ear. He does not agree with critics who think that MOOCs will replace classrooms. "The objective is not to replace, but to complement. You could apply the same argument to Facebook, but that hasn't replaced our social lives, has it? It gives you added possibilities."
Minister Bussemaker would like to provide universities with more space to use online education. With supervision and good testing, MOOCs can be incorporated into regular education. There are solutions for identifying fraud on the part of participants in online education, such as tests on campus for university students who are taking an MIT course, explains Timo Kos, Director of Education and Student Affairs. Students are not yet able to earn any credits with MOOCs, however.
One year after their pioneering work at TU Delft, Van Lier and Smets look back with satisfaction. Whether the MOOC phenomenon is a hype or a revolution in education, Smets does not know. "During the closing reception, Executive Board President Dirk Jan van den Berg said that it should be seen as a voyage of discovery: we are doing new things. When we look back fifteen years from now, it might be nothing, but it could also be the first step in a huge educational revolution." <<

PROFESSOR JULES VAN LIER AND HIS TEAM REDUCED 24 DOUBLE LECTURES FROM A THIRD-YEAR BACHELOR'S COURSE ON WASTEWATER PURIFICATION TO AROUND 40 YOUTUBE KNOWLEDGE VIDEOS OF 8–10 MINUTES IN LENGTH.

New MOOCs

In April, TU Delft will start two new MOOCs: 'An Introduction to Credit Risk Management' by Dr. Pasquale Cirillo and 'Next Generation Infrastructures' by Prof. Margot Weijnen. More information: www.edx.org/school/delftx.



Alumni Chapters:
TU Delft meets more and more of it's alumni

TU Delft has an increasingly international role in the academic world. One third of the Master's students come from somewhere other than the Netherlands, and TU alumni can be found everywhere. Last year, TU Delft strengthened contacts with its alumni by organising international TU Delft Alumni Chapters. A number of volunteers have taken it upon themselves to organise an activity for alumni at least twice a year in the relevant city or country. In 2013, we met alumni at fifteen different locations throughout the world. And in 2014 events have also taken place. In Mexico there was a first-ever alumni meeting, organised by a student ambassador. Twenty-five alumni from both Mexico City and far beyond met. One alumnus even travelled 1,000 km! In late January, an alumni networking reception took place in Boston, and the TU Delft Alumni Chapter in London organised a very well-attended New Year's reception. Do you live abroad and want to start a TU Delft Alumni Chapter? Please contact the Alumni Office.

'Talent, Technique and TUDelft' are the research priorities of the Delft University Fund. With subsidies, grants and awards, the fund motivates and supports Talent at our university with students, societies, lecturers, PhD graduates, alumni and many others. Would you like to support this too? Then become a 'Friend of TU Delft' at universiteitsfonds.tudelft.nl

Ab Streppel wins UfD-Cofely Energy Efficiency Award

His research on storing wind energy in ammonia has earned Ab Streppel the UfD-Cofely Energy Efficiency Award. Streppel will receive the €7,500 prize for the great importance to society of his graduation project and his convincing presentation. Venkatesh Chandrasekar and Nick Verwaal also won awards, each of them receiving €2,500.
The UfD-Cofely Energy Efficiency Award is awarded annually to students who have made a tangible contribution to energy saving, sustainability or CO2 reductions.
Steppel also conducted research into storing surplus electric energy in ammonia. Due to fluctuating energy production from wind energy, surpluses may arise, causing this energy to get lost. Streppel studies a cell in which this energy can be converted into ammonia. Besides the possibility of producing fertiliser, the ammonia can also be converted back into energy. The great advantage of this material is that in can be stored and transported everywhere. With the results so far, the cell can attain an efficiency of 80 per cent, according to Streppel.
Venkatesh Chandrasekar conducted research into inkless printing, while Nick Verwaal's research was on developing a model-based control model for wind turbines using LIDAR to accurately predict wind velocity.

Alumni Activities:

26 March
Coach Café 'Experienced alumnus helps starter'

28 March
Alumni Day 'Practical Studies'

31 March
UfD: 'Damen Bachelor Awards'

2 April
UfD: Registration ends for Marina van Damme Grant

3 April
AVTN: Kavli Colloquium 'A Nanoscientist's Journey to Biology'

9 April
Hannover Messe: networking over drinks at Holland Hightech House

16 April
Topical meeting 'Data Science for Environmental Monitoring: Water Management Case'

16 April
UfD: 'EBN Geo Energy Master Award'

23, 24, 25 May
ZOMERfestival Delft

15 May
Alumni lecture, theme: Light

15 May
UfD-IHC Merwede Teamwork Award

4 June
Comfort in Transit Symposium, www.io.tudelft.nl/comfortintransit

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

ALUMNIPORTAL
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.

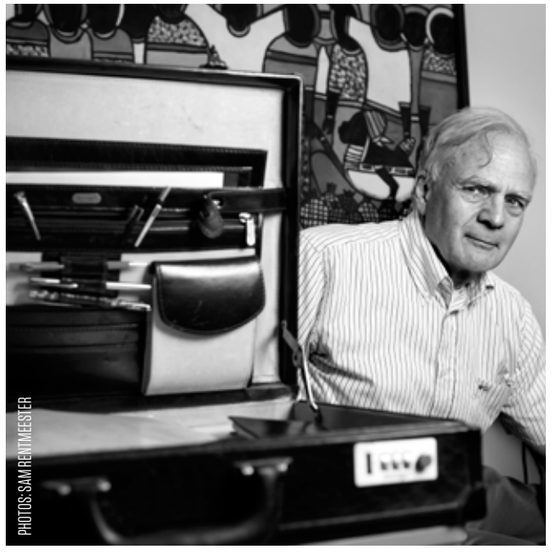
FRIENDS OF UFD FUND:
Become a 'Friend of TU Delft' and support Talent, Technique and TU Delft with your contribution. Bank account IBAN number NL19FVLB0226850471, account name 'stichting UfD', description 'friends'. universiteitsfonds.tudelft.nl

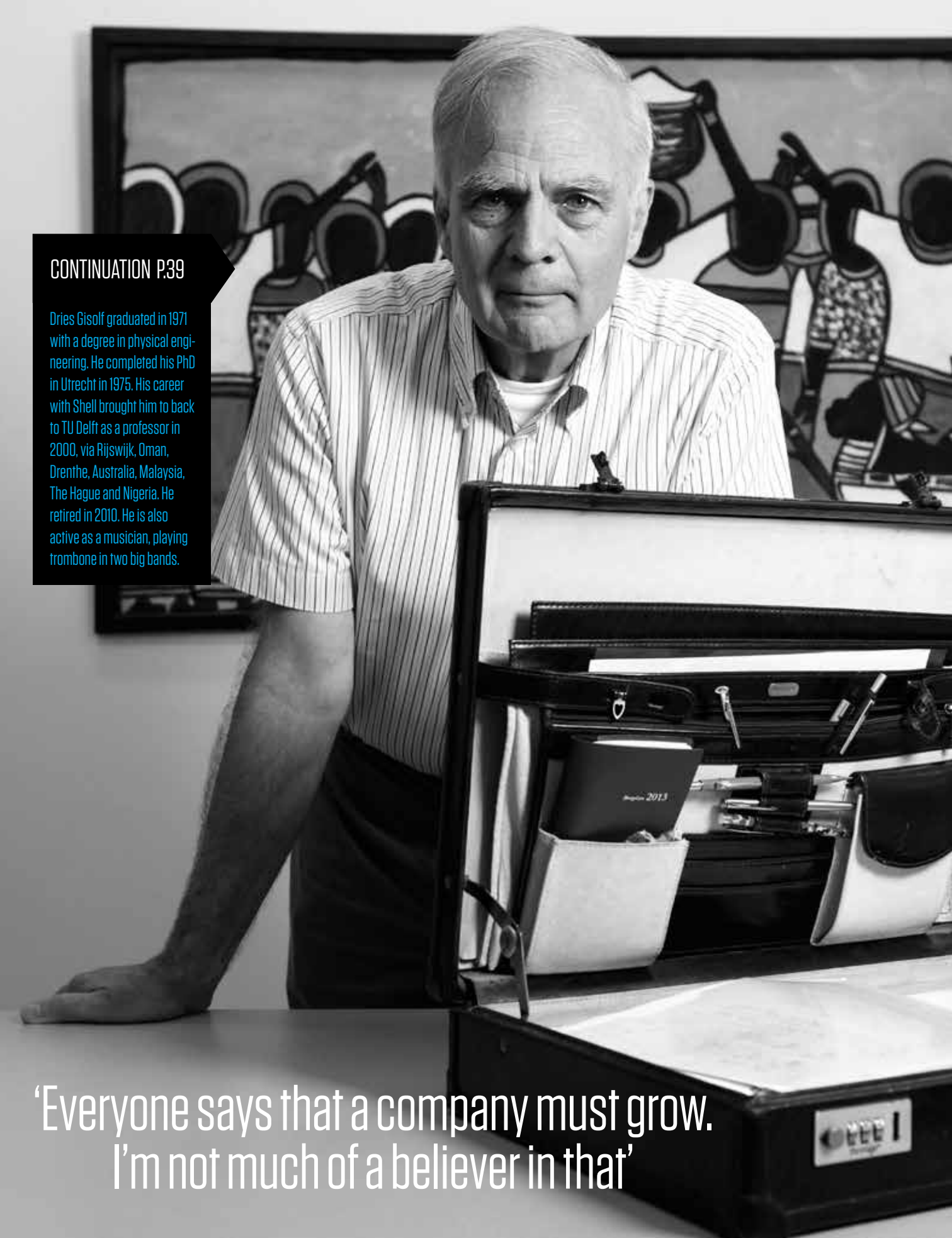
OAPS

Dries Gisolf

Like other employees, professors retire when they turn 65. But there are exceptions. This week: Expert in acoustical imaging, Prof. Dries Gisolf (68).

The room in the Applied Sciences Building appears remarkably bright and orderly. A colourful painting hangs on the wall above an empty table. No, Prof. Gisolf does not spend much time here. He spends most of his time at YesDelft, where his start-up company Delft Inversion is located. Today, he spent the entire day there as well, apart from a visit to the garage and two hours in the dentist's chair. He cannot make an estimate of the number of hours. Five days, evenings and weekends – how many is that? "What is work, and what a hobby? For me, there's no difference. I simply do what fascinates me".
Despite the fact that Gisolf is in his golden years, (he began his studies at the Delft Institute of Technology in 1963), the Professor Emeritus seems more like a young entrepreneur. Until the age of 55, Gisolf worked for Shell and travelled all over the world. He enjoyed working on practical matters, all the while remaining a scientist, sitting at a table with a physics book on Sunday afternoons. He gradually developed the notion that the seismology used in industry had reached its limits. The interpretation of reflections of sound waves from the subsoil depends upon the physical soil model that is used. "They were simple models including a few geological layers and interfaces. these hadn't changed in 30 years". When he was 55 and working in Nigeria, he applied for the position of Professor of Acoustical Imaging at TU Delft. This job offered him the opportunity to elaborate his ideas for improved modelling and, conversely, improved imaging. "The model has now been expanded with multiple reflections. This has made it more widely applicable, and we are now able to use the entire signal, where we previously used 10% and treated the remaining 90% as noise. That was the breakthrough". After his retirement in 2010, Gisolf worked with two former PhD students (Dr Peter Haffinger and Dr Panos Doulgeris) to build the company Delft Inversion, which offers the improved form of seismological analysis as a service to oil and gas companies. Before that time, Gisolf had been the leader of the acoustical imaging group. That involved signing paperwork, serving as head of personnel, thinking strategically and being an active presence in the faculty. "I am happy to have been able to set that aside", remarks Gisolf. "I immediately dived back into technology with both arms". Gisolf's ambitions are very practical. He does not care much about publications. His motivation is to come up with things and then carry them out. Although of course the aim is for the start-up to thrive, Gisolf is not yet sure how large the company should become. "Everyone says that a company must grow. I'm not much of a believer in that. When you grow, the tasks change. Instead of developing new ideas and talking with clients, you're back to managing – and I was so happy to be finished with that". The finish line is not yet in sight, "as long as things are going well and as long as I remain healthy". He does not have a real life motto. One thing he does impress upon his students that they should develop a real skill that will always get them work. JW


PHOTOS: SAM REIJTMEESTER



CONTINUATION P.39

Dries Gisolf graduated in 1971 with a degree in physical engineering. He completed his PhD in Utrecht in 1975. His career with Shell brought him to back to TU Delft as a professor in 2000, via Rijswijk, Oman, Drenthe, Australia, Malaysia, The Hague and Nigeria. He retired in 2010. He is also active as a musician, playing trombone in two big bands.

‘Everyone says that a company must grow. I’m not much of a believer in that’