

# UNIVERSITY OF TWENTE.

**50 YEARS UT**

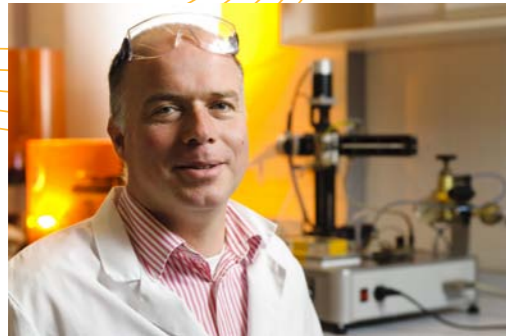


**THE WEAKEST LINK**  
dependent on fallible systems

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self-organizing tissue from a matrix printer

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**INTERNATIONAL MEETING PLACE**

On 25 November 2011, the University of Twente will celebrate its 50<sup>th</sup> anniversary in the presence of Queen Beatrix of the Netherlands.

Our *Dies Natalis* is not only an occasion for celebration but is also a good moment for us to look ahead. The University of Twente is in a process of continuous development. Our organizational structure in research is being refocused and aligned along institutional strengths of our profile, in areas like nanotechnology, biomedical technology, ICT, sustainable energy and governance.

The UT is currently developing a new educational model comprised of a limited number of Bachelor courses, which are initially broad in scope but which gradually taper to defined specializations. One of the challenges here is to enable all students to gain experience abroad through an exchange programme, a final (thesis) project, an international minor or an overseas study trip.

We are also expanding our provision of courses with the establishment of a University College programme that will afford highly talented students to acquire the competences to address major issues inherent in a high-tech society.

Strategic networks are essential to the university for making our mark internationally and are also a prerequisite for attracting both European funding for education and talented students from abroad. Expanding international partnerships, such as with the European Consortium of Innovative Universities (ECIU) and the University of Münster, will

strengthen the 'High Tech, Human Touch' profile of the UT. Furthermore, we are in the process of setting up joint degree programmes with strategic (research) partners from around the world, such as the Bandung Institute of Technology in Indonesia as well as several Chinese institutions of higher education. Our alumni living outside of the Netherlands also have a key role in realizing the international ambitions of the UT. In the coming years the university plans to cultivate its relationship with this important group via both local meetings and activities and through online services.

In order to increase the appeal of the UT to prospective international graduate students, joint educational programmes are being created together with UT partner institutions in the following target countries: Indonesia, India, Poland, Greece, Mexico, China, Turkey, Brazil and Russia. Besides this we also have an expanding Graduate School that should likewise appeal to and attract global talent.

As you can see, we are actively addressing a future in which the University of Twente continues to maintain and expand its role as a meeting place for talented people from around the world. You will be able to read more about these developments in this magazine.

I hope you enjoy reading this magazine and please feel free to contact me directly if you have any comments or suggestions (a.h.flierman@utwente.nl).

"WE SEE A KEY ROLE FOR OUR ALUMNI FROM ABROAD IN THE REALIZATION OF THE UT'S INTERNATIONAL AMBITIONS"



**DR A.H. FLIERMAN** HAS BEEN PRESIDENT OF THE EXECUTIVE BOARD OF THE UNIVERSITY OF TWENTE SINCE 2005.



# BRAILLE FOR CELLS

Professor Clemens A. van Blitterswijk (1957) studied cell biology at Leiden University and holds the chair of Tissue Regeneration at the University of Twente.

Van Blitterswijk has received the George Winter Award of the European Society for Biomaterials. He has co-founded various biomedical companies including IsoTis and Materiomics BV.

On Friday 25 November 2011, Clemens van Blitterswijk will deliver the UT's Dies (foundation day) speech on the possibilities of regenerative medicine.



Regenerative medicine and tissue engineering conjure up visions of artificially grown organs, renewing damaged joints and regrowing lost limbs. The photo of 'the mouse with the ear' which circled the globe in the summer of 1997 aroused horror but certainly appealed to the imagination. Nearly 15 years later the hype is over because cultivating stem cells to produce the desired tissues is still surrounded by problematic issues. Nevertheless, important progress has been made. By combining biology and technology, regenerative medicine has quietly entered a new phase and more and more applications are reaching the clinic. BY Maarten Evenblij PHOTOGRAPHY Kees Bennema ILLUSTRATIONS Tobias Schalken

## MORE AND MORE APPLICATIONS FOR REGENERATIVE MEDICINE REACHING THE CLINIC

Clemens van Blitterswijk is the expert in bone. During the 80s, he started studying the formation of bone under the influence of ceramic materials and stem cells in Leiden. This was the era when stem cells were pointing the way to the promised land; cells in a still pristine state which, with a little manipulation, could form any kind of tissue. Very quickly, researchers were able to create a vast variety of cells: heart cells and blood vessel cells, bone and cartilage cells, intestine and skin cells and liver, kidney and pancreas cells. But it was difficult to get the cells to function properly in the body and producing tissue composed of a number of different cell types proved extremely difficult.

### Hybrid

It soon became clear that cells cannot easily be implanted in isolation. They need a carrier which can provide them with a temporary structure where they can feel comfortable. A carrier which can also contain all kinds of biologically active substances such as adhesives and growth factors and which can be broken down in the body whilst the implanted cells form ever stronger tissue. The University of Twente

is good in biomaterials and so it became a natural partner for the biologists. "We are a hybrid department," says Van Blitterswijk, who now leads the UT's Department of Tissue Regeneration. "We understand process technology, molecular cell biology and also embryology. For a number of years now, we no longer base our designs on the certainties and diagrams of the technical engineer but rather on the complexity and uncertainties of biological systems. This has led to surprising insights and results."

### Surface structures

During the last ten years, it has become clear that the structure of an implanted material extensively influences the behaviour of cells. Tests carried out with goats and mice indicated that calcium phosphate with specific micropores led to bone recovery as effectively as ceramic to which stem cells and factors stimulating bone growth had been added. Van Blitterswijk: "This observation stimulated us to look at the influence of surface structures. With the help of nanotechnologists, we have developed chips full of small compartments, each with their own surface struc-

ture. These allow us to determine very quickly how cells are functioning in the different compartments."

### 158 million topographies

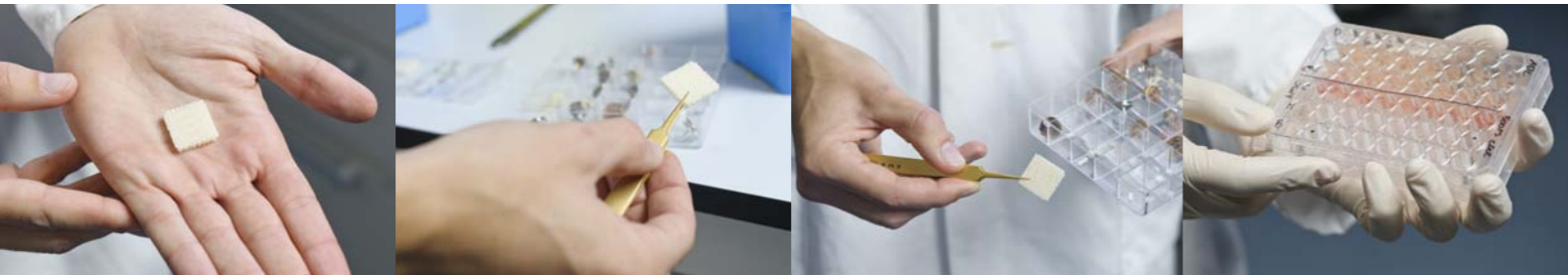
Using three basic shapes - a circle, triangle and rectangle - an almost unlimited number of combinations can be made so that little compartments with divergent surfaces are continually created. This can be done with various materials which are frequently used for implants

"The function of the cells follows the form and not just the other way around as we long thought"

such as polylactide, calcium phosphate and titanium. In this way, the researchers are able to make and test 158 million different 'topographies'. Cells placed in these shape matrices or TopoChips react differently even when they are of the same kind. Some stem cells may for instance develop into bone cells, others may be more likely to form blood vessel cells and still others may remain intact as stem cells or refuse to multiply.



“Innovations are often technology-driven, rather than arising from a demand from patients or doctors”



Professor Maarten J. IJzerman (1969) studied Biomedical Health Science at the University of Nijmegen and holds the chair of Health Technology & Services Research at the University of Twente. IJzerman is co-founder of PANAXEA, a spin-off company of the UT which is aimed at collaboration with healthcare institutions and large pharmaceutical and/or medical technology companies.

**Building blocks**

“The cells ‘read’ the surface as it were and react to it,” continues Van Blitterswijk. “We call it ‘braille for cells’. We have discovered clusters of structures which prompt cells in a particular direction and we can now predict fairly accurately how a cell will behave under the influence of a particular structure.” The structures can be superimposed with a specialized printer and are suitable for application on every implant. The principle has been taken to an even higher level and been applied in larger units and in three-dimensional space. By using different structural entities as a kind of building block, the researchers have succeeded in integrating different cell types with each other (for example, bone cells and blood vessel cells) on a few cubic millimetres. In this way, differentiation in the tissue is created just as it is in the body. Also, by forcing

cell groups into a certain form, such as a cube, a sphere or tetrahedron, they can be forced to differentiate into a particular cell type. Van Blitterswijk: “We have shown that the function of cells follows the form and not just the other way around as we had long thought. This is only possible if you have high-quality biological as well as technical knowledge and a facility such as the nanolab at your disposal.”

**Bioactive materials**

“Ten years ago, we thought we would easily be able to make every kind of tissue,” confesses Van Blitterswijk. “Now we know that it is quite a bit more complicated and we know that there are a number of things which we do not know. This has led to the emergence of other research which is focused less on technology and more on the needs of the clinic.” A demand for pro-

**TECHNICAL MEDICINE**

According to Heleen Miedema MSc, director of education for Technical Medicine and Biomedical Technology, developments such as those in regenerative medicine will change the need for both research and healthcare professionals. “There is much more technology in the medical world than merely the equipment used. In regenerative medicine, the professional is required to have both an understanding of technology and of individual patients.” To educate such professionals, accumulating disciplines such as medicine and technology, is not sufficient, warns Miedema. “Nowadays, you do not need to know anything about cars in order to be able to drive one because the car has been fully developed. A hundred years

ago, driving a car did require a lot of technical knowledge and mechanics. And that is also how it is now with the new medical technology. Much can go wrong and one must at least know what can go wrong. Professionals adhere to the mindsets and practices from their last study; so do doctors and technologists. Medical technologists approach questions from doctors in their entirety. The doctor wants to portray a tumour in the brain better for instance or be able to transplant Islets of Langerhans more efficiently. The medical technologist supports the doctors by developing new, specially adapted solutions and supervising their application in practice.”



ducts is starting to emerge from the clinics. Bone and cartilage regeneration are already being applied and patients are being treated with cultured skin. Laboratory-grown bladders and windpipes have been implanted in several patients. There is an ongoing trend to create organs as well as tissues. “That is much more complex and it is more difficult to predict the result,” claims Van Blitterswijk. He expects that the use of bioactive materials which can prompt the tissue in the body to repair itself is going to become more and more important. “Cell therapy with stem cells for instance will stay limited to the more difficult cases, such as cardiac muscle tissue following a heart attack. There is a need for technologies which can be applied immediately during an operation and which do not have to wait several days or a month until the right cells have been cultivated.”

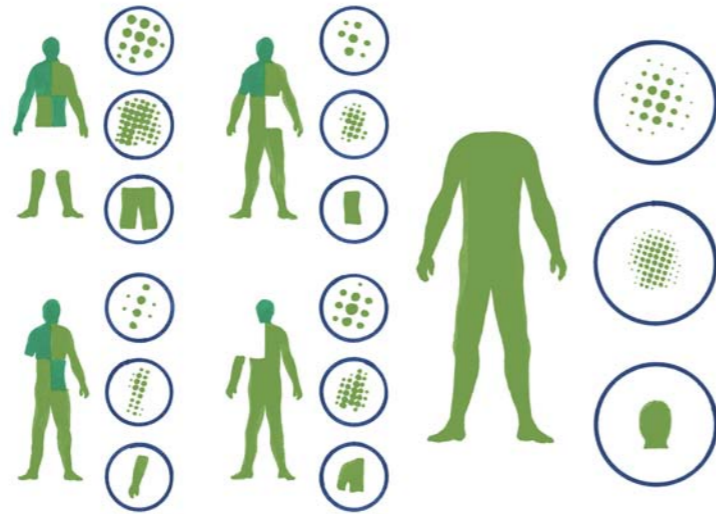
**Business case**

From the School of Management and Governance, specifically the Department of Health Technical and Services Research, Maarten IJzerman is following the developments

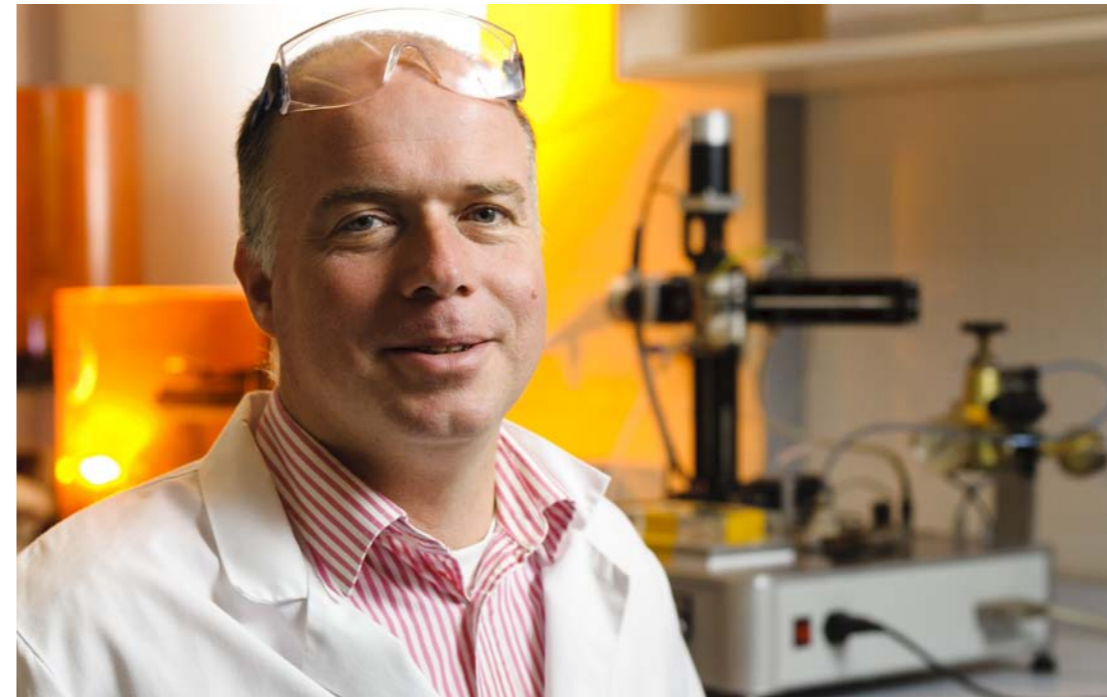
in regenerative medicine with interest and he is investigating certain aspects. “Regenerative medicine certainly has potential,” he claims. “It is however important to ask yourself what you are going to concentrate on. Which tissues do you want to change and what advantage does your approach have compared with other methods? These kinds of innovations tend to be technology-driven rather than arising from a demand from patients or doctors.” IJzerman is involved in research into various social aspects of technologies in regenerative medicine. “If you can show that early detection and cartilage repair in a large group of patients with knee cartilage defects can postpone an operation by ten years, that work productivity will be increased and that patients will have less pain and a better quality of life, then that is not only interesting from a technological point of view but also from a social point of view,” feels IJzerman. “We try to establish very early on in developments what opportunities exist. If you do not succeed in presenting a good business case for a new technology, then no company is going to take it on.”

**Run aground**

“Other criteria apply for research into a better transplantation of the Islets of Langerhans in patients with type 1 diabetes than for the regeneration of knee cartilage for example,” realizes IJzerman. “In that instance, it is not about a lot of relatively healthy patients, but about just a few very sick patients. It is a high-end solution as a last remedy. Does such a technology have a place in the whole range of treatment options?” IJzerman knows of many very appealing technological innovations which eventually came to nothing because they were not applied in the clinic or were not used by patients. “A laboratory-grown bladder seems very interesting, but for which kinds of patients? Are they people who are in a very poor state anyway? And what then is their prognosis? We have also had visions of nerve regeneration, of brain recovery after a CVA (stroke) or of an 18-channel neurostimulator in the spinal cord. Many products have run aground in development not only because the clinical reality turned out to be more complex, but also because patients did not want to use them.”



Emanating from behind a plexiglass protection screen is the grating stuttering sound of an old-fashioned matrix printer. The sound is coming from a laboratory installation suspended from clips with small tubes coming out of glass jars and converging in a small metal block. If you look closely, you can see a little needle sticking out of the bottom which is applying material, layer by layer, onto a surface of a few square centimetres. BY Maarten Evenblij PHOTOGRAPHY Kees Bennema ILLUSTRATIONS Tobias Schalken



Dr Marcel Karperien (1967) works in the Tissue Regeneration research group of the MIRA Institute at the UT. His research focus includes new treatment methods for type 1 diabetes. Karperien has received various awards, including the ECTS Career Establishment Award for young researchers.

# BREEDER FOR SELF-ORGANIZING TISSUE

"This 3D-plotter prints biomaterial like an inkjet printer. This is how we make various three-dimensional structures in which we can grow cells," explains Marcel Karperien.

"Regenerative medicine is going to be made up of cell-free materials which relay instructions to the tissue in which they are implanted"

As a developmental biologist, he works at the cutting edge of technology and biology in the Department of Tissue Regeneration of MIRA. Karperien and his team are researching tissue engineering of joint cartilage and of the Islets of Langerhans which produce insulin

in the pancreas. What is involved here is a technology for cultivating cells. In order to be able to grow both structures well, the researchers have made specific tiny microwells (small cavities) in which individual Islets or microaggregates of cartilage can be made and grown. Cartilage itself regenerates too poorly to be able to repair a defect of a few square centimetres. Growing cartilage in microwells enhances the regenerative ability.

### Carrier Material

"We are currently studying techniques for keeping these cell aggregates in place in the cartilage of a damaged knee for instance," continues Karperien. "We developed a kind of two-component adhesive for this which resembles the matrix material of cartilage. The adhesive is biosoluble and gradually disappears while new cartilage is formed." With the regeneration of

cartilage it is difficult to get the correct structure which is necessary in a joint for example. Often a kind of connective tissue results instead of the pressure-resistant 'hyaline' cartilage. By implanting cells in our material, we believe we are creating the right conditions for the formation of hyaline cartilage."

### Implanting Islets

Tissue engineering of the Islets of Langerhans can reduce the number of donors needed to help diabetes patients. In patients met type 1 diabetes the insulin-producing cells in the pancreas have broken down, deregulating their glucose metabolism. A number of these patients can be helped by transplanting the Islets of Langerhans from donors. The cells are injected into the hepatic portal vein so that they can lodge themselves in the liver. "Unfortunately, 80 percent of the Langerhans cells do not survive the

transplantation. For sufficient insulin regulation, Islets from the pancreas of three to four donors are required. Implanting the Islets in another part of the body, for example in the peritoneum, could be the solution," remarks Karperien. "That could be in small cavities, such as microwells. Because a few hundred thousand Islets are required for just one person, you then need to make a compact, stacked structure; for instance with the two-component adhesive. Within that, factors to stimulate the ingrowth of small blood vessels are also necessary so that there is sufficient blood flow. That is what we are busy working on now."

### Instructing tissue

Moving on, Karperien reveals a laboratory full of bioreactors, incubators and clean benches where cells are pipetted from plastic jars containing pink-coloured culture

medium onto small dishes. Behind a glass pane is the hypoxia chamber where cells are grown under low oxygen tension in order to mimic the situation in oxygen-starved tissues. Sensors measure how they get on. "In the last 20 years, wonderful biomaterials have been developed and used. They are selected on inertia so that they will not be rejected by the body. The disadvantage of these materials is that they indeed do not do anything," remarks Karperien. "Now we modify these materials so that they will instruct cells and tissue to repair themselves. So they are in fact eliciting a reaction. This can be via the surface structure, as with the TopoChips, but also by attaching bioactive substances such as growth factors. I think that a large portion of regenerative medicine is going to be made up of cell-free materials which relay instructions to the tissue in which they are implanted."

### Giant leap

Body, tissue and cells exhibit the right self-organization in the right environment, according to Karperien. "Take a look for instance at the cultured bladder. In fact, that is a donor bladder which has been stripped of all life, of all cells. If you then seed the remaining matrix with smooth muscle cells and epithelial cells, the tissue automatically organizes itself. All kinds of signals for the organization of the bladder are concealed within that matrix. Scientists are now trying out the same approach with lungs, liver and kidney. Over the last years, tissue engineering has clearly reached maturity in a multidisciplinary approach combining molecular biology, embryology, biomaterials and nanotechnology. I expect that regenerative medicine is going to take a giant leap forward and that within 10 to 15 years, products will be being used in patients."

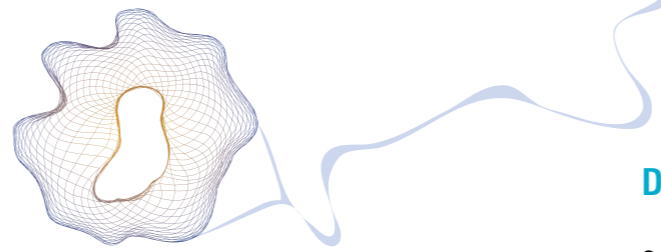


## CRIMINAL CITIES ON THE INTERNET

The Russian city Chelyabinsk is the most crime-ridden city on the internet, with Kuala Lumpur and Buenos Aires occupying second and third place. This has appeared from research by scientists at the UT and the spin-off company Quarantainenet, who examined from which city the majority of internet attacks took place. Chelyabinsk tops the list with 120 internet attacks per million inhabitants. Usually, investigations into internet crime only look at the countries from which the majority of internet attacks are launched, but according to the UT researchers, this fails to reveal the actual problem areas. The more accurately you can pinpoint where internet criminals are operating from, the greater the chance of preventing internet crime, is their idea.

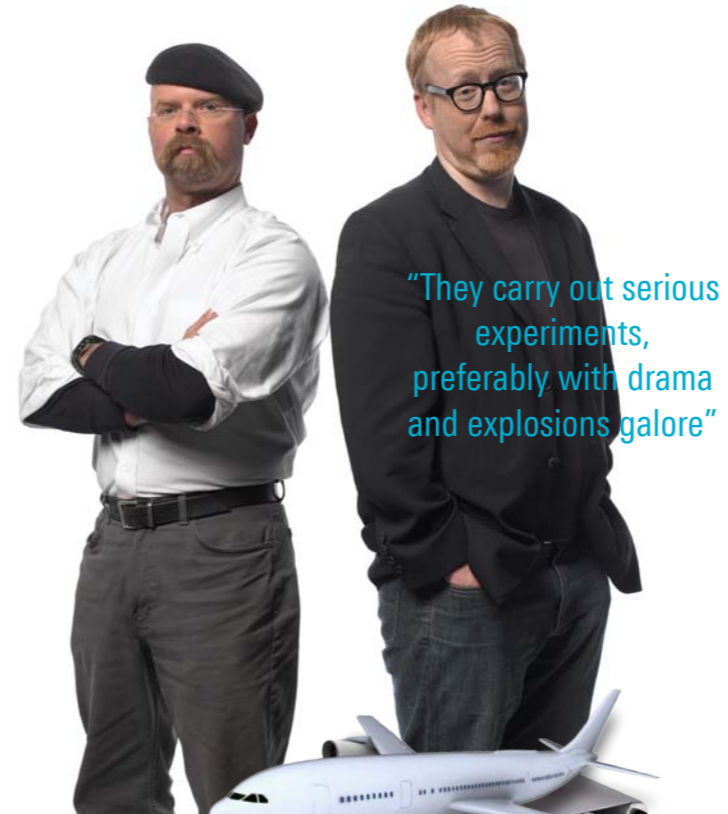


The UT has launched over **750** successful spin-off companies since it was founded



## DOCTORES HONORIS CAUSA

On its 50th anniversary, the University of Twente confers four honorary doctorates. BY Wiebe van der Veen



"They carry out serious experiments, preferably with drama and explosions galore"

"An inspiring captain of industry at the cutting edge of science and business"

## HENRI TERMEER



For almost thirty years Henri Termeer was CEO of Genzyme Corporation in the USA, one of the world's most successful enterprises in biotechnology. Dutch by birth, he managed to turn a modest start-up company into one with an annual turnover of more than four billion dollars. Honorary supervisor and Professor of Tissue Regeneration, Clemens van Blitterswijk, is full of admiration for Termeer's pioneering work in drugs and therapies for rare diseases, the so-called orphan drugs.

"Our 'High tech, human touch' can profit from her analytical skills"

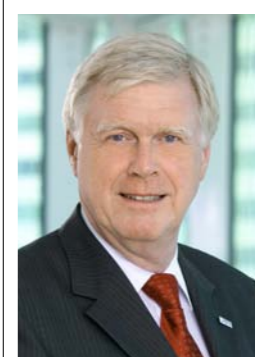
## HELGA NOWOTNY



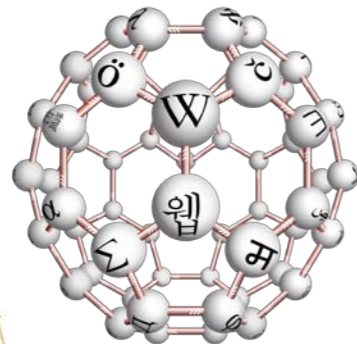
President of the European Research Council, the organization that stimulates and finances top research in Europe. Helga Nowotny has published widely on the social, ethical and political aspects of science and technology. According to honorary supervisor and Professor of Science, Technology and Society, Stefan Kuhlman, her 'Mode-2 society' concept is in close keeping with the profile of the University of Twente.

"One of the leading and truly multidisciplinary physicists of our time"

## WOLFGANG KNOLL



As scientific director of the Austrian Institute of Technology (AIT), Wolfgang Knoll is in charge of more than 1,100 researchers. He made his mark in bio-nanotechnology and materials science, and has more than 850 publications to his name. According to honorary supervisor and Professor of Materials Science and Technology of Polymers, Julius Vancso, Knoll has collaborated closely with groups within the UT's MESA+ and MIRA institutes for over a decade.



## BLIND FAITH IN WIKIPEDIA

For many, Wikipedia is an important source of information. However, research by Teun Lucassen of the UT reveals that people usually only look fleetingly at the content and supinely believe what is written. In his experiment, Lucassen imported considerable and crucial mistakes into various Wikipedia articles and then let participants, of whom approximately half were expert in the

subject, read them. As expected, the mistakes did not compromise the non-experts' faith in the content of the text, whereas the confidence of the experts was swayed, albeit only slightly. With manipulated articles, in which half of the statements were incorrect, 65 per cent of the experts still trusted the accuracy of the article, compared with just over 80 per cent with the original text.



## TOPOCHIP

The surface structure of a medical implant influences the reaction of body cells. It determines whether they will attach themselves, grow, or – in the case of stem cells – develop into the desired type of cell. To date, it was difficult and quite time consuming to test which surface structure was the most suitable for a specific medical implant. That is why researchers at the UT have developed a chip with which the influence of various structures can be tested easily and on a large scale. With this TopoChip, which took six years to create, it is now possible to study the effect of 2178 different surface structures simultaneously, instead of only a few at a time. This means the surface with the desired effect on the cells can now be detected much, much faster. To make the technology available to the market, the spin-off company Materiomics BV was founded, which does not actually sell the TopoChip but explores which surface structures are suitable for its clients' specific application.

Number of registered student-run companies: **91**

Number of commercial jobs on Kennispark Twente: **5905**



# SEE, DO & EXPERIENCE

BY Joost Bruysters PHOTOGRAPHY Rikkert Harink



To mark its 50th anniversary this year, the University of Twente is organizing a wide range of celebratory activities. One of the highlights was the Open Day on 17 September which drew more than 10,000 visitors to the UT Campus to see and experience but particularly to participate in what was on offer. Fourteen domes had been placed on campus, each allowing members of the public to acquaint themselves with various scientific disciplines, from robotics to nanotechnology and from gaming to driving on solar power. Visitors could also carry out experiments, visit laboratories or attend one of the many lectures.







# A MATTER OF HABIT

"Sadly, security is often viewed as a cost item"

Surfing the web without having your credit card number stolen; trusting that hackers won't break into the systems of a nuclear power plant: people tend to place their trust in technology for their sense of security. In reality, security is an interplay between technology and man, the latter often being the weakest link. BY Christian Jongeneel PHOTOGRAPHY Kees Bennema ILLUSTRATION Rhonald Blommestijn

## MODERN MAN INCREASINGLY DEPENDENT ON FALLIBLE SYSTEMS

Last March, as citizens in the Netherlands were getting ready to submit their tax return, the government ran an intensive campaign to remind people always to keep their DigiD, their 'passport' for digital contact with officialdom, to themselves. If they wanted to let someone else fill in their online forms, a separate authorization code could be requested. One wonders how many people took the trouble. After all, if you trust someone with your finances, surely you can trust them to manage your contact with the tax authorities, too?

This is a simple example of a system that is technically sound and secure, but in practice invites unsafe behaviour. "That's why, when designing ICT systems, it's so important to have someone from the behavioural sciences watching over," says Peter Apers, scientific director of the Centre for Telematics and Information Technology at the University of Twente. "The human factor is always the weakest link."

### Losing votes

This is not just down to people's carelessness with passwords, but because they generally have great difficulty weighing up ICT's pros and cons. "You see that with the

public transport smart card, for example," says Apers. "First it appears that you can't get good technical security for a couple of cents per chip, but then people seem to think that smart cards are more susceptible to fraud than ticket strips. That is nonsense, of course. The same applies to voting machines. No sooner were these traded back in for red pencils than eighty votes went missing in an election in Almere. That would never have happened with a machine, yet such incidents fail to sway perceptions."

### Stumbling block

This is also confirmed by Alexander van Deursen's PhD research into Dutch people's internet skills. From his annual trend survey of computer and internet usage, it would appear that people don't worry too much about their online security. "That's despite a relatively large number of people having painful experiences. At the same time, they find it difficult to take simple measures such as installing a spam filter, carrying out automatic software updates and having a firewall to keep out hackers." A good password policy seems equally hard to achieve, even at the highest level. In March, journalists hacked into the voice-

mail boxes of several ministers who had neglected to change their default password. It should be the case that every user of a newly acquired device or software immediately changes their password. "There is still a lot to improve on this front." For Van Deursen, a large-scale information campaign would be a good first step.

### Below the max

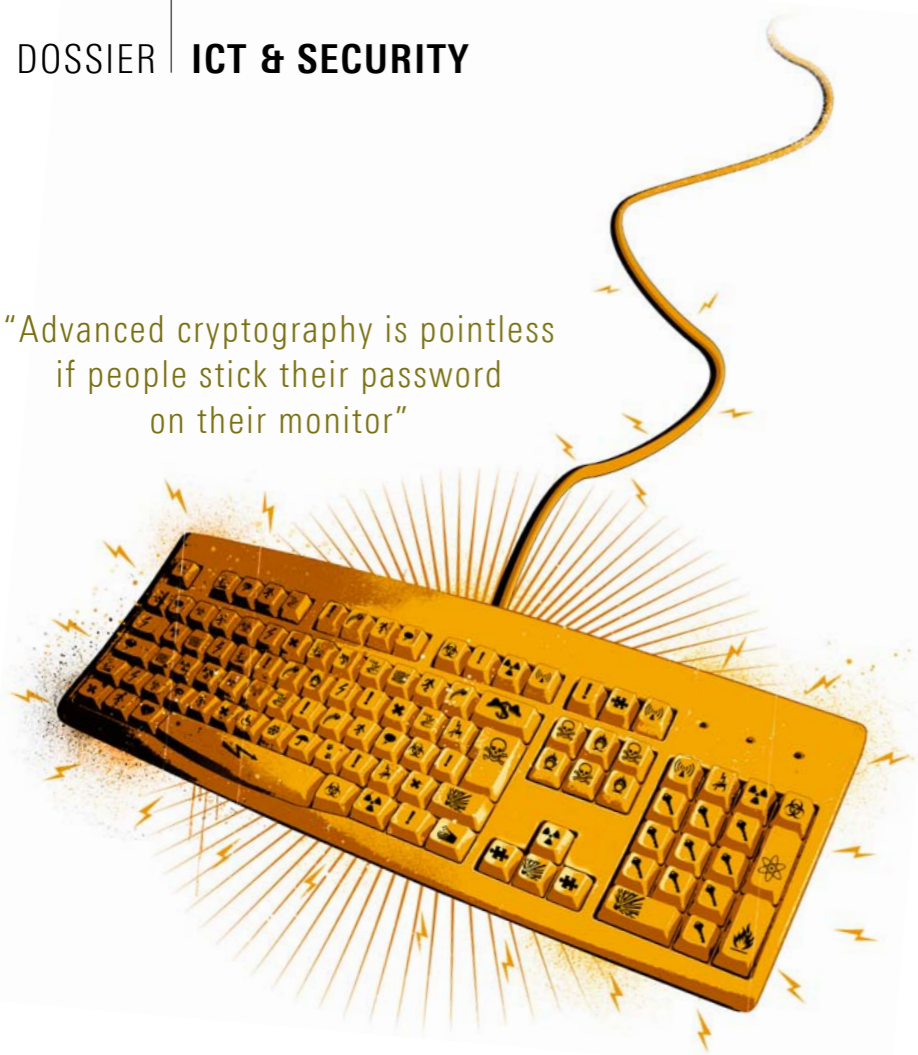
But even aware citizens are powerless when the technology fails. Security always starts with a well-designed system. "Sadly, it's often

"Security does not always need to be maximum level"

viewed as a cost item," cites Apers. "People start designing a system and only later consider: of course it must be secure. So security is attached to the system, instead of being an integral part of it. Soon this will no longer be acceptable." While security needs to be given a central role in the design of systems, it does not always need to be maximum level, Apers stresses: "If your PC crashes, that's annoying."



“Advanced cryptography is pointless if people stick their password on their monitor”



**CRYPTOGRAPHIC FEAT**

In all ICT security, cryptography is reserved a central role; the encryption of information so that only those authorized can get to it via a password and/or token (an access pass, for example). Svetla Nikova is helping with the development of AES, the security standard for ‘top secret’ information devised in Leuven and since adopted by the American government. To date, no one has succeeded in cracking the maths underlying this cryptographic feat, however that does not mean each of its applications is safe. “You can measure a chip’s energy consumption during encryption and decryption,” says Nikova. “That consumption says something about what the chip is doing. In this way information about the key can leak out of the chip. We have developed a method to prevent this form of information leakage, by cutting up the working of the key into pieces. An attacker can still find information about the pieces, but can’t place them in the greater whole.”

If Netherlands Railways has a glitch and passengers are stranded, that’s really annoying. But if a nuclear reactor derails, it can be deadly. The degree of security required for these systems will vary, and the costs involved are proportionate.”

“Clearly define beforehand when information will be destroyed”

**Trade-off**

“Developments in cryptography are way ahead of what is applied in practice,” asserts Svetla Nikova, who tackles the subject at the University of Twente and the Katholieke Universiteit Leuven (see frame). “However, there is always a trade-off between the degree of security

and efficiency.” Put simply: a good cryptographic safeguard demands a lot of computing power and sometimes several additional procedures. Not everyone wants to have to perform all those procedures every time. So the crux of the problem lies not in the technical capability to safeguard systems, but in this human consideration. And even then advanced cryptography is pointless if people subsequently choose too simple a password – or post-it to their monitor.

**Ambient living**

Nikova is currently involved in the ALwEN project (Ambient Living with Embedded Networks). Its goal is to free up care workers by providing an environment for the elderly and others in need of care that can support them electronically as far

as possible. One way is to equip people with sensors – to automatically warn them when their blood pressure is too high, for example. Environmental sensors can help, too, for example by signalling if someone doesn’t get out of bed in the morning. Medical technology can take over many of the routine tasks of nursing staff. “We are working with a hospital and several companies to try out this concept.”

**Integrated approach**

ALwEN is a fine example of a system where protection of information is integrated into the design. “But then in a way that’s as transparent as possible for the user, who doesn’t need to know the technical workings,” according to Nikova. After all, when it comes to their health, people are prepared to provide a lot

“Are these still systems or rather organisms, with an unpredictable behaviour of their own?”

Peter Apers is Professor of Databases at the University of Twente. He has served several terms as dean of the Faculty of Computer Science and was a member of the UT’s Executive Board, responsible for research. Since 2002, he has been scientific director of the University’s Centre for Telematics and Information Technology (CTIT), the largest academic ICT research institute in the Netherlands.



of information, but they don’t want it falling into the wrong hands.

**Investigating authorities**

Also Peter Apers emphasizes that security will play a key role in the acceptance of future systems. The fact that users themselves are the weakest link does not lessen the responsibility of designers to design good systems that will prevent people from compromising security out of idleness or ignorance. “For that reason you see the rules constantly being tightened. Oddly enough, the biggest problem is actually with the government, which itself seeks to store ever more data for longer. The rationale is that it can be useful for investigating agencies. But the more information you save, the greater the chance that something leaks.

**Information shredding**

Apers argues, therefore, for continually evaluating the usefulness and necessity of stored information. Certainly for sensor networks such as ALwEN that record people’s doings in intimate detail, one has to clearly define when information will be destroyed. “Often enough it’s not necessary to make information about individuals accessible, it’s the bigger picture that matters. You could shred all the individual information from ALwEN at the end of the day, but keep the averages. Such global information can be guarded less strictly.”

**Hot**

Security of ICT applications will remain a hot topic in the near future, predicts Apers: “Demands put on systems are growing, and so is their

complexity. You can almost wonder whether these are still systems or becoming organisms with their own, unpredictable behaviour. The current systems are already so complicated that we can actually only test parts of them. Whether the system works as a whole can only be proved in practice.”

**Habit**

People will therefore have to learn to live with the thought that the electronic systems on which they increasingly depend are fallible. The controversies surrounding public transport smart cards and voting machines betray the human discomfort here. Yet the eagerness of younger generations in particular to entrust their entire existence to Facebook, suggests it’s a matter of habit.





# CYBER-SKIRMISHES

“Over the past millennia, people have waged war using every conceivable means,” says Aiko Pras, researcher in Design and Analysis of Communication Systems at the University of Twente. “It’s only since the atom bomb that we have become more hesitant about deploying every means available. Thanks to the internet, we now have the tools to thwart each other at a whole new level. There are most definitely countries that are investing here. The Netherlands is naive on this score.” BY Christian Jongeneel ILLUSTRATION Rhonald Blommestijn

Pras cites the example of the Stuxnet virus, responsible for crippling a number of nuclear installations in Iran last year. Experts’ analysis showed it to be a highly sophisticated piece of software, which disrupted specific hardware in such a way as to avoid immediate detection while causing the installation to break down. It was widely assumed that the Israeli government (possibly with American help) was the author of the virus.

Pras: “Israel has in the past bombed a nuclear installation in Syria. Had

they done that in Iran, the political and military fallout would have been huge. With the virus they achieved the same result, knocking back the Iranian nuclear programme two years. Only now everyone thinks: those Iranians have been suckered. Cyberwar has serious consequences – but people’s perception of it is different.”

### Botnets

Governments visibly engaging with cyberwarfare is a recent trend. A decade ago, hackers were still

mainly hobbyists, who saw hacking into systems as a technical challenge. Five years ago, organized crime began to get involved, operating out of Russia and Nigeria in particular. Criminals set up so-called ‘botnets’, networks of PCs whose owners are unaware they are being put to misuse. Botnets misuse PCs to harvest information like credit card numbers, spread spam and to carry out DDoS attacks – paralysing a system by bombarding it with information requests.

### DDoS

Pras conducted detailed research into DDoS attacks that took place on the websites of credit card companies, when these refused to provide financial services to whistleblower website WikiLeaks. A group calling itself Anonymous spread a small programme that enabled anyone to start hacking. “That was new, too,” according to Pras. “No hobbyists, criminals or secret agents, but the public at large were deployed as soldiers in a cyberwar. If that becomes a trend, the impact will keep growing.”

From a technical point of view, the Anonymous software was primitive. But now the potential for hacking by the general public has been demonstrated, it’s a matter of waiting for a programme that really is state of the art.

### Backstreets

Pras’ research group focuses particularly on flows of information – looking not at the content of information packets sent over the internet, but at timing and addresses. When a DDoS attack is launched, one can see which computers made the first onslaught. Going back in time, one might be able to

link those computers with, for example, a chat channel. By ascertaining who was connected with that channel, the organizational structure of the perpetrators can be laid bare.

In this way, Pras and his cohort are attempting to map the internet’s backstreets. It is well-known that many trails lead to Russia and China, but specific measures can only be taken if one can identify the rotten apples amongst the providers. Some of these are quite candid, incidentally. A Chinese provider recently admitted openly to accommodating several hundreds of criminal hackers on his systems. That was not a problem, he found, as they paid well and the government did nothing..

### More serious

Until recently, Pras was inclined to dismiss the relative importance of DDoS attacks. A view he has now reconsidered. Websites being struck down causes hindrance but is surmountable. But now that more and more infrastructure is being plugged into the internet in one way or another, the potential consequences are more serious. A DDoS attack on the electricity or water grid could really paralyse society.

“Added to this we have a growing collection of boxes at home that we no longer recognize as being computers, such as the network router and VOIP box that makes telephony via internet possible,” says Pras. “Suppose someone successfully manages to hack a provider’s VOIP box. Within a day he could then get control of all those boxes. The only way the supplier could regain control of his connections would be to go round and visit every user. A supplier would quite likely never recover from such a hit.”

“Cyberwarfare has serious consequences – but the perception of it is different”

### Jaunty

Moreover, what guarantee is there that the boxes don’t contain back doors? A box of Chinese manufacture was recently found that activated the microphone when a certain code was sent, effectively turning the telephone into a listening device. It may have been a programming error, but Pras doubts it. “It’s a wonderfully interesting field,” he observes jauntyly.

“A DDoS attack on the electricity or water grid could really paralyse society”



Dr Aiko PRAS is associate professor at the Faculty of Electrical Engineering, Mathematics and Computer Science of the University of Twente, where he leads the research into Dynamic Systems and Processes (DACS).





The blockbuster Alice in Wonderland used Xsens technology. The Knave of Hearts character has extra long legs in the film, which is why the actor is on stilts. His movements are registered with lifelike precision thanks to the Xsens suit under his green outfit. All green elements are later filled in with 3D animation.



Casper Peeters (l) and Per Slycke, whose Motion Capture System has unleashed a revolution in the entertainment sector.

Xsens has meanwhile been split into separate divisions: Entertainment, Industrial, Movement Science and Training & Simulation. The most important advantage of this split is that each division can specialize in its market and fields of application for Xsens products.

# ENTREPRENEURS IN WONDERLAND

Their story reads like a Boys' Own adventure: two young graduates from the University of Twente start a company and conquer Hollywood. The tale is far from over, because Casper Peeters and Per Slycke are looking beyond Alice in Wonderland and Iron Man 2. Their technology is now becoming available for human movement scientists, the automobile industry and the world of computer games. BY Marco Krijnsen PHOTOGRAPHY Jan Schartman, Walt Disney Studios Home Entertainment, et al.

A second office, Xsens North America Inc, has been up and running in Los Angeles for just a year. It's a stone's throw from Hollywood, where many big clients are located.

*"We deliberately concentrated on the games and film industry first"*

The Enschede company is booming, despite getting off to a shaky start. The founders of Xsens focused initially on a speedometer for runners

based on movement sensors, but the product never made it to market. "It wasn't viable. We discovered how hard it is for a fledgling company to gain a foothold in the consumer market. You are dealing with low margins and high risks. So we decided to aim at companies, where you work with lower volumes and higher margins," says CEO Casper Peeters. That decision has certainly paid off. Xsens has grown explosively, appearing in recent years in the Deloitte & Touche Fast 50, which ranks the fastest-growing technology companies.

## Revolution

Xsens' core business is the Inertial Measurement Unit. This matchbox-sized device measures and records human movements. Motion tracking, in industry jargon. In the past five years, the technology developed by the company has unleashed a revolution in the entertainment sector. "We deliberately concentrated on the games and film industry first, because we thought that was where our know-how was needed. We took our Motion Capture System along to trade fairs in California," recounts Peeters.

It was an opportune move. Game makers and animators – by and large American – are especially keen to transfer the nuances of human movement faithfully to their product. After all, characters need to come across as lifelike. This used to be done with cameras and small reflective balls attached to the actor's body. "That's a complicated and time-consuming technique," remarks Peeters. "You always need three cameras to keep track of the position of the ball."

## 50,000 Euros

Xsens did things differently. It developed a special suit, Xsens MVN, with seventeen movement sensors that wirelessly transmit each movement to the computer in 3D. The Lycra suit, costing 50,000 euros, looks something like a surfer's outfit. It is an ideal piece of kit for makers of computer games and animations.

Guerilla Games, part of Sony Computer Entertainment, and Gearbox Software were the first to switch to the new technology for the making of Killzone 2 and Borderlands respectively. Peeters summarizes the advantages. "In the old days, you had to spend a week with an entire team in a London studio recording everything with cameras. The results only came in later, which often meant having to do new takes. Now the animation specialist has our system tucked into a case under his desk. Any time they want, they can do a take with the suit in their own backyard in the middle of Amsterdam. It's not only much cheaper, but it also gives the designers a lot more freedom. No cameras are involved any longer."

## Capturing movement

The Enschede company is already looking further ahead. The Motion

Capture System is being used not only in the game industry but also in advertising and feature films, with Alice in Wonderland and Iron Man 2 as foremost examples. The Xsens suit was used for the Knave of Hearts character in Alice in Wonderland. The natural movements of the actor in the suit were captured by Xsens' MVN Studio software.

*"A reliable simulation program is essential for car designers"*

The suits are in demand: new Hollywood productions are under way. The Los Angeles office, now eight strong, is having to open the door to new customers. Xsens is adding new wireless technology (RF) that enables determining the positions of several people sharing the same space even more





accurately. "It makes capturing interaction a lot more reliable," says Peeters. "Whenever the position of a person within the space is also important – for example because of interaction with another person, the environment or a camera – then this technology handles it. For games and films that's a tremendous leap forward."

**Rehabilitation and automotive industry**

The technology can also be of tremendous value beyond the entertainment industry. Movement scientists and rehabilitation doctors have a keen interest in easily deployable and accurate measuring equipment for recording patients' movements. With the arrival of the Motion Capture System they can leave the cameras at home. It can help them determine when surgical intervention is required or which muscles should be injected to relieve a patient's spasticity. Xsens is researching this application with the University of Twente and Roesingh Research & Development (the independent R&D organization linked to the Roessingh rehabilitation centre in Enschede). Also the automotive industry has approached them. Designers of new models want to know how future users will experience their design in practice. With a sensor suit, one can already discover at

drawing board stage whether the entry height is too low or whether the driver will knock his knees against the dashboard. Peeters: "Mercedes is a good client of ours. A reliable simulation program is essential for car designers. That also applies to virtual reality labs, which affords firemen or soldiers, for example, to practice real-time drills. The Motion Capture System is now being used for that, too."

**Divisions**

XSens has meanwhile been split into separate divisions: Entertainment, Industrial, Movement Science and Training & Simulation. The most important advantage of this split is that each division can specialize in its market and fields of application for Xsens products. This approach is beginning to bear fruit, as witnessed by the long list of renowned clients becoming equipped with Xsens products. There has been collaboration with such Hollywood productions as PAUL, X-Men: First Class and THOR, while in the industrial sector SAGEM and Cargotec are new partners. In the Human Motion segments, much collaboration takes place with prestigious universities and researchers worldwide. A recent project with the Rothschild Fund, for example, caught the motion of a horse in 3D imagery for the first time, using 3D inertial motion capture.



"By splitting into separate divisions, Xsens can specialize in markets and fields of application"



VENTURELAB TWENTE GATEWAY TO INTERNATIONAL NETWORKS IN BUSINESS, SCIENCE AND FINANCE

**SMART SUPPORT FOR SMART TEXTILES**

The development of a new type of self-cleaning textile by his company Agrawal Ecolabs is just one of Pramod Agrawal's projects. He is also involved in high-tech fibre and textile consultancy, works as a lecturer at Enschede's Saxion University of Applied Sciences, and holds a Temporary Entrepreneur Position at the University of Twente. And all is part and parcel of his drive for innovation. Helping him to transform Agrawal Ecolabs into a successful product-based company is VentureLab Twente. BY Hans van Eerden / Hans Morsinkhof PHOTOGRAPHY Gijs Versteeg

After obtaining his Bachelor's degree in pharmacy in India, Pramod Agrawal switched to a Master's course in biotechnology, with a main interest in textiles. Whilst conducting his PhD research at the UT, he had already applied for two patents for cotton processing "I can see opportunities here," he explains, "with the sector in Europe changing from labour- to knowledge-intensive." Agrawal is developing innovations for a sunblinds manufacturer, as well as contributing to the development of new high technology. "I want to move from high tech consultancy to concrete products based on 'smart' textiles and improved, sustainable processes for the textile industry."

**Training & coaching**

This is the reason why Agrawal, descendant of the Indian entrepreneurial dynasty, approached VentureLab Twente (VLT), a programme by UT-based NIKOS, the Dutch Institute for Knowledge Intensive Entrepreneurship. "VLT combines networks and experience with supporting business development of the UT and Saxion," explains Aard Groen, scientific director of NIKOS and Professor of Innovative Entrepreneurship at the UT. "VLT offers ambitious entrepreneurs training, coaching and expert support in the areas of strategy, technology, finance, organization, marketing and sales, in addition to personal and team skills. Our services also include laboratory facilities and access to national and international networks in business, science and finance."

**Progress**

"VentureLab Twente has helped me, and is still helping me, to transform my service-based consultancy firm into a product-based company," Pramod Agrawal evaluates. "They not only offered the best lectures, but also actual tools for monitoring my progress in product development. Both the VLT expert panel and my VLT business coach taught me many things, including that you have to envisage your future customer before actually starting to develop your product. You need a coach to learn from and share things with, and who teaches you to think from different angles. Only then do you make progress."



EUROPEAN FUNDING FOR RESEARCH IS THE WAY FORWARD

Between 2010 and 2013, the European Union research budget will double whilst the Dutch government will make drastic cutbacks. So it makes sense to turn more towards Europe for research funding. With this task in mind, the University of Twente appointed Rolf Vermeij as liaison officer. He maintains contact between Twente and Brussels and helps young UT researchers to write proposals. This year, the UT received no fewer than four ERC Starting Independent Researcher Grants and two Marie Curie Career Integration Grants. Other universities are intrigued by Vermeij's approach.

BY Hans van Eerden PHOTOGRAPHY Agnes Booiijk



MARIE CURIE: QUANTUM BITS AND MINIATURIZED OPTICAL AMPLIFIERS

This year, two researchers from outside received a Marie Curie Career Integration Grant (100,000 Euros) to work for two years at the UT:

- Sonia García Blanco studied Telecommunication and Engineering in Madrid, got her PhD in Glasgow, worked as a postdoc in Toronto and then for six years as a researcher in Québec. In the UT Integrated Optical Microsystems Group, she is working on further miniaturizing optical light signal amplifiers on a chip.
- Floris Zwanenburg studied Applied Physics in Delft and obtained his doctorate there in 2008. He was subsequently a postdoc at the University of New South Wales in Australia. In the UT Nano-Electronics Group, he is engaged in the realization of quantum bits, the building blocks for the quantum computer.

# TALENTED FUNDRAISER FOR RESEARCH TALENT

Successful scientific research inevitably leads to writing good proposals in order to obtain funding. With the researchers faced with the bureaucracy and 'high politics' of Brussels, a good reason for the UT to appoint Rolf Vermeij as liaison of-

**Seventh Framework Programme**

The EU Research Policy is incorporated in the Seventh Framework Programme and comprises four blocks: Cooperation (the large international projects), Capacities (a 'catchall' for research infrastructure and the like), Ideas and People. The UT participates in more than a hundred projects under Cooperation. The senior researchers of Twente have meanwhile become very adept at writing extensive, complex research proposals and Vermeij makes use of his Brussels contacts to draw their attention to calls for large projects even before they are officially published. But for the time being, he is investing most of his energy in the two last blocks for individual research funding.

**Radiating excellence**

Vermeij feels that his greatest added value lies in supporting individual, mostly young researchers who are inexperienced in submitting requests to Brussels. They can draw from Ideas (grants from the European Research Council, ERC) and People (the Marie Curie Programme). Vermeij emphasizes that attracting talent is as important as money.

"Research is an international market. The fact that you attract ERC grants as a university displays clearly to researchers that you have a certain excellence. And it fits in with striving for a European Research Area (ERA) with unrestricted access for researchers."

**Training**

Together with the UT Career Development Centre, Vermeij has developed a training course for writing good ERC proposals. The first round started in 2009 and resulted last year in ten requests, three of which were honoured; that is a splendid score by European standards. This year, as many as four ERC Starting Independent Researcher Grants were awarded to UT researchers. "With our ERC score, we stand out far above the average in Europe. I have already been invited by universities in Denmark and other countries to explain our approach."

**Tenure track**

A number of recipients of an ERC Starting Grant hold a so-called

tenure track position at the UT and Vermeij regards this as a success factor. Since 2008, the UT has employed this procedure which enables talented people to rapidly build a career in science based on performance agreements for a period of five years. "When the UT commits itself for this kind of period and expresses confidence in young researchers in this way, it makes a good impression on talent-driven instruments such as the European Research Council."

**Marie Curie**

Talking about career advancement, Vermeij experienced a great deal of satisfaction this year with awards of the Marie Curie Career Integration Grants. He supported two young researchers from outside in their

successful bid for a grant which they wanted to use at the UT (see inset). But Vermeij also helps UT researchers with a Marie Curie Grant who wish to go and work elsewhere for one or two years; someone who wants to go to MIT for instance.

"The fact that we attract ERC grants displays that we have a certain excellence"

"You don't know whether they will return, but we still stimulate this because international experience can contribute to their scientific career. Also they can spread the word that the UT is a great place to work and that it also offers first-class guidance, for instance in applying for grants like these."

"I participate in European networks to ensure that the UT is prepared for long-term policy"

ficer. Formerly a researcher at the MESA+ Institute of Nanotechnology in Twente, he already knows his way around Brussels. "I follow what is happening in the EU and participate in European networks to ensure that the UT is prepared for long-term policy. In addition, I support researchers with their proposals."



# SPORTS SHOE ON WHEELS



At the Dutch sports car manufacturer Donkervoort, UT alumnus Jordi Wiersma (MSc Industrial Design) designed a prototype with a roof: the D8 GT. BY Rianne Wanders PHOTOGRAPHY Maarten Noordijk

## 1 LIGHT AND EASY

"The classic Donkervoort is an open sports car. It has to feel like a sports shoe that just slips on: as lightly and as easily as possible. It's all about how it feels. It is not the adjustments to the car that allow you to comfortably negotiate a bend, but your skill behind the wheel. The essence of driving a Donkervoort is the experience."

## 2 DESIGNING THE PROTOTYPE

"For my final thesis project I had to design a synthetic roof for the first covered version that would allow one to continue driving in bad weather. It soon became apparent just how contrived such a roof looked. This led to our brainstorming ideas for a whole new car. Within a year the prototype of the covered D8 GT was a fact."

## 3 CLOSE-FITTING DOORS

"The doors were the trickiest with the new design. As this is where many components meet, it meant there was little margin for error. Everything had to fit in such a way that the crack round the door was exactly the same on all sides."

## 4 ONLY TWENTY KILOS

"With the new car only able to weigh twenty kilos at the most more than the standard Donkervoort, we profited from new materials. Instead of aluminium we now use a lot of PREPREG carbon. With all the latest know-how of light and durable materials, Joop Donkervoort and I have been able to set up a new company within Donkervoort: Design and Engineering."



# COMPOSING WITH LIGHT

She wants to create artificial molecules that can be 'manipulated' with light.

Jennifer Herek, Professor of Optical Sciences, likes to draw the comparison with music: composing with ultrafast laser pulses. BY Wiebe van der Veen PHOTOGRAPHY Marieke van der Velden

"The infrastructure I encountered at the UT is quite unique. As is the quality of the people: the most important factor"

## JENNIFER HEREK WANTS TO CREATE MOLECULES THAT WILL PRODUCE SOMETHING ELSE

Behind each blackout curtain is an impressive 'optical table' full of lenses and mirrors. Laser beams seek their path. In Jennifer Herek's lab, playing with light is a serious business. That much is clear. The American-born scientist is pleased with the infrastructure: "When I started here five years ago, I encountered a top-ranking group that for two decades had been working on the development of optical techniques and with which they had really made a name for themselves. Delving to molecular level with microscopy, for example. It was my job to steer the group in a new direction, and in doing so I wanted to deploy their expertise."

### Strong in optics

"When I was asked to take up this position, I had only been working in Amsterdam for a few years," Herek continues. "I did wonder whether it might be too soon. But we have meanwhile found our new direction: moving from the development of techniques more towards the fundamental concept. The group has since been renamed Optical Sciences. At Twente we are really strong in optics, with five optical research groups in the MESA+ Institute, one focusing more on applications, the other more fundamental. They enhance one another."

### Interaction and colour

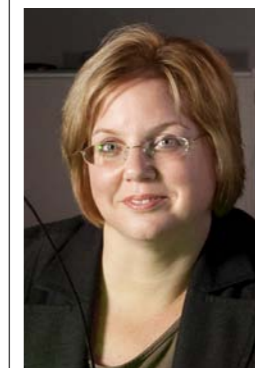
Herek is particularly interested in the interaction between light and matter. "You can study molecules with laser light. But we don't just observe. You can also produce an effect in the molecule, a chemical reaction, for example, with ultrashort laser pulses lasting only about ten femtoseconds [a billionth of a second, ed.]. An extremely narrow pulse that in another respect, the spectrum, happens to be quite wide. One can vary endlessly with the wavelengths of light: with the colours. Like sitting at the piano and composing. Now it's down to mastering the 'melody' of that pulse waveform that will have an effect on the molecule. That's not just trial and error; a computer calculates the correct pulse and is becoming increasingly proficient at it, learning from each interaction."

### Building molecules

To make things even more exciting, Herek wants to build artificial molecules: structures at the nanometre scale that imitate the behaviour of molecules. Building blocks of these artificial molecules are, for example, gold nanoparticles, which have a mobile electrical charge and thus serve as a model for the charged particles in the molecule. In this way the researchers can control a molecule's behaviour with laser light.

And they will be building the molecule itself, too.

For this ambitious plan, Jennifer Herek was awarded a VICI grant in 2010, VICI being the highest subsidy category in the VENI, VIDI, VICI series of the Netherlands Organisation for Scientific Research (NWO) and offered to individual senior top scientists. At one and a half million Euros, it will be sufficient to give a new research line body. "When I heard this great news, it really went 'bang'! This gives me the opportunity to set up something really new and recruit good staff."



Professor Jennifer Herek (1968) holds the chair of Optical Techniques and Biomolecular Systems at the Faculty of Science and Technology. Herek graduated cum laude in chemistry and obtained a doctorate at the California Institute of Technology. With the VICI grant awarded to her by NWO in 2010, Herek is setting up a new research line that combines her expertise in molecular laser spectroscopy with the nano-technological infrastructure of the research institute MESA+ of the University of Twente.

### Solar cells

But artificial molecules? "Indeed, at first glance it seems strange to start constructing molecules, and when you look at our nanostructures, you might not immediately think of molecules, despite a comparable interaction occurring as in 'natural' molecules. We are really interested to see whether we can also develop new types of interaction, because then we will be creating molecules that will produce something novel. In the first place we are considering photovoltaic applications: is it possible to build molecules that effectively convert sunlight into electricity? And what about applications in the field of medicine? But all that's still a long way off. First we are going to build them, then 'manipulate' them with light."

### Culture

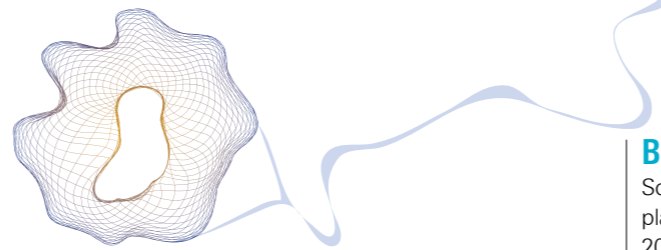
Herek lives on the UT campus. Her husband is a professor in Amsterdam. "Of course there was a moment I considered moving back to the States, but I chose not to on account of the American research culture in which you are more confined to a monodiscipline. Certainly more than in Europe, where people are more receptive to collaboration. Conversely, in America you are more flexible and your career isn't already fixed by the age of 35 or 40. But once again, the infrastructure I encountered here is quite unique. As is the quality of the people: the most important factor."



## UT WINNERS OF SIMON STEVIN MASTER AND APPRENTICE AWARD 2011

On 6 October 2011, the State Secretary for Education, Culture and Science, Halbe Zijlstra, presented Dave Blank, Professor of Inorganic Materials Science and scientific director of the MESA+ Institute for Nanotechnology with the Simon Stevin Master Award, the highest prize for technical-scientific research in the Netherlands. With this award the Technical Sciences Foundation (STW) honours researchers who successfully combine fundamental scientific work with socially relevant issues and applications. According

to State Secretary Halbe Zijlstra, Dave Blank is no stranger to his ministry and he paid tribute to Blank's efforts to make the fascinating world of nanotechnology accessible to the widest possible audience at venues such as Lowlands and the Black MotoCross. The Simon Stevin Apprentice and the Simon Stevin Fellow Awards went to Loes Segerink, a member of Albert van den Berg's BIOS Lab-on-a-Chip research group (MESA+). Segerink obtained her doctorate with research into a chip for testing male fertility.



## BETTER THAN EVER

Solar Team Twente ended in fifth place in the World Solar Challenge 2011. As one of the 37 competitors, this was the best achievement of the team ever. On Friday 21 October and after having clocked almost 3,000 kilometres, the team crossed the finish in Adelaide where they drove a victory lap before halting at the fountain on Victoria Square. Team captain Siebe Brinkhof: "Throughout the race the car was technically in order. We had no flat

tyre, no mechanical defects and, considering the circumstances, we drove really well. The [classical] elements put us to the test, though, with bushfires, sun, wind and rain, and spending the night in the outback."

The team had one hiccup when the engine controller broke down shortly after the start. Nevertheless, on this first day of the race they still managed to overtake nineteen cars.

On day 2 the race was aborted half-way owing to bushfires alongside the Stuart Highway. On days 3 and 4 Solar Team Twente managed to overtake two competitors and secure fourth place in the race. Day 5 was marked by bad weather, little sun and much wind. On day 6 the team slipped to fifth position amid horrendous weather with wind and rain. After a neck-and-neck race with Ashiya from Japan, Solar Team Twente ended fifth.

**UT Academic staff: 1,826**  
**UT Support staff: 1,347**



## IG NOBEL PRIZE FOR BLADDER RESEARCH

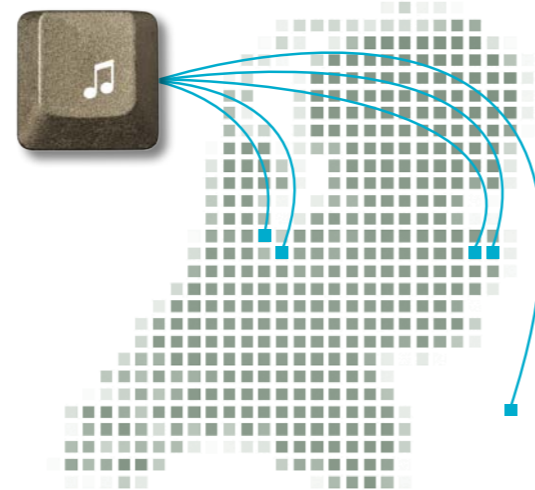
In September 2011, UT researcher Mirjam Tuk was awarded the Ig Nobel Prize at Harvard University in the States. She received this prize for research with which she demonstrated that better decisions are made with a full bladder. The Ig Nobels are awarded for 'improbable' research that 'first makes people laugh and then makes them think'.

At the University of Twente Mirjam Tuk studied the influence of physiological factors (determinants) on people's self-control. Self-control, such as not eating excessively or violating social norms, influences one's daily functioning. In this way, hunger, for example, effects a decrease in self-control. Scientific studies have shown that those with greater self-control are more successful. In her prize-winning research, Tuk addressed the influence of bladder control on decision making and demonstrated that people with a full bladder were better at making balanced choices. Bladder control is thus the first physiological determinant to effect an increase rather than a decrease in self-control.

**At the end of 2010, the UT had**  
**2,352 international students**  
**(1,002 BSc; 734 MSc;**  
**616 PhD)**

## SPONTANEOUS COMBUSTION IN NANOBUBBLES

Nanometre-sized bubbles containing the gases hydrogen and oxygen appear to combust spontaneously, although nothing happens in larger bubbles. For the first time, researchers at the MESA+ Institute for Nanotechnology, led by Professor Mike Elwenspoek, have demonstrated this combustion reaction in a publication in the September 2011 issue of Physical Review E. The fact that a violent reaction takes place is already evident from the visible damage incurred by the electrodes with which the reaction is kick-started. These electrodes are used to make hydrogen and oxygen by electrolysis, in the usual manner, in an ultra-small reaction chamber. By repeatedly alternating the plus and minus poles, tiny bubbles containing both gases arise. The frequency with which the poles are alternated determines the size of the bubbles: the higher the frequency, the smaller the bubbles. With bubbles larger than 150 nanometres (a nanometre is one millionth of a millimetre) nothing happens. Combustion only occurs when they become smaller. Earlier experiments in microreactors also showed that nothing happened in larger bubbles, the theory being that the heat can dissipate to the larger internal surface.



## HIGH-LEVEL MUSIC

In recent years the music industry has undergone a metamorphosis thanks to internet technology. That is why the University of Twente is investigating the possibilities and the scope of new technologies in this sector. To mark its 50th anniversary the university carried out a unique experiment, MUSIC:LINKED, with the object of seeing whether it was possible for a group to perform together even if they weren't in the same place, or even in the same country. The test passed with flying colours and could be seen live via the internet, radio and on location. Stefany June and her band performed together whilst two of the band members were on the UT Campus, one was in the studio of Radio 3FM, one was at the top of a 105-metre high radio mast in Amsterdam and one was even in Germany.





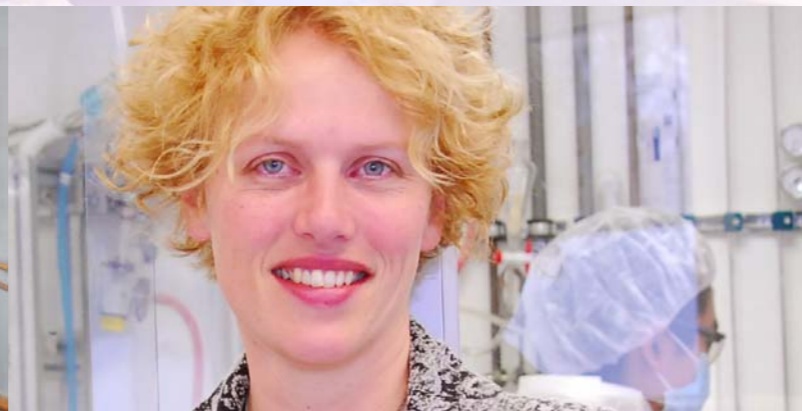
# SPIN-OFF

The UT Campus can now boast an exceptional facility, with the High Tech Factory offering nano- and microtechnology companies a workplace to develop their prototypes and run (batch) production. It is therefore not an ordinary multi-tenant business complex, but a collection of top-notch laboratories with test and production facilities as well as office space. BY Marco Krijnsen PHOTOGRAPHY Agnes Booijink

"The High Tech Fund makes it possible for leaseholders to work with expensive and state-of-the-art equipment"



Arjen Janssens (SolMateS)



Miriam Luizink (High Tech Factory)

## HIGH TECH FACTORY PROVIDES LAB FACILITIES FOR NANO- AND MICROTECHNOLOGY COMPANIES

# SPRINGBOARD

The High Tech Factory breathes new life into the former MESA+ cleanrooms. The prominent research institute for nanotechnology recently moved to brand new quarters, the NanoLab. This means the old accommodation can be rendered suitable for nano- and microtechnology production companies with relative ease.

### Facilitation

"The need for such a shared production facility has been around for a while," Miriam Luizink, commercial director of MESA+ explains. "Our institute establishes many spin-off businesses. Approximately 45 have seen the light of day in the past few years and new ones are added each year. These companies prosper with an average workforce of fifteen employees. They cannot, however, afford a nanolab with a replacement value of 80 million Euros, all on their own. We would like to provide facilities for these companies and cater for their production needs with the High Tech Factory, which is situated close to our NanoLab."

### Twente

The spin-off businesses enjoy a close partnership with MESA+. All founders are UT graduates and their products are based on MESA+ knowledge and expertise. Many employees were at the UT at some point or other and the companies also use the NanoLab for the development of prototypes and small batch production runs. Luizink: "The spin-offs are all in Twente because we have facilities here that are not available in Maastricht or Amsterdam."

### Deposition equipment

One of the lessees of the High Tech Factory is SolMateS. Founded in 2006, the company designs deposition equipment for the semiconductor industry. The equipment applies a coating to chips that enables the new generation of application possibilities, such as micro pumps for print heads and mirrors for micro projectors; products that are an extension of MESA+.

### HIGH TECH FUND

You could think of it as the propelling force of the High Tech Factory. A special UT fund makes it possible for leaseholders to work with (expensive) state-of-the-art equipment. Companies with a concrete request for equipment turn to the High Tech Fund, which has 9 million Euros at its disposal. Once the request is granted, the fund procures the equipment. A lease agreement is then concluded with the user (i.e. lessee of the High Tech Factory).

"Our partnership with the UT is strong," says co-founder and director, Arjen Janssens of SolMateS. "We conduct joint research with the IMS (Inorganic Materials Science) department and we test wafers in the NanoLab. Everything we need is on hand: good infrastructure and people who know what they're doing."

### Leasing equipment

Janssens is pleased he can make use of the High Tech Fund (see inset). "It is often impossible for us to secure a bank loan to procure expensive equipment. They

generally consider it too risky because we are a small and young company. We still have to prove ourselves. We work with machines that banks know nothing about. They cannot see the significance. Thanks to the fund, the equipment is currently in our own laboratory." According to Janssens, the High Tech Fund is way ahead of new government policy. "The number of Dutch government subsidies will only continue to decrease in the coming years. There is a need for new sources of funding."

### Staying close to each other

Delivery of the High Tech Factory will take place in two phases. The first part has been in operation since 2010, following major internal refurbishment. Five companies have set up shop in the laboratories: SolMateS, TSST, Medimate, Medspray and Smarttip. Micronit Microfluids and Deltamask operate from within the renovated cleanroom. They also make use of the office space. The other wing of the building will be renovated in the next phase and a new central entrance will be realized. Completion of the entire complex is slated for summer 2012. MESA+ commercial director Luizink expects the High Tech Factory to be fully occupied quickly. "Close to 80% of the first part has already been leased, just ten months after opening its doors. Companies see the benefits of staying close to each other. I think the quality of the spin-offs is also boosted significantly, as a result."



# TWENTE DOWN-TO-EARTHNESS IN PARAMARIBO

## YOUNG UT ALUMNUS THE SURPRISING PRESIDENT OF UNIVERSITY OF SURINAME

Ryan Sidin came to Twente in 2003 from far away Suriname to pursue an MSc in Physics of Complex Fluids. On graduation he returned to Paramaribo to continue his work at the Anton de Kom University (AdeKUS). Seven years later, Sidin rose to the position of president of the executive board.

BY **Hinke Barry-Mulder** PHOTOGRAPHY **Hedwig de la Fuente**

**NAME** Ryan Sidin  
**AGE** 34  
**EDUCATION** Physics of Complex Fluids  
**FUNCTION** chairman of the executive board of the Anton de Kom University in Paramaribo  
**EMPLOYER** Anton de Kom University in Paramaribo



The return to his native country after graduation was brief. "I had no second thoughts when I spotted a vacancy on the UT website for a PhD candidate at the Department of Engineering Fluids Dynamics," Sidin recalls. "It was a good opportunity and I was eager to pursue my scientific career." Sidin and Twente appeared to be well-suited. He enthuses: "The campus is a definite advantage: the facilities, the rural setting, I really enjoyed my time there. Not the hustle and bustle of a big city. The friendly interaction between the people in Twente made me feel at home."

### Track record

On obtaining his doctorate degree in 2009, Sidin returned again to Suriname. "My time in the Netherlands played a crucial role in shaping my outlook on the lack of professional development in Suriname: I wanted

to pull my weight in my country's advancement." At AdeKUS he evaluated bachelor and masters programmes and launched a restructuring process designed to make them more relevant to social needs. To his great surprise, Sidin was approached at the beginning of the year to preside over the university for the coming period. "My track record of academic excellence in the field of technology played a role in my being selected. My work on blueprints for the restructuring of the Engineering Sciences Faculty effectively set the ball rolling for the reorganization of the university."

### Performance-driven

Sidin is hoping to transform the university into a performance-driven business and advocates a transition to personal grants. "What I am really thinking of is the awarding of full grants to students." Sidin belie-

ves a substantial part of the funds could be generated from accommodating foreign students. "Our masters programmes lend themselves perfectly to this as they are generally taught in English, which in turn lowers the language barrier for people from the Caribbean."

"Sound education is the key to development. I want to pull my weight in my country's advancement"

### Science

Sidin would like to return to scientific practice at the end of his period as president. "My passion for science drove me to opt for the presidency, because I realized that if AdeKUS did not reorganize, it would be impossible to practice science at a high and meaningful level."

# YOUNG AND IN COMMAND

Erik van Ommeren studied at the University of Twente, but before obtaining any degree he was scouted by Sogeti. Riding the business wave of the world wide web, he became Director of Innovation at Sogeti's thinktank VINT. BY **Hans van Eerden**

**NAME** Erik van Ommeren  
**AGE** 37  
**EDUCATION** Electrical Engineering (not finished), Industrial Engineering and Management (not finished)  
**FUNCTION** Director USA of New Technology Research Institute VINT (Vision - Inspiration - Navigation - Trends)  
**EMPLOYER** Sogeti (professional IT services provider, with over 20,000 professionals in 15 countries).



No degree, yet Director of Innovation at a large international consultancy firm...

"I started as an Electrical Engineering student in 1992. Within two years, however, I fell into an 'existentialist' doubt whether I was doing the right thing. Opting for a broader foundation, I decided to continue in Industrial Engineering and Management. I learned about business operations and how people fit in, I witnessed the rise of the world wide web and soon I was inspired to develop business ideas. Participating in a start-up competition, I was scouted by Sogeti. Immediately, I quit university and started my career in business."

Starting off with Electrical Engineering, you're now analysing technological trends in a conceptual manner. Please explain.

"I have worked at Sogeti as an in-

formation technologist, project leader, and architect of IT solutions. I became a unit manager, did business development and ended up in innovation. Now, at VINT we analyse technological trends and how they can help businesses to make progress. Examples are collaboration software, cloud computing, social media and 'big data'. This even involves Artificial Intelligence. What you could call the 'magic' part of IT: when really smart things start to happen.

### What's 'magic' about IT?

"Considering man as an 'information organism', the business question is: what service proposition can you make? Value is created at the interface of technology and behaviour, when one starts to apply technology. It makes VINT stand out, in my opinion, taking the human and philosophical aspects into

account. How does new technology affect our view of humanity, how do people and technology interact, how susceptible are they for example to technological addiction?"

"Value is created at the interface of technology and behaviour, when one starts to apply technology"

That's a long way from Twente. "A lot of the concepts we employ at VINT, such as automation, systems engineering, innovation, strategy, et cetera, I first encountered in my formative years in Twente. Sometimes I feel sorry about not obtaining my degree(s), but never enough to put my career on hold. Now I lecture on technology trends within MBA programmes and I write strategy and management books."

## DIRECTOR OF INNOVATION AT A LARGE INTERNATIONAL CONSULTANCY FIRM

# MAN AS A SERVICE ORGANISM



# NANO BUILDING BLOCKS

Name **Tian Gang, PhD (27)**  
 Function **Postdoc (PhD obtained 28 October 2011)**  
 Education **Materials Chemistry, Biotechnology (China), Nanotechnology (Twente)**  
 Lab **NanoElectronics Group**

BY Hans van Eerden PHOTOGRAPHY Rikkert Harink

## Research

"With a Scanning Tunneling Microscope (STM) I have been investigating electron transport through magnetic nanoparticles. The STM has a very small probe, a kind of needle, for scanning the surface of a material. The first challenge is to locate such a nanoparticle, only a few nanometres in diameter, and to prevent the probe from kicking the particle away as though it were a football. This work paves the way for using magnetic nanoparticles with an organic molecule coating as building blocks for electronic devices. A two-dimensional nanoparticle assembly could be of interest for low-cost and ultra-high density data storage applications. During my thesis work, I studied several such organic-inorganic hybrid systems, often at low temperatures. In the lab, the organic and inorganic materials are smartly combined for investigating electronic and magnetic phenomena at the nanoscale."

## Wants to achieve

"The last chapter of my thesis addressed the mutual interaction of localized magnetic moments and their interplay with itinerant ('wandering') conduction electrons in a solid. The idea is that a periodic distribution of these impurities in a solid might represent a model system for a high-temperature superconductor. As a postdoc I am now working together with my colleagues to investigate this subject further."



"The coolest place to enjoy research"