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Making impact

UT2020

Photo: Gijs van Ouwerkerk

CONTENT

Colophon

This journalistic special edition of U-Today of the University of Twente was drawn up together with Marketing & Communication of the University of Twente.

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FOREWORD

Societal challenges

The world around us is changing at an ever-increasing pace. All these changes have consequences for the future of our university. Increasingly, universities are being called on to help find solutions to the complex challenges our society is facing today. At the same time, the ways in which research is being funded are changing too, with resources being allocated thematically. Reductions in funding also require more intensive collaboration to increase chances of acquiring external funding.

In anticipation of these and future changes, the university drew up principles for a renewed organisation in 2016. Starting with the Faculty Boards, the new style of institutes and focusing on five profiling themes in which societal challenges are related to the internal strengths of the University of Twente.

How are these changes working out? That is what we show you in this magazine. From inspiring examples of our scientists' contributions to solving today's challenges to 'the story of the University of Twente'.

Bertyl Lankhaar,
Marketing and Communication, University of Twente

Thom Palstra
'The institutes focus on major cross-disciplinary research'

Victor van der Chijs
'Everyone is working hard to make a real impact as a university'

Text: **Rik Visschedijk**
Photos: **Gijs van Ouwerkerk & Rikkert Harink**

PRESIDENT AND RECTOR ABOUT UT2020

'We want a leading position within major research programmes'

Making an impact, acquiring external projects and attracting funding: that sums up the key aspects of the organizational changes known as UT2020. Rector Thom Palstra and the president of the Executive Board Victor van der Chijs see a bright future for the UT.

The new organization of research consists of three institutes: TechMed Centre, Digital Society Institute and Mesa+ Institute. Scientific directors are the heads of each institute. Rector Thom Palstra is clear about the role these research organizations play. 'They react to demands from the outside world and are responsible for the preparation for major calls,' he says. 'To do so, they are actively involved in the environments where decisions are made, such as at the NWO and in Brussels where research programmes are drawn up. We take part in these discussions, so we can present our excellent research at an early stage. Our ultimate goal is to acquire a leading position within major national and European research programmes.'

With this approach, the UT wants to acquire more external research projects. 'That is necessary, because in recent years the UT has been underperforming when it comes to attracting indirect government funding and commercial funding,' Palstra says. 'To do so, the disciplinary research takes place in the faculties and research groups in newly formed clusters. That makes the research groups more effective, because funding flows directly to the faculties. The faculties therefore have research vice-deans. The institutes focus on major cross-disciplinary research.'

The perfect infrastructure

The Strategic Business Development (SBD) department plays an important role when it comes to the University's outside perspective. 'The unit supports knowledge valorisation and collaboration with businesses,' says Victor van der Chijs, president of the Board. 'Another core task will be added: supporting initiatives that tie into the UT's five main themes. The EU Office, which supports researchers with subsidy applications, has therefore been folded into SBD. Together, they have the perfect infrastructure to link our scientific directors and research to national and European research projects. In the end, this has to lead to the acquisition of more financial assets from indirect government funding and commercial funding.'

In addition to the research vice-deans, the faculties have also appointed education portfolio managers. They form the links between the dean, education directors and commissions. 'Our bachelor education is constantly evolving,' Palstra explains. 'The wishes and demands of the Ministry of Education, Culture and Science may change. Other examples include the ongoing implementation of student-driven learning, which allows students to choose their own academic path, and improvements to the quality of the education. We can overcome these challenges by creating a single point of contact within a faculty for all matters pertaining to education.'

The UT's master education is not overlooked either. The UT wants to retain more bachelor students and attract more students from outside for a master's programme in Enschede. 'We are reassessing the master's programmes with the faculties,' Van der Chijs says. 'We want to tailor our curriculum to our research profile even more effectively and offer cross-disciplinary master's programmes.'

Van der Chijs believes the UT is ready for the future with these organizational changes. 'We will face the challenges on our path. We have plenty of support. Everyone is working hard to make a real impact as a university. That is what UT2020 is all about.' ●

AN EXTERNAL TREND ANALYSIS

A sharper profile and branding

Linking the challenges of the outside world to the organization's inner strengths: that was the task of the Marketing and Communication department in light of UT2020. Director Atilla Kerpisci and communication adviser Geertje Verschuren conducted an external trend analysis and supported the UT and the academic staff on the road to a sharper profile and branding.

ROLF VERMEIJ

'Well prepared with new orientation'

'These days, research is no longer funded from a technology-driven perspective. Instead, it is based on challenges,' says Liaison Officer Rolf Vermeij. He believes this new playing field calls for a different approach from the University and its researchers. 'We can take steps in the right direction with UT2020.'
Vermeij, who works in the Strategic Business Development department, believes large subsidy providers have undergone a paradigm shift. 'Everything used to be driven by technology. Funding was based on that aspect and we set up our research

Text: **Rense Kuipers**
Photos: **Gijs van Ouwerkerk & UT archive**

If you ask your mother-in-law what comes to mind when you talk about the UT, you hope she mentions a few relevant terms. That is not enough for a subsidy provider in Brussels or a major corporation; they must immediately know what the UT stands for and which fields of research it excels in. The University wants more recognition in order to attract indirect government funding and commercial funding, as well as talented researchers and students. That was reason enough to make the University's profile even more distinctive. 'During the process we concluded that our university distinguishes itself by its entrepreneurial attitude, societal and industrial engagement, cross-disciplinary way-of-working with the typical engineering approach. We demonstrate these distinguishing traits by showing how we use these in our contribution to societal challenges', says Geertje Verschuren.

What are the major challenges that our modern society faces? This was the main question for an external trend analysis. 'In addition to various sessions and interviews with internal and external parties, we used reports such as the United Nations' Global Goals, the Societal Challenges in Horizon2020, the European Commission's BOHEMIA report and a recent prognosis of the OECD,' says Verschuren. 'Those interviews and reports formed the foundation of our efforts to connect current and future social challenges to the UT's scientific strengths and core technologies.' She continues: 'What exactly are we good at, though? What does the world expect from us? This is a constant interaction: knowing what our own strengths are, understanding the challenges society faces today and tomorrow and then linking these together. After several sessions, we eventually developed five themes.'

Kerpisci says the theme 'health' was too broad. 'First, we changed it to 'health technology' and then to 'improving healthcare with personalized technologies,' Kerpisci explains. 'That was concrete enough to choose a clear direction that suits our strengths, yet comprehensive enough to accommodate a multitude of research fields.' This explains why the director of Marketing and Communication explicitly refers to the themes as 'frameworks.' 'I am convinced that virtually all researchers and students have a project that can be placed within one or more frameworks. No, we do not expect everyone to refer to them constantly, since this depends largely on one's specific audience. They should be seen as tools to help you define the social relevance of your own research.' Kerpisci concludes: 'Universities tend to first consider what they have to offer. We have turned that around: what does our society need? By doing so, we hope our vision contributes to a stronger position for the UT.' ●

THE FIVE PROFILING THEMES

#1 Creating intelligent manufacturing systems
#2 Improving healthcare with personalized technologies
#3 Engineering for a resilient world
#4 Engineering our digital society
#5 Shaping our world with smart materials

New branding for more focus

One overarching, strong brand has more potential to generate brand awareness with the right associations. With this in mind the choice was made to put up 'University of Twente' as a strong 'umbrella brand'. The institutes are the sub-brands that - linked to the parent brand - are brought out to mutually reinforce each other.

institutes accordingly. These days, however, funders are no longer only interested in the technological aspects. They want to know how they can help people directly. The creative aspect now lies in the hands of the applicant. Researchers have to prove that theirs is the best solution to a problem.' Comparisons are made based on impact and track record. Vermeij believes that the UT2020 themes can help define this track record. 'You could see it as a frame of reference. It allows you to develop a track record in your own distinctive fields.'
Vermeij expects the trend towards challenge-driven research to continue in the future. 'In the Netherlands, we have the National Research Agenda that the NWO will translate into funding in the years to come. In Europe, the next framework programme for research and innovation puts the global challenges first for technological research as well. With this new orientation, we are well prepared for these developments.'

Text: **Frederike Krommendijk**
Photos: **UT archive & Shutterstock**

Intelligent manufacturing is the key to success

The demands made of manufacturing processes continue to grow. At the same time, the working population is ageing. The Intelligent Manufacturing Systems theme focusses on ways to improve the entire manufacturing processes.

An avatar that negotiates on your behalf during a purchasing process: it sounds futuristic, but professor Holger Schiele's department is hard at work to develop such a negotiation machine, as he calls it. 'At the moment, the buyer and the seller have to negotiate with each other to discuss prices, delivery times, service levels, etcetera. The software we are developing can take care of these negotiations and compare all possible parameters. This results in the optimal deal in a way that is far more effective than requesting quotations from everyone, comparing them all and then making a choice.'
Will the relationship between buyers and suppliers suffer from having avatars doing the negotiating? Schiele does not believe so. 'Parties sometimes negotiate so fiercely that it is hard for them to work together afterwards. If a computer is responsible for making the best possible deal, no one needs to feel short-changed.' On top of that, the avatar forces purchasers to think very carefully about what exactly they need. This prevents disappointment, delays due to returns and wastefulness. 'The idea can ultimately be expanded into a global digital marketplace, where everyone can order exactly what they need at the lowest possible price anywhere in the world.'

Another research project Schiele is involved in concerns communication between machines, e.g. a soap dispenser equipped with a sensor that tells it when it is nearly empty, so it can order a refill for itself. That would eliminate the need to have a real person check every soap dispenser in every bathroom every day. Another example is a supply system that places a new order whenever the weight of a supply bin's contents drops below a certain level. 'It is certainly not true that intelligent technology will leave thousands of people without a job. On the contrary: people who cannot perform certain jobs on their own may be able to do so with the help of technology. As the working population ages, we are left with no choice: we are already short on people to keep our economy running.'

Intelligent technology can also help optimize the efficiency of production processes in the manufacturing industry. Ton van den Boogaard, Professor of Mechanics, works on simulating production processes in this sector of industry. 'The demands made of production processes continue to grow. Governments and buyers require more and more accuracy from products. For example, you can imagine that, when producing a Philips shaving head, a tenth of a millimetre makes the difference between a hair that is shaved off cleanly and one that is pulled out,' he illustrates.
Achieving a production accuracy of a hundredth of a millimetre requires intelligent machines that can conduct measurements at lightning speed, calculate the consequences and make any necessary adjustments to the production process. 'All that has to be done in just a few tenths of a second. If you can get your machines to operate in such an intelligent manner, you can save a ton of money during production. That could allow our manufacturing industry to compete once again with low-wage countries such as China.'
The research into intelligent production techniques not only involves mechanical engineering, but also business administration, computer science, electrical engineering, education and even psychology.
'Working with more intelligent machines packed with sensors and big data also calls for new training programmes for employees and new competences; human skills, in other words. That is exactly what makes our university so strong: we not only possess the technological know-how, but also knowledge of psychology and learning processes,' says Van den Boogaard. ●

THEME #1

CREATING INTELLIGENT MANUFACTURING SYSTEMS

From prehistoric time, finding new ways of creating products has been central to human existence. The depletion of Earth's resources is pushing us to reduce waste and to create a more circular economy. At the same time, consumers demand better and more personalized products. Industries want efficient production. Formerly isolated factories and supply chains are merging into so-called Intelligent Manufacturing Systems (IMS) that are changing the manufacturing industry beyond recognition.

The UT is a leading international player in this emerging field. The real key to mature IMS lies in merging technical disciplines like production technology, ICT, supply chains, business modelling. This cross-disciplinary way of thinking enables the UT to contribute to entirely new concepts and production ecosystems.
A few examples:

MEGaFiT is a large European project with 17 partners, such as Philips, Siemens, Rihs and ETH Zurich, focusing on the development of on-line control strategies to achieve zero-defect manufacturing of mass production.

SUPREME Smart Sensoring and Predictive Maintenance in Steel Manufacturing is a project that aims to reduce the down time and associated costs in a production facility by monitoring operational conditions and big data processing to obtain accurate estimates of time to failure. The project will result in a decision support tool enabling optimization of the maintenance process.

The Fraunhofer Project Centre for Design and Production Engineering for Complex High-Tech Systems, FPC@UT, in which the UT have teamed up with Fraunhofer IPT and Saxion University of Applied Sciences, serves high-tech industry by pushing smart product and production technologies.

Ton van den Boogaard
'Working with more intelligent machines calls for new human skills'

Holger Schiele
'If a computer is responsible for the deal, no one feels short-changed'

Injectable hydrogel helps to repair damaged cartilage

A knee that is as good as new again, without major surgery or a prosthesis. That is something osteoarthritis patients can only dream of. But this will soon change, according to UT professor Marcel Karperien. If all goes well, the first patients will have their sore knee healed with an injectable hydrogel plaster before 2020.

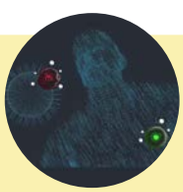
Osteoarthritis is one of the major medical problems of our time. In our country alone, about 1.2 million people suffer from osteoarthritis of the joints. Worldwide, there are more than 100 million patients. 'And the actual number is probably higher,' says Marcel Karperien, Developmental Bio-Engineering professor at the UT and a founder of the spin-off Hy2Care. If you consider that almost a third of all osteoarthritis patients suffer from (painful) knee problems, it becomes clear that an injectable plaster, which repairs the damaged cartilage in the knee without surgery or placing a prosthesis, will be a gift from heaven for many people.
Such a plaster is now available. And it does not come from heaven. It has been developed by TechMed Institute, the research centre for Biomedical Technology and Technical Medicine at the University of Twente. The product, which consists of a hydrogel, is almost ready for human use. Since last year, it has extensively been tested on horses. Karperien says that the results from these animal studies are so promising that testing on humans may start as the first half of 2020. 'If these tests are equally successful, the product may be brought to the market in 2021,' predicts Karperien.
'The hydrogel consists of naturally produced polymers,' says the UT professor. 'We have chemically modified these sugars, creating a kind of two-component glue. The orthopaedic surgeon injects this glue into the knee joint using a special syringe under arthroscopic guidance. The two components then are mixed and fill the gap in the cartilage, providing mechanical stability. This prevents further wear of the joint. Additionally, the gel also facilitates the development of new cartilage cells, which are extracted from the surrounding area. Thus, all gel is ultimately replaced by new cartilage.'

No need to use stem cells

Although solutions for osteoarthritis are also being looked for in other parts of the world, the research institute is the first to develop a gel which does not rely on stem cells to restore cartilage. According to the professor, this means that treatment with the hydrogel is far less complicated - and therefore much cheaper - than treatment with products containing added stem cells.
It is, therefore, not surprising that there is worldwide interest in the research at the University of Twente. Particularly the world of orthopaedics closely follows local developments. Karperien thinks this is understandable: 'If the hydrogel can be used for the treatment of cartilage trauma, we have the first effective, cell-free treatment with minimally invasive surgery. In other words, there is a real cure for osteoarthritis.'

This research project is a collaboration between the Department of Developmental BioEngineering of the UT, the department of Equine Sciences and department of Clinical Sciences of Companion Animals of Utrecht University and the spin off company Hy2Care BV. Alternative applications or our hydrogel technology to treat osteoarthritis are developed in close collaboration with the University of Gotheborg, the University of Manchester and the University of Nottingham. ●

THEME #2



IMPROVING HEALTHCARE BY PERSONALIZED TECHNOLOGIES

The healthcare sector worldwide faces many challenges. Among the answers emerging in our time is the trend towards personalization as a means of offering patients more effective treatment. At the same time, governments and insurers are faced with mounting pressure on budgets due to population ageing and rising life expectancy. The University of Twente is a frontrunner in conducting research, providing education and valorizing enabling technologies in personalized healthcare. The Technical Medicine Bachelor's and Master's programme is the first in the world in which professionals are trained to treat individual patients by fusing medical expertise with engineering skills. On a broader level, the university is updating healthcare and creating more customized

Text: **Kitty van Gerven**
Photos: **Gijs van Ouwerkerk**

Marcel Karperien

treatments with technologies in **three key domains:**

One example of **early detection of diseases** is our work on a new, cost-effective, high-precision and painless technique for detecting breast cancer. Drawing on photoacoustics, we are exploring the potential of this so-called PAMmography – from the prototype's name, PAM, or Photoacoustic Mammoscope – for large-scale breast cancer screening.

The organs-on-a-chip research, in which specialists in electronic engineering, nanotechnology, biomedical engineering, health sciences, ethics and philosophy are exploring the use of chips designed to simulate a human organ for investigating a patient's condition and identifying the best **targeted treatment of diseases**.

A great example of **improved independency** is the bioartificial kidney we are developing, which could free millions of kidney failure patients from the need for dialysis or transplantation.

Let's meet the Faculty Board

Text: **U-Today**
Photos: **Rikkert Harink**

**The UT faculties have a new form of governance since this academic year. Each Faculty Board consists of the dean, being the chairman, vice-deans of education, research and management, and a student member.
The aim of introducing these Faculty Boards is to encourage an integrated and coordinated approach of managing research, education and operational support. This will give researchers more opportunities, space and time to pursue science and acquire external funding.**

ST

The Faculty Board of Science and Technology Faculty: Wiendelt Steenbergen (research), Nieck Benes (education), Anneke Kolhoop (secretary), Hans Hilgenkamp (dean), Christy Schoonheijt-Oude Veldhuis (operational management) and Sofie Kölling (student).

ET

The Faculty Board of Engineering Technology: Niek ten Brinke (student), Bart Koopman (research), Geert Dewulf (dean), Marjolein Dohmen (education) and David Korringa (operational management).

BMS

The Faculty Board of Behavioral Management and Science: Ciano Aydin (education), Ellen Giebels (research), Theo Toonen (dean), Fabian Klaster (student) and Marion Kamp (operational management).

ITC

The Faculty Board of Geo-information Science and Earth Observation (ITC): Freek van der Meer (capacity development), Jaap Zevenbergen (education), Tom Veldkamp (dean), Erna Leurink (operational management), Simbarashe Chereni (PhD-student) and Alfred Stein (research).

EEMCS

The Faculty Board of Electrical Engineering, Mathematics and Computer Science: Stephan Maathuis (operational management), Joost Kok (dean), Jan Willem Polderman (education) and Lynn Bruins (student). ***At the time of the creation of this special, the selection procedure for the new portfolio holders education and research is still ongoing.***

Text: **Frederike Krommendijk**
Photos: **Gijs van Ouwerkerk & ITC**

CLIMATE CHANGE AND EQUAL OPPORTUNITIES IMPORTANT AREAS OF RESEARCH

Working on a resilient world

How can you make a country or system more sustainable and more resilient against all kinds of obstructions? The new UT research theme 'Engineering for a resilient world' focuses on that question. Resilience in the face of climate change and creating equal opportunities for everyone on the planet are two key areas of research.

Professor Andy Nelson knows Africa like the back of his hand. From above, that is, because he carefully studies this continent by monitoring satellite images. Where do harvests thrive and where do they fail due to drought? What areas are affected by overgrazing? The satellites not only show problems, but also opportunities for development.
Developing countries often have a single large capital where opportunities can be found and where more and more people are drawn to as a result. For local farmers, these capitals are often far away and hard to reach. 'Governments and businesses should not only invest in the capital, but also in smaller cities. That will give every region its own heart where farmers can sell their products on the market and where education and healthcare are available. By not concentrating all services and facilities in one place, but instead investing in multiple regions and making them easily accessible, you give people a reason to stay.'
Nelson identifies options for the agricultural sector. 'Planting drought-resistant crops, better access to marketplaces and insurance policies that cover failed harvests are all viable options. Of course, the problem is far bigger than just agriculture. That is why the Resilience group also collaborates with engineers, social scientists and economists. We do not impose anything: it is a process of true co-creation and it is fantastic to work together like this on a socially relevant theme.'

Taking responsible measures not only presents opportunities for people and the environment on land. Professor Suzanne Hulscher conducts research into the dynamic of water systems. This knowledge makes it possible to manage water more effectively.

Rijkswaterstaat, engineering agencies and water authorities all have their own ideas when it comes to water, e.g. on how to improve safety or facilitate shipping. 'Water systems are under increased strain as a result of both human actions and climate change. That means you have to think more carefully about what measures to take, to avoid doing something that ends up being useless or causes problems somewhere else in the future.'
In order to predict the 'behaviour' of water in extreme situations, Hulscher, her group and students are researching soil dynamics, such as the effects of the influx of enormous quantities of water. 'To determine which measures are useful and sustainable, you have to know how water behaves. Reinforcing every single dyke is too expensive and unnecessary. We are also studying the effects of sustainable solutions such as planting waterside plants that slow down the water's flow slightly before it even reaches the dyke. In some cases, it is not necessary to take any measures at all. If a piece of dune is destroyed during a storm, it will grow back over time. You can take advantage of nature's resilience.'

Hulscher is currently researching water movements and soil dynamics in mangrove forests. Planting these mangrove forests is seen as an alternative to building dykes in South America and Asia. 'Mangrove naturally protects the coastline by absorbing some of the water's force. Because sediment collects in mangrove, the coastline can grow back. This may even happen fast enough to keep up with rising sea levels. Planting mangrove forests is a sustainable solution and it looks better than building a dyke.' ●

Andy Nelson
'By investing in regions, you give people a reason to stay'

Suzanne Hulscher
'To determine which measures are sustainable, you have to know how water behaves'

THEME #3

ENGINEERING FOR A RESILIENT WORLD

The United Nation's Sustainable Development Goals (SDGs) call for new and broader perspectives. Technology plays a leading role in providing today's solutions. The diverse disciplines of the UT offer a unique key to unlocking these global ambitions, with three vital knowledge domains:

Data. UT researchers are developing data technologies capable of unlocking exciting new sources of insight, knowledge and information about causes and consequences.

Technology. In an age of science-based engineering, our multidisciplinary design approach to problem-solving results in technologies that immediately impact society where it matters.

People. In all of our work, we integrate science and engineering with social and behavioral sciences to ensure the solutions we come up with will work in the real world and answer to people's needs.

Maintaining a dynamic global network, the UT is skilled in building robust public-private partnerships wherever they are needed - and equipping them to quickly and effectively roll out hands-on, resilient solutions. A few examples:

The STARS Consortium, funded by the Bill Gates Foundation, is a major UT research initiative aimed at boosting economies in sub-Saharan Africa and South Asia by helping smallholder farmers perform better with advanced remote sensing technology and earth observation data.

SCALAR, an ERC Starting grant project, that goes about major disruption to social-economic development of coastal regions because of changes in the risk patterns due to climate change. Together with several partners the University of Twente is going to work on developing simulation models that account for adaption efforts – both on individual and public level.

The power of data

Internet of Things (IoT) is one of the research topics in the Digital Society Institute. IoT isn't only about personal devices connected to the Internet. It is about connecting everything but, more importantly, it's about reasoning, services, and value creation. 'It can make lives healthier, make the world more sustainable and more efficient. It can save lives,' says Nirvana Meratnia, UT researcher, from the department of Computer Science.

Tekst: **Michaela Nesvarova**
Photos: **Pascalle ten Bloemendal & Shutterstock**

IoT has become somewhat of a hype. 'People and companies want to know how they can benefit from this technology and here at the university we have the expertise and experience to help them analyze and realize its potential. Our group has a strong background in IoT and we don't do research for research's sake. We want it to have an impact, real-life application,' stresses Meratnia.
Just like any other technology, IoT has its less positive aspects, namely privacy and security,' continues the Associate Professor at the UT's Pervasive Systems Research group. 'At the same time, these aspects provide new opportunities for research. It is only through research that the extent and impact of these less positive aspects can be discovered and addressed, it can help us use the technology in the best possible way. Because IoT technology is evolving and finding its way into our society either way.'

Monitoring underground water

The research group is currently working on a pilot project with the Municipality of Enschede. 'This is a nice example of an application of IoT,' says the scientist. 'The municipality faces many issues with flooding and wishes to monitor underground water. We are working with the concept of using many small wireless sensing devices. There are many challenges - the battery lifetime, data interpretation, wireless communication deep underground, small devices being exposed to water, animals and so on -, but there is a real value as it could help the municipality to design appropriate policies and respond to real needs of citizens.'

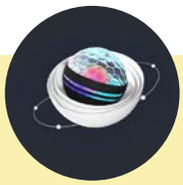
Mobilizing citizens

The researcher mentions another project demonstrating the power of IoT. 'We are working on a project on monitoring road quality. Nowadays, roads are monitored by very specialized and expensive cars once or twice a year. However, as we know, the quality of a road can change rather quickly due to traffic or weather. That's why we would like to mobilize citizens. People drive frequently on the same route and they usually have their mobile phones with them. These phones are also equipped with sensors that we could utilize for monitoring roads. Because even though these sensors aren't as accurate, the large volume of data and efficient data analysis would compensate for the lower accuracy. On the other hand, there are personal aspects to this method. Why should users want to share data from their personal devices? How can they be sure they won't be leaked? Once again, this brings new research opportunities.'

IoT center of excellence

As Meratnia points out, such projects are interesting for many reasons: 'They are compelling for researchers, but also for the end users and they offer various business opportunities. I believe IoT is one of the research topics that can strengthen the pioneering research and the entrepreneurial spirit that the UT is famous for. Not only that, it has the potential to enable collaboration within and outside the university, because multidisciplinary approach is crucial in this case. Twente could become the IoT center of excellence.' ●

THEME #4



ENGINEERING OUR DIGITAL SOCIETY

Digitalization is forming entirely new worlds. Reaching into the very fabric of society, it is redistributing power, shaking up our notions of privacy, identity, democracy.

The UT embraces the leading role of ICT in the digitalization of society in all of its research, education and technology valorization. The university robustly integrated the hard-core ICT expertise with non-ICT disciplines. The main challenges are:

Building digital systems you can trust blindly and use effortlessly. Research at the UT is taking digital systems much further. For example, the integrated circuit (chip) designs are making mobile devices more energy-efficient and capable of transporting more data. Another example is our research in vehicular networking, in which our aim is to enable vehicles to interact with each other, the Internet and their surroundings.

Finding new ways of seamlessly integrating digital systems in our environment, making them a natural part of our day-to-day activities and experience. In the field of robotics, for example, we are exploring ways of creating socially conscious robots – think of a robot providing care in a socially appropriate and pleasant manner.

Well-informed decision making and explainable data analytics. Research in this domain is aimed at three focal points. New and better ways of converting raw data into reliable information and decisions, designing these systems in such a way that they will automatically be able to explain their decisions and actions, and the next logical step is to define responsibilities and liabilities.

Text: **Rik Visschedijk**
Photo: **Gijs van Ouwerkerk**

Wiebe de Vos

THEME #5

SHAPING OUR WORLD WITH SMART MATERIALS

The stone, bronze and iron ages owe their names to the materials that shaped them. Today, the challenges society faces call for an entirely new kind of material, with functionalities not yet found in the physical world. Materials that are lighter, cheaper, stronger, more versatile and easier to process and maintain than any we know. By manipulating the very building blocks of nature, we are creating those materials. UT scientists participate in numerous prominent public-private partnerships with the aim of discovering how to make materials with the right functionalities and predictable properties. We operate in diverse domains, for example:

One exciting domain UT scientists are

The next generation of membranes

UT researcher Wiebe de Vos won major grants to continue his research into membranes. He sees opportunities to make membranes smart by making them more sustainable and giving them new properties. His work is a great example of shaping our world with smart materials.

Membranes are everywhere. These thin layers stop certain substances or allow them to pass through. In our daily lives, we use membranes to purify our water. The chemical industry uses membranes to separate compounds with relatively little energy. The medical sector uses them for renal dialysis. The membrane only allows waste products to pass through, while blood cells and proteins are kept inside the patient's blood. Synthetic membranes are copies of nature's own designs. The cells in our bodies are surrounded by cell membranes that keep them together and protect them from the outside world.

Green image

'Membranes have a green image,' De Vos says. 'That is not surprising when you consider their applications. Nevertheless, the vast majority of membranes are made using chemical solvents. The most commonly used compound, NMP, has reprotoxic properties, which means it has a negative effect on reproduction. Membranes therefore have to undergo lengthy treatment processes to make sure the properties of these solvents are removed entirely.'

Wiebe de Vos is in charge of the membrane surface science research group, which is part of the Membrane Science & Technology cluster. With his group, which consists of ten research assistants, two technicians and two postdocs, he conducts research into the latest generation of advanced membranes. He received a Vidi grant for this research, as well as an ERC Starting Grant. 'It is possible to reinvent membranes,' he explains. 'This gives us the opportunity to give them new properties and use them for entirely new applications. If we can develop water-based membranes that do not require any chemical solvents at all, we will open up a whole new range of possibilities. We can, for example, make them responsive or resistant to contaminants. We can also add enzymes, to give them highly specific properties.'

Physical chemistry

De Vos immediately saw the potential of the idea. The combination of making membranes more sustainable and having the opportunity to add new properties is truly unique. That idea was confirmed when he locked himself in his lab for two weeks to develop a fully water-based membrane. 'That is our first evidence that the theory is correct,' he says. 'Of course, we have to conduct more research. Creating the right membrane structure and improving its stability will still require a lot of work. The initial results are promising, though. If this works, we can present the new membranes to businesses within five years. A major advantage of our new membranes is that they can be produced using existing equipment and techniques. It will not require an entirely new infrastructure.' ●

pioneering is that of **nanomaterials**. We work with industrial leaders such as ASML and Zeiss, the equipment manufacturers behind the chips inside the fastest smartphones and computers. We are changing the game in photolithography, materials analysis, space telescopes and microscopy. Much of this work takes place at our internationally renowned MESA+ Institute for Nanotechnology benefiting from infrastructure that rank among the very best on the globe: NanoLab.

Biomedical materials hold a lot of promise for healthcare, with technologies capable of restoring diseased organs and damaged tissues in the human body. For example, the development of a membrane that may be able to cure Type 1 diabetes patients.

At our ThermoPlastic Composites Research Centre (TPRC), we are developing new **Engineering materials** like plastics and composites e.g. lighter and stronger materials for aerospace.

Text: **Maaike Platvoet, Rik Visschedijk & Rense Kuipers**
Photos: **UT archive**

‘This is a promising time’

The three research institutes TechMed Centre, Mesa+ Institute and the Digital Society Institute have to improve the University’s visibility and attract more external financial assets. The Scientific Directors have ideas regarding the best way to go about this and present their views.

Nico Verdonschot (54) sets a high bar for his research institute TechMed. He wants the funding to have increased drastically in four years' time. The newly minted director wants to create favourable conditions for the acquisition of subsidies and he is already launching several initiatives to realise that goal. One example is the 'TopFit' programme, a collaboration between the UT, Radboud University, Wageningen University & Research and the Radboudumc. 'Our goal is to develop a research programme and collaborate with businesses to come up with concrete solutions for a wide range of ailments. We want to make the people in the east of the Netherlands healthier and keep them that way.' Verdonschot wants TechMed to play a major role in this project. 'We can look at a patient from several technical perspectives. Together with our partners in the TopFit programme, we want to further develop that ability.'

He sees his role in the project as that of an 'accelerator.' As scientific director, he wants to be innovative. 'We must focus on making the most of it. We have to show what we are capable of. There is room for improvement in terms of our profiling. We have to put ourselves out there more.' Luckily, he encounters plenty of positivism. 'I am joined by my fellow scientific directors in the other institutes. We see this as a promising time.' It should be clear that Verdonschot is excited. 'I am particularly looking forward to helping others. What can I do for researchers to allow them to excel even more? I am also looking forward to the new building of TechMed Centre that will be ready in 2019. It will be a leading innovation hub with state-of-the-art infrastructure, ranging from research labs, preclinical testbeds and simulated hospital environments up to the actual healthcare system. We can release all the vibrant energy of our research there.'

According to its two scientific directors, Guus Rijnders (photo left) and Albert Van den Berg, MESA+ has grown into a top institute in the fields of materials, fluidics and photonics. Van Den Berg: 'We want to attract more top talent in these research fields, e.g. researchers who have received an ERC grant and bring commercial funding with them. That will result in more external financial assets.'

The scientific directors also want to focus on European networks. Van den Berg: 'Many parties want to do business with MESA+. First, we have to translate our fundamental research into practical applications.' Rijnders adds: 'We will not set up our own production line or anything, but we will translate our research from a proof of concept to a demonstration wherever possible.'

A small cultural shift is coming. The doors have to be opened to allow MESA+ to have an impact on our society. Van den Berg believes he has the right ingredients: 'MESA+ is involved in the quantum/nano route of the National Research Agenda,' he says. 'Another great example is the presence of

the NanoNextNL programme office at the UT. Guus and I can build upon that strength.'
The institute literally opens doors – and not just for employees, either. The scientific directors want to involve ordinary people in nanotechnology. 'The people on the street are important to us,' says Rijnders. 'We live in a new reality and people want to know what nanotechnology contributes to that. For example, the ability to detect cancer in someone's urine has a direct impact on people. We have a responsibility when it comes to raising that awareness. In the time to come, we will start telling this story about MESA+ and the UT to research financiers, businesses and the people on the street.'

Maarten van Steen:
'One day the institute will operate as a single unifying link'

Our challenge is to get research groups involved in new research programmes,' says Maarten van Steen, scientific director of the new Digital Society Institute. 'Research groups come into contact with the theme of digitization from all angles at the UT. Our added value comes from participating in research projects or representing the research group on those projects. My hope for the institute is that it will one day operate as a single unifying link.'
Van Steen believes that his institute, and the UT as a whole, can play a leading role in the creation of large consortiums. 'These are cooperative alliances that involve many parties and attract millions in subsidies. We can contribute to the realization of such large-scale collaboration, for example by conducting preliminary activities for a year.'
Van Steen believes it is crucial for his institute to emphasize the social relevance of its work. 'Many people outside the world of academia have no idea how digitization affects them. The smartphone, the Internet of Things, autonomous vehicles: these are all developments that have major consequences. It is important that we focus on those aspects and research them.'
Van Steen is not out to recruit top talents, like MESA+ is. 'No, our institute needs unique and appealing research projects in which IT is a major component, but not the only one. As an institute, we take on the responsibility of shaping those projects and bringing the various parties closer together.'
The UT alumnus believes that the UT holds a strong hand when it comes to digitization. 'I am convinced that we have everything we need to become the #1 digitization university in the Netherlands and even Europe. We have many people ready to go to work to realise that goal.' ●

THREE RESEARCH INSTITUTES

The new institutes are to improve the visibility of the University and bring in more external financial assets. The Executive Board feels this is necessary because the UT lags behind other Dutch universities when it comes to acquiring indirect government funding and commercial funding.

The annual report of 2016 states that the research component of the state grant (direct government funding) amounted to €105.1 million. This money is mainly used to finance infrastructure and permanent researchers. The UT received €25.5 million in indirect government funding from the Netherlands Organization for Scientific Research (NWO) to conduct specific research projects. This was less than the amount received in 2015. The majority of the remaining research capacity was financed by governments and businesses (commercial funding). In 2016, this amounted to €54.4 million. Since 2012, this sum has decreased by nearly €20 million as a result of the conclusion of the FES programmes. This loss could only partially be compensated with contributions from Top Sectors, particularly High Tech Systems and Materials (HTSM), Energy, Life Sciences & Health (LSH), Chemistry, Water and Logistics.

Together, the three research institutes lead cross-disciplinary research programmes. Each institute is assigned a number of leading researchers, the so-called principal investigators, from different faculties. Together, they must tie into the domains in which the UT wants to stand out.

Text: **Jelle Posthuma**
Photos: **UT-archive & Shutterstock**

'We are looking for the music'

The UT is attracting attention from the general public with its five new themes, says Kees Eijkel, director of Strategic Business Development (SBD). Within these themes, SBD develops "ecosystems" as drivers for research.

Kees Eijkel calls his organization a nervous system within the UT. 'We do not want to be a separate service; our people are everywhere. SBD ties the UT's internal strengths to external needs with its outside-in perspective.'
The things the UT does as a university do not necessarily match society's needs, Eijkel says. 'A university's standard products are education and research, for example by a doctoral candidate. This research often has a low Technology Readiness Level or TRL. The focus is primarily on informing other researchers, rather than on commercial research.'

Ecosystems

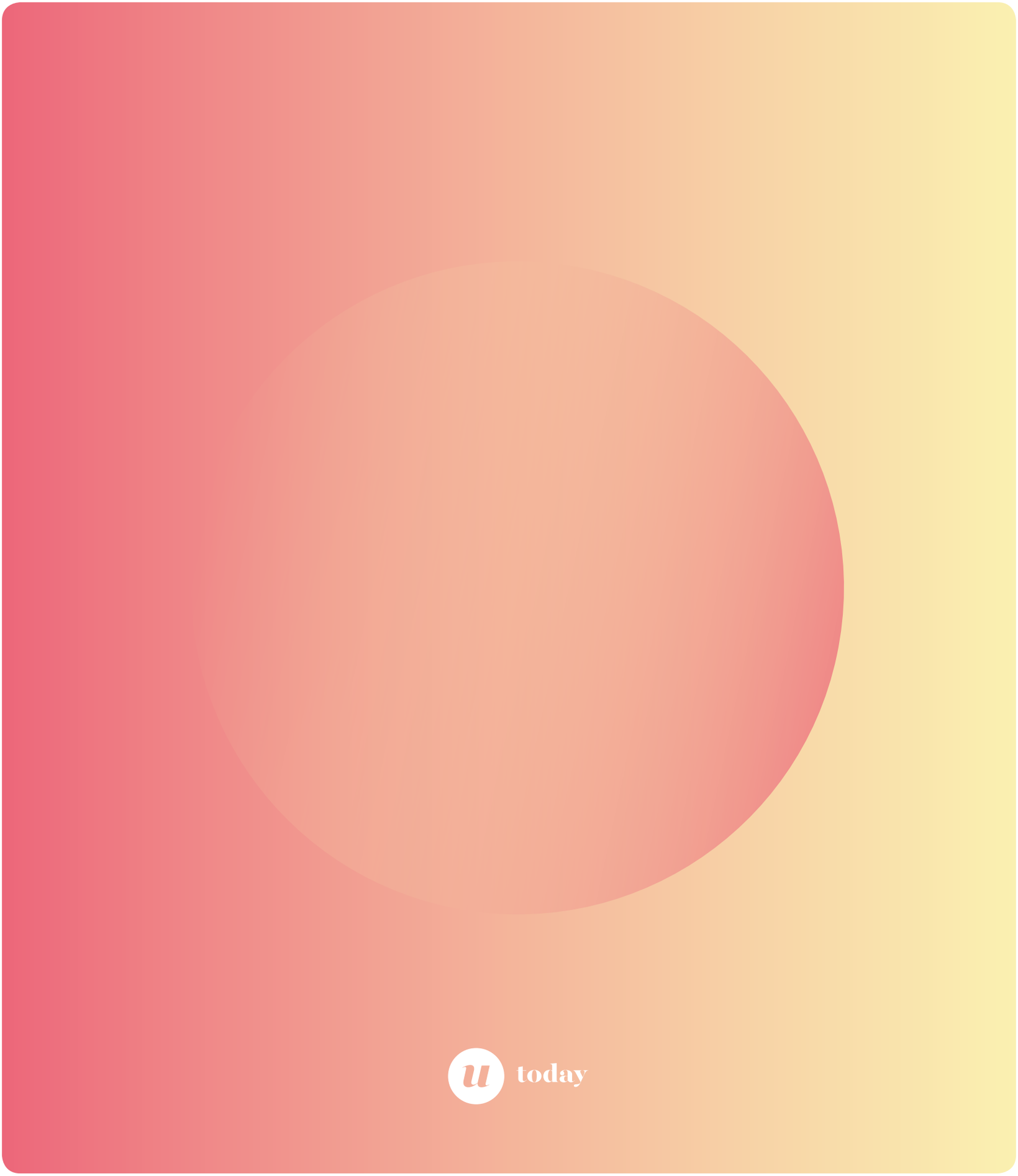
Eijkel believes the UT should make it as easy as possible for businesses, hospitals, governments and other organizations to take new steps towards research collaboration. 'A business is often looking for more than just a research project. They need a commercialization process, facilities and expertise to execute their plans. They want a complete product, which the UT cannot always offer. Instead of sending them away, we are developing ecosystems. We bring various public and private partners together within these ecosystems. Together, they possess the necessary means and have the ability to significantly increase the impact on society.'
The UT is developing these ecosystems within the five new themes. 'These themes clearly demonstrate market demands and the UT's strengths. The ecosystems drive research and allow us to offer clients better services.'

Subjects

Eijkel says the five new themes have a high level of abstraction. 'That was done to draw the attention of as wide an audience as possible. The industry adopts a more detailed perspective. Take the theme of Intelligent Manufacturing Systems. Several subjects fit within this theme. Fraunhofer, for example, is an ecosystem for production technology and the ThermoPlastic Composites Research Center (TPRC) focuses on lightweight construction materials. SBD gives substance to the larger theme with concrete subjects, which in turn let us develop ecosystems.'

No standard list

The director of SBD says the UT has four or five main subjects at the moment. 'Advanced manufacturing, Photonics and the TopFit programme, for example. On top of that, several other subjects appear to be quite promising. In total, there are twenty to thirty subjects that can all be placed within the five themes at a higher level of abstraction. The same goes for the new institutes. At SBD, we are constantly looking at all these subjects. We do not have a standard list that we draw up once every five years. We are always looking for the music.' ●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