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Developing knowledge and innovations together:

big data



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‘TOGETHER, WE WANT TO ACHIEVE SOCIETAL IMPACT’

The director of a service organisation recently asked me a question. A question that is increasingly challenging both for profit and non-profit organisations: how do we deal with big data? You can collect all kinds of customer data via the digital highway. But, at the same time, it is important to consider how to collect, store, share and use data in a responsible and ethical manner. Also – when collecting and analysing such data – how do you identify your goals and how do you decide which techniques to use for this purpose? For example, are you aiming to enhance the organisation of internal processes? Or do you plan to make the results more widely available, for the purpose of advising consumers about energy consumption, for example?

In short – there is no shortage of questions. In many cases, no ready-made answers are immediately available, and new knowledge is required. Accordingly, a question is often the first step in assessing the feasibility of designing a collaboration programme with the University of Groningen (UG). The UG is keen to establish links with the business community, non-profit organisations, knowledge institutions, educational institutions, government bodies and members of the public. Together, we want to boost the innovative strength of the Netherlands and to achieve societal impact.

This portfolio book sets out the opportunities for collaboration and the opportunities they offer for developing new knowledge and innovations. This edition is devoted to the theme of ‘big data’. In this modern and complex theme, many questions – spanning a wide variety of disciplines – await an answer. It is one of the strengths of the UG that the University has in-house expertise in all of these disciplines. Our highly-qualified researchers are experts in their own disciplines and they also engage in interdisciplinary collaboration through various research centres.

Is your organisation seeking answers to a big data issue or some other topic? The Industry Relations team is committed to finding and establishing links with all stakeholders, together with their various perspectives and ideas. We would be happy to discuss the options with your organisation. Do you have any questions or comments? Please get in touch with us.



Iris Vis
Dean of Industry Relations
University of Groningen

At the Zernike Campus, the most sustainable educational building of the Netherlands is established: **the Energy Academy Europe**, initiated by the University of Groningen, the Hanze University of Applied Sciences Groningen, GasTerra, and Energy Vally. Businesses, educational institutes, and researchers work here together in energy research and education.

The University of Groningen: at the heart of society

1

The University of Groningen is at the heart of society. It is fully engaged with companies, non-profit organisations, government bodies, knowledge institutions and members of the public. The goal: contribute to a resilient society that tackles societal challenges.

Broad and distinctive

The University of Groningen (UG) distinguishes itself, both at the national and international level, by its strong links between education and research. The three main focus areas are: ‘energy’, ‘healthy ageing’ and ‘sustainable society’. The University’s eleven faculties develop knowledge in disciplines such as engineering, philosophy, law, social sciences and economics. Such unique breadth offers ample opportunities for multidisciplinary and interdisciplinary education and research, while providing a fertile environment for knowledge and innovation. Cooperation with partners is an important aspect; this can pave the way for the creation of new developments, products and services.

Establishing links

The UG’s Industry Relations team works to establish links between the University and other parties. An important step of this process is that the partners – each on the basis of their own core qualities and core values – formulate a common goal, to tackle societal challenges. This goal is then translated into a sustainable collaboration programme.

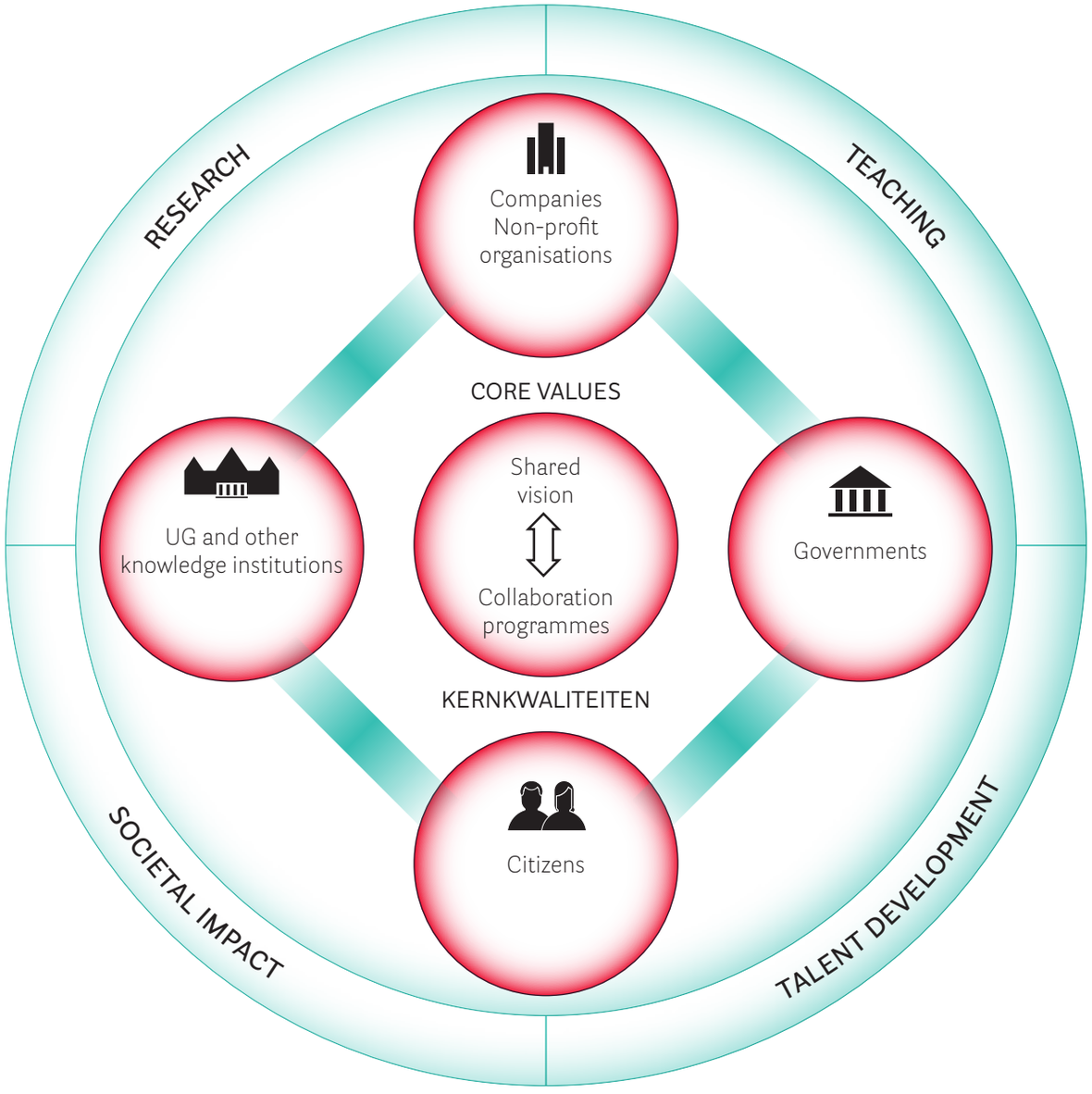
The collaboration may focus on research, education, talent development or societal impact. This involves aspects such as knowledge sharing, question-driven fundamental research, or the translation of knowledge into products or services. It could also include internal training programmes, student engagement and the establishment of new networking organizations. The images on pages 8 and 9 demonstrate plenty of options!

Are you curious to find out about collaboration in the big data? You will read some highly interesting examples in **Chapter 2**!

Sustainable cooperation between the RUG and its partners

OPPORTUNITIES FOR COLLABORATION:

- Interdisciplinary and multidisciplinary fundamental question-driven research
- The formation of consortia and networks, joint research applications to, for example, NWO, the NWA or the EU, or as part of the national Top Sectors policy
- Talent development among students through placements and participation in research projects
- Sharing knowledge and inspiring people
- Transformation of knowledge into pilot projects, demo projects or end products and services
- Joint infrastructure and facilities, working close to each other
- Making results visible
- Professionalisation of staff through training courses
- Identifying and addressing societal challenges





The Bernoulliborg at the Zernike Campus Groningen is one of the main buildings of the Faculty of Science and Engineering.

Examples of research projects

2

Big data involves collections of data that are so vast and complex that they cannot be maintained in traditional databases. This concerns digital data that is collected via social media, population surveys, online purchases, etc. But what can we actually do with this big data?

Research projects

The University of Groningen's (UG) research into big data spans many disciplines, ranging from philosophy to mathematics. You will find a small selection of these research projects in the following pages. These are projects in which collaboration is an important factor – either with other academics or with companies, non-profit organisations or members of the public, for example.

More online

Would you like to know more about other research projects at the UG in the area of big data? Or would you like to find out about other research projects being carried out by the UG, in collaboration with its partners? If so, please visit www.rug.nl/industry-relations for more inspiring examples.

Using machine learning to analyse Tweets

Details of the study

Politicians and journalists are increasingly posting tweets on Twitter. In terms of scientific research, the content of these tweets is quite interesting. For example, it shows how these individuals behave online. Before these tweets can be analysed, they must first be coded to group similar tweets together. For instance, into categories based on whether the individuals concerned are campaigning, engaging in debate, criticising competitors, and so on. This is still being done manually, but it is a very time-consuming process. For this reason, researchers at the UG's Centre for Media and Journalism Studies (CMJS) are trying to find ways of automating the processes of coding and analysis. Together with the UG's Center for Information Technology (CIT), they have designed a Twitter Crawler. This application downloads, codes and analyses a selection of tweets. The challenge here is to interpret people's behaviour in passages of text. This always involves a degree of ambiguity, something that computers usually can't handle. That is why machine-learning algorithms are being developed. If a large enough training set of manually coded tweets are input, the algorithm is able to learn from them. Based on what it has learned, the algorithm is then able to automatically code tweets.

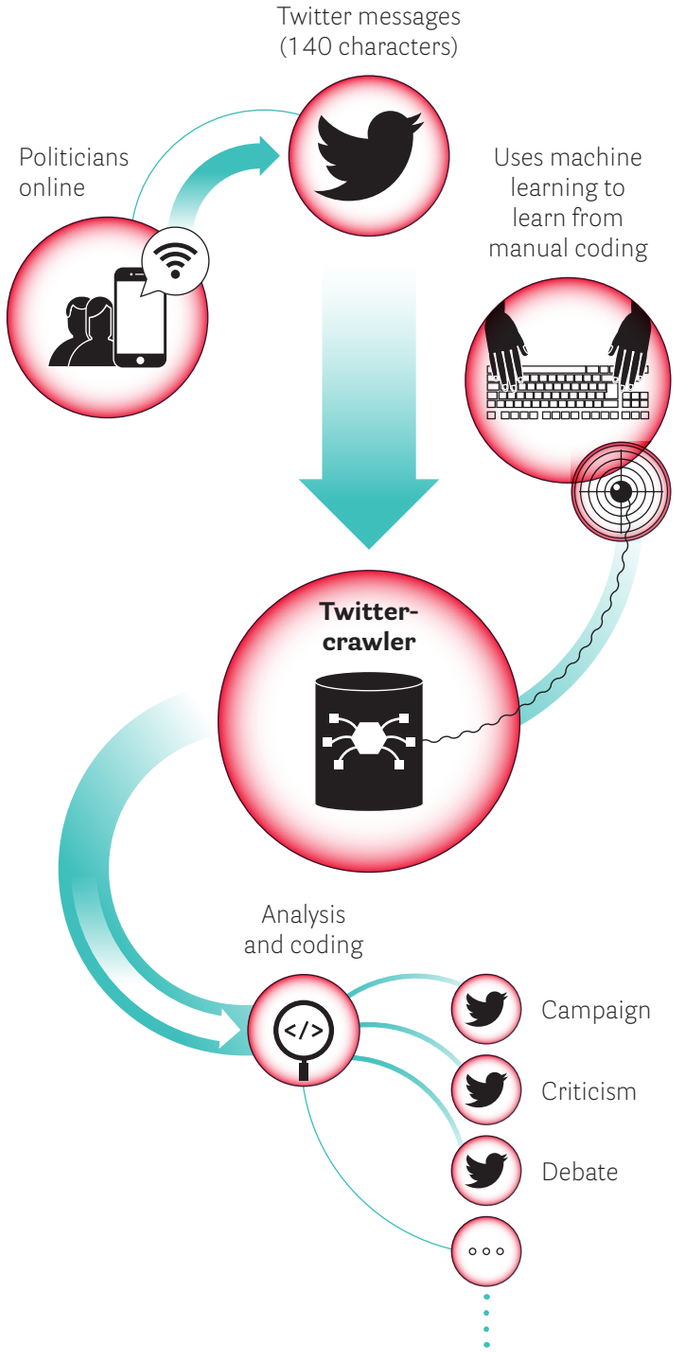
In everyday practice

This project therefore makes it possible to conduct comparative scientific research into people's behaviour – in this case, the behaviour of politicians and journalists. But what does this actually involve? A good example is a previous study into the online behaviour of British, Dutch, Italian and Swedish politicians. This addressed a number of important questions, such as – to what extent do politicians engage in debate with citizens? It is often claimed that social media make this possible. But does it really happen? The results showed, for instance, that – when it comes to important topics – Dutch politicians have much more direct contact with members of the public than do their British counterparts. Another study into online behaviour carried out a detailed analysis of tweets from Dutch and Flemish journalists. One of the results to emerge from this study was that freelance journalists spend more time in maintaining contacts (selling themselves as a 'brand' on Twitter), while staff journalists spend more time promoting their own articles.

Joint opportunities

With just a few modifications, the automatic coding algorithm for tweets could also be used on data sets from an entirely different context. Also, in the future, there will no longer be any restrictions on the number of messages that can be coded. This makes the algorithm a useful tool for new studies. It will not only be useful to scientists, but also to any companies and other organizations that wish to analyse big data. For instance, one such application involves filtering and collecting news items, to enable relevant information to be posted directly onto news websites.

'THIS PROJECT BRINGS TOGETHER A WIDE RANGE OF EXPERTISE'





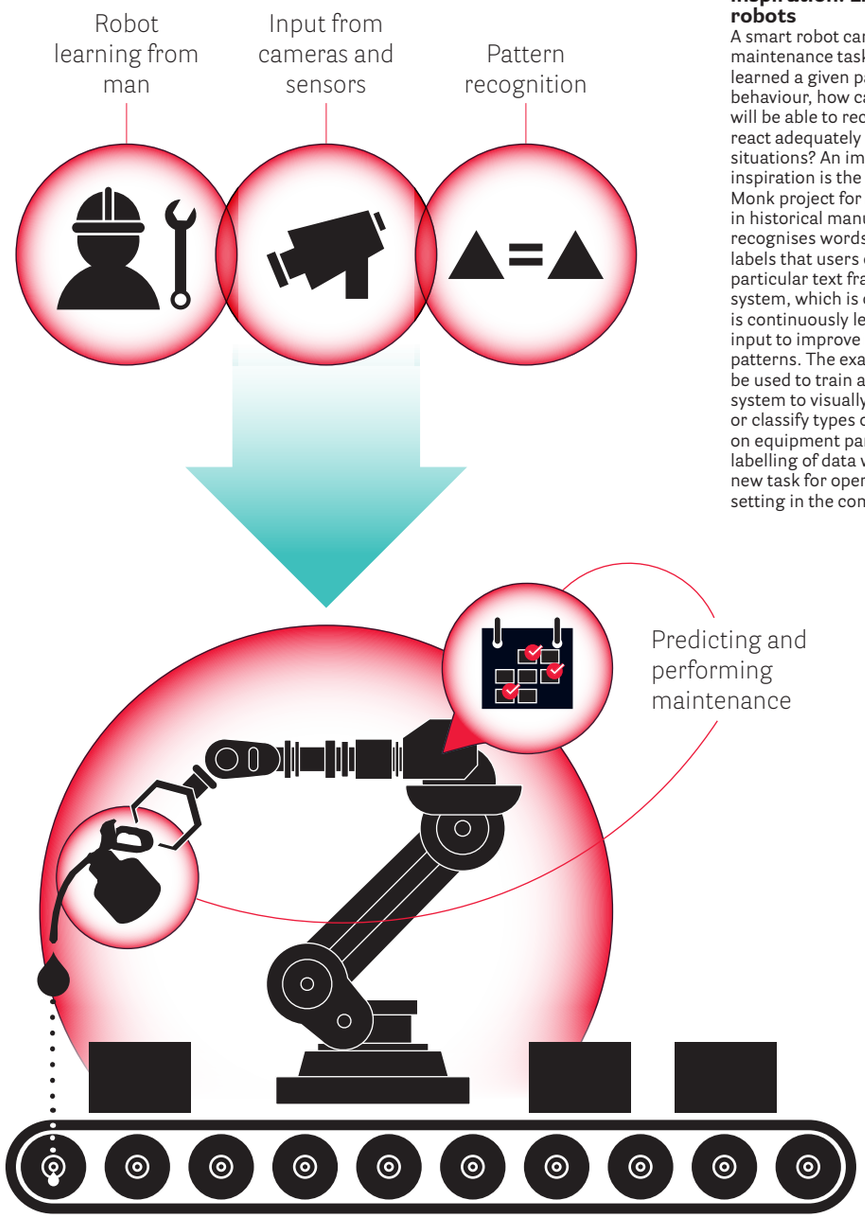
Professor
Marcel Broersma
Faculty of Arts/Centre for Media and Journalism Studies at the UG

'A tweet tells us more than you might initially expect. In addition to general information, such as when it was posted and by whom, you can also view each message as a distinct form of behaviour. For example, politicians provide campaign updates or engage in debate with members of the public. On Twitter, this type of behaviour is particularly interesting in terms of comparative scientific research. Unlike general information, which is relatively manifest and accessible, information about behaviour is more latent and requires much interpretation. For this reason, our project combines the expertise of computer scientists with the know-how of researchers in the areas of political communication and journalism.'

Project partners
The University of Groningen, the Netherlands eScience Center and the Center for Information Technology (CIT; part of the UG)

Extra information
The research work involved in this project was supported by grants from the Netherlands eScience Center and UG.

Using smart robots to improve maintenance in production processes



The Monk system as an inspiration: Lifelong learning in robots
A smart robot can be trained to perform maintenance tasks. But once a robot has learned a given pattern and the necessary behaviour, how can you ensure that it will be able to recognise that pattern and react adequately in a range of different situations? An important source of inspiration is the seemingly unrelated Monk project for the recognition of text in historical manuscripts. This system recognises words by learning from the labels that users over internet give to particular text fragments. The Monk system, which is operational since 2009, is continuously learning from this user input to improve its recognition of image patterns. The exact same architecture can be used to train an Artificial Intelligence system to visually judge product qualities or classify types of wear and deterioration on equipment parts, for example. The labelling of data will become an important new task for operators in an industrial setting in the coming decade.

‘CREATING A SELF-SUSTAINING PRODUCTION PROCESS TOGETHER’

Details of the study
In the framework of the Mantis project, researchers from the UG’s Faculty of Science and Engineering are developing Artificial Intelligence techniques for smart robots for production processes. These robots use big data to predict where and when maintenance is needed. This data is obtained by monitoring bottlenecks in the production process, using sensors and cameras, for example. These developments will impact the role of production staff. While human workers point out maintenance problems and demonstrate an adequate corrective action to the robot, the latter will gradually learn from this and will eventually take over such tasks.

In everyday practice
Companies in the manufacturing industry in particular, encounter similar problems. In any production process, the maintenance policy is mainly determined on the basis of experience. In current practice, the problems occurring along industrial production lines are often solved by perfecting or replacing a given module or component. In this way, a single, specific problem is solved. In today’s complex production processes, however, this approach is becoming extraordinarily expensive and time consuming. Moreover, solving one problem usually spawns a host of other problems. By integrating smart collaborative robots (cobots) into a production process, it will be possible to determine in advance where and when maintenance will be needed.

Joint opportunities
In the context of this project, the UG is collaborating with 47 industrial companies and centres of expertise. This provides the researchers with the big data that they need for their research projects, plus an opportunity to test their smart robots. This collaboration program also enables companies to tackle problems in their maintenance processes, such that the mean time between failures is increased. Instead of replacing large modules in a lengthy and expensive process, small but annoying failures of the existing assets are predicted, prevented, or solved ad hoc, in a timely fashion, until complete replacement becomes unavoidable. In the long term, this will enable European industry to cut production costs and to remain competitive.

Extra information
Mantis was awarded a grant of more than € 30 million, from the European Commission’s Horizon2020 programme. This project produced The MANTIS Book – Cyber-Physical System Based Proactive Collaborative Maintenance. River Publishers Series in Automation, Control and Robotics (575 pages). Public PDF: https://www.riverpublishers.com/research_details.php?book_id=573

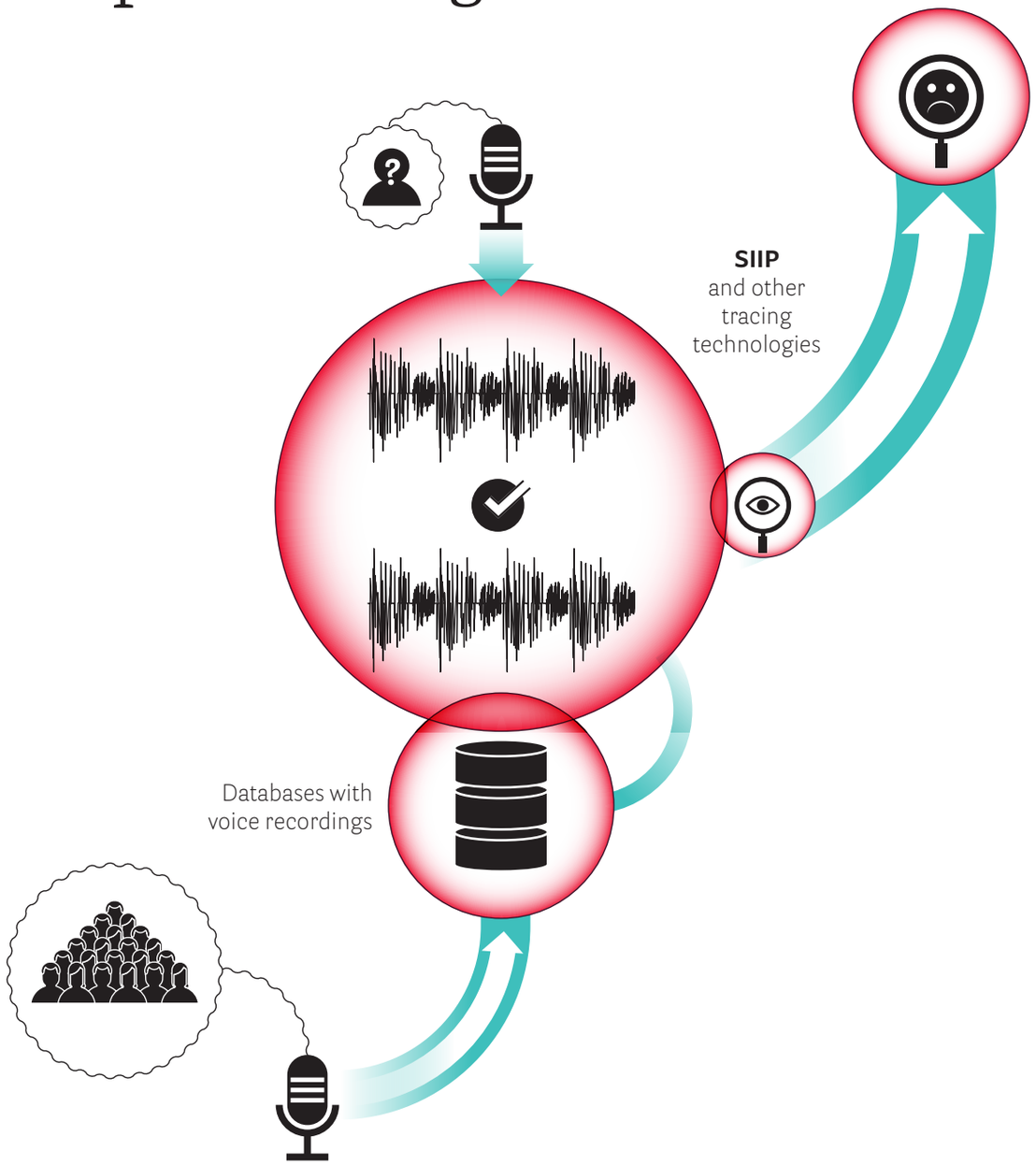


Professor Lambert Schomaker
Faculty of Science and Engineering at the UG

‘In the future, smart robots will increasingly become part everyday life, at home and at work. Indeed, people are already using smart vacuum cleaners or lawn mowers, at home. In industry, cobots will become essential, as a means of keeping maintenance costs under control. But the ultimate goal is to design self-sustaining production processes. For space operations, such as mining on the moon or on other planets than Earth, the dependency on the presence of humans surrounding such systems needs to be minimised. In my view, these exciting new prospects are virtually impossible without mobile, general-purpose maintenance robots. By setting such high goals, one can ensure that the increased levels of system autonomy will greatly benefit existing industries on Earth, even if we never reach Mars. We are looking forward to collaborate with young companies!’

Projectpartners
The University of Groningen and 47 companies, mainly from the manufacturing industry

Voice recognition technology identifies suspects via big data



Details of the study

Every individual has an element in their voice that distinguishes them from others. The Security, Technology & e-Privacy (STeP) research group at the UG's Faculty of Law is looking at the legal implications of new voice recognition technology. They are part of the Speaker Identification Integrated Project (SIIP) which developed technology to identify individuals through their voice. This will supplement existing identification techniques, such as fingerprint recognition and visual material. That will improve the police's ability to identify suspects.

In everyday practice

Suppose that the police have a video recording in which a suspect cannot be seen properly but can be clearly heard. The police can then upload this voice recording to the SIIP software. The software application then compares the voice with recordings held in local police databases and in other databases of legally obtained voice recordings. If SIIP fails to find any hits in these big data repositories, it will also search social media platforms, such as YouTube, for voice matches. The software may not infringe the privacy of the general public. For this reason, the researchers have adopted a privacy-by-design approach. This involves choosing design solutions that are privacy friendly, investigating situations in which the software can be used and finding out which individuals within the police force are authorised to access it. They also develop training courses on how to operate the software in a responsible manner.

Joint opportunities

The development of SIIP involves collaboration between 19 partners from across Europe, the United States and Israel. Moreover, every police organisation throughout the European Union may have access to this voice recognition technology. So, this software will increase security at both the national and international level. This joint use will also involve a major focus on the privacy of the general public. As part of the project's remit, the STeP researchers compared the legislation of 27 European countries and Israel, to find out exactly where the differences lie. This will reveal the extent to which voices (obtained through the lawful wiretapping of telecommunications and also available as big data) can be used in the countries concerned.

'SIIP IS AN EXTRA TOOL FOR IDENTIFYING SUSPECTS'



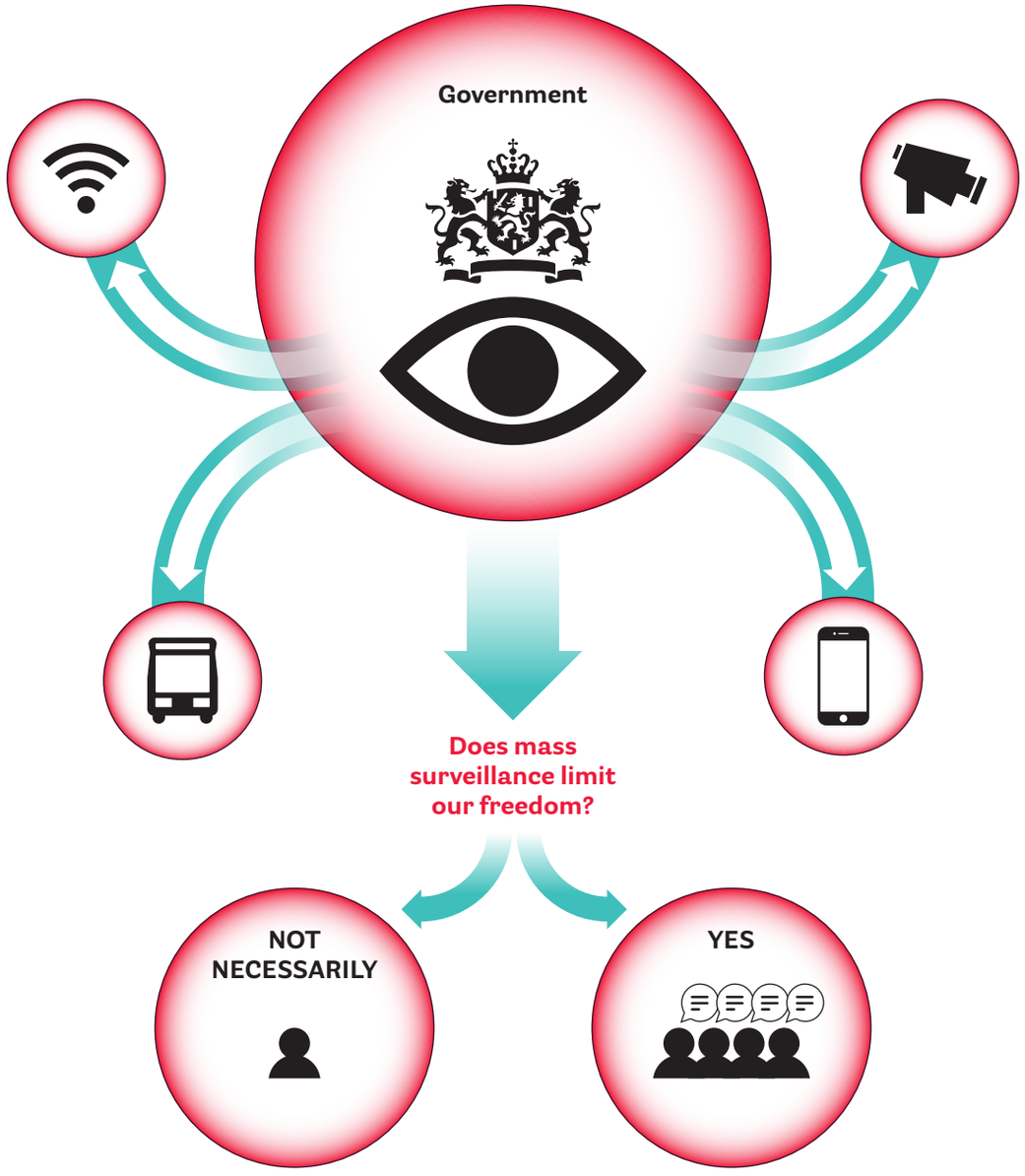
Professor Jeanne Mifsud Bonnici
Faculty of Law at the UG

'The ultimate goal of SIIP is to offer the police an extra tool for identifying suspects even more quickly and reliably. This technology is particularly valuable in helping to track down criminals who leave a voice trace during the preparation or commission of crimes or terrorist attacks. In situations like this, the authorities can use SIIP to compare the voice trace to voices that are available through social media and police databases. At the same time, we always keep privacy issues front and centre.'

Projectpartners
A consortium of 19 organisations from across Europe, the United States and Israel, including the University of Groningen, police organisations, research institutes, and various companies

Extra information
The project is funded by a grant of more than € 10 million from the European Commission

Privacy and democracy: the effect of mass surveillance



‘THE SOCIAL VALUE OF PRIVACY MERITS GREATER ATTENTION’



Assistant Professor Titus Stahl
Faculty of Philosophy at the UG

‘Its opponents often argue that mass surveillance is a violation of their personal freedom. But most members of the public have nothing to hide, and suffer no adverse personal impacts whatsoever. However, this research project shows that privacy is not just an individual matter. Surveillance affects the way that people interact with each other. Consider, for example, how the atmosphere changes once people know that their conversation is being recorded, even in a consequence-free environment. The development of new political ideas is a case in point. New social movements might not emerge if people know that others are listening in. My research, therefore, focuses on the harmful effects that mass surveillance can have on democracy, even where individual rights are not at stake.’

Details of the study

Mass surveillance involves the interception of digital data from large groups of people (in particular, members of the public) by the government. This is known as a ‘fishing expedition’ because data is collected in a non-targeted way. The researchers from the UG’s Faculty of Philosophy are researching the effect of mass surveillance on society as a whole (rather than focussing only on individual rights). Democracies have an interest in allowing members of the public to freely discuss their ideas without the government watching what they do and listening to their every word. This research is also exploring new forms of power that arise from mass surveillance.

In everyday practice

This study into the effect of mass surveillance will be translated into a vision of privacy that encompasses more than the rights of the individual alone. This vision will enable stakeholders such as government bodies and privacy ‘watchdogs’ to understand issues better. For instance, this could address the concerns of members of the public who are worried about what surveillance does to democracy.

Joint opportunities

The UG hopes that it will be able to involve organisations such as Amnesty International and Bits of Freedom in this study, as well as other privacy advocates. Together, they can engage in a dialogue about privacy-related questions in this era of big data. Companies may also have an interest in an analysis of privacy that encompasses more than the rights of the individual alone. For instance, their customers might be concerned about big data’s implications for society

Extra information
Following on from a research, Dr Stahl has earlier offered Master’s course unit at the Faculty of Philosophy, entitled Philosophical Perspectives on Privacy and Surveillance

Big data predicts the payback periods for sustainable investments

Details of the study

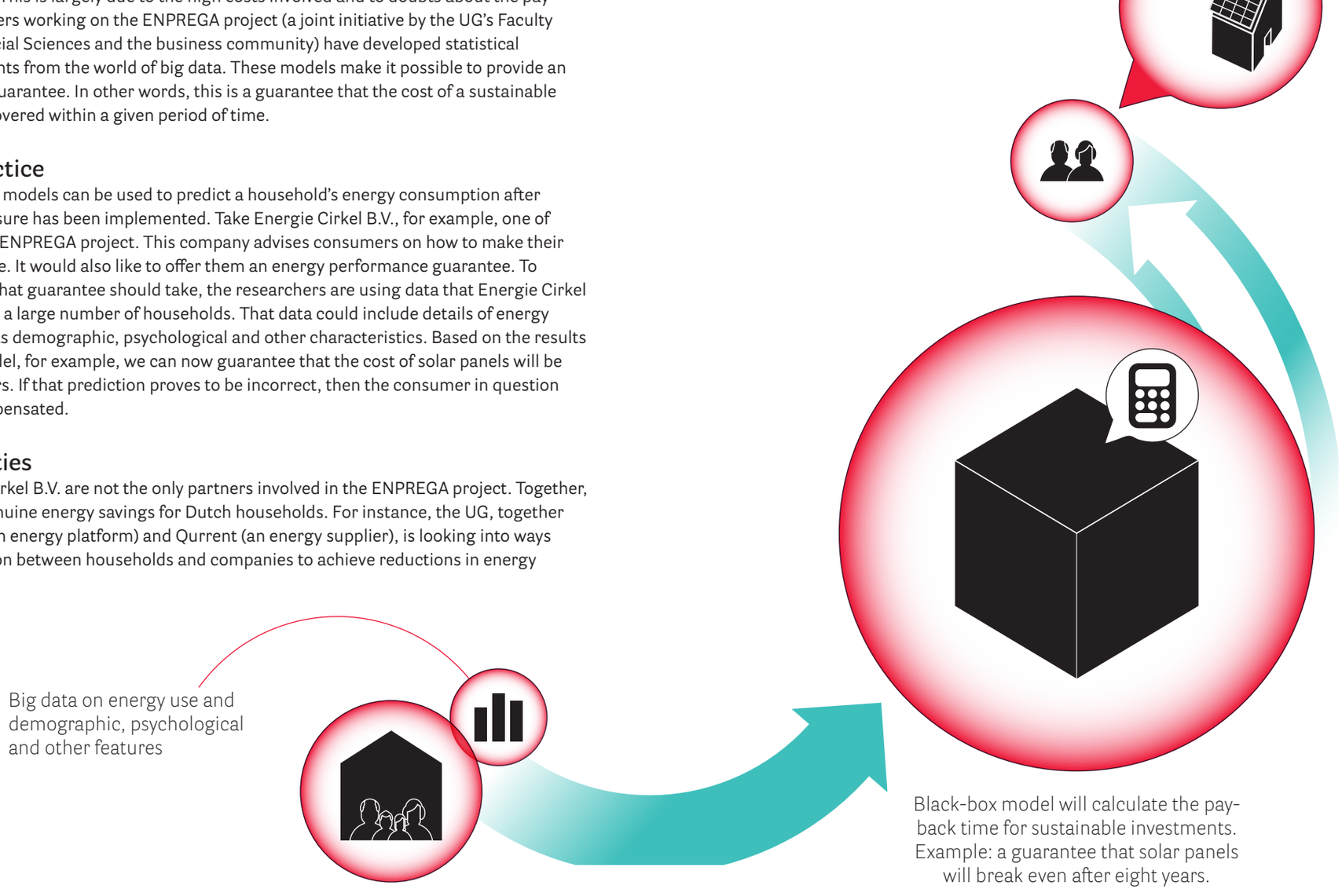
However well-intentioned people may be, few of them actually take steps to make their home more energy efficient. This is largely due to the high costs involved and to doubts about the pay-back period. Researchers working on the ENPREGA project (a joint initiative by the UG's Faculty of Behavioural and Social Sciences and the business community) have developed statistical models based on insights from the world of big data. These models make it possible to provide an energy performance guarantee. In other words, this is a guarantee that the cost of a sustainable investment will be recovered within a given period of time.

In everyday practice

These UG researchers' models can be used to predict a household's energy consumption after an energy-saving measure has been implemented. Take Energie Cirkel B.V., for example, one of the participants in the ENPREGA project. This company advises consumers on how to make their home more sustainable. It would also like to offer them an energy performance guarantee. To determine what form that guarantee should take, the researchers are using data that Energie Cirkel B.V. has collected from a large number of households. That data could include details of energy consumption, as well as demographic, psychological and other characteristics. Based on the results obtained from the model, for example, we can now guarantee that the cost of solar panels will be recovered in eight years. If that prediction proves to be incorrect, then the consumer in question will be financially compensated.

Joint opportunities

The UG and Energie Cirkel B.V. are not the only partners involved in the ENPREGA project. Together, they plan to deliver genuine energy savings for Dutch households. For instance, the UG, together with Rentalsplit B.V. (an energy platform) and Qurrent (an energy supplier), is looking into ways of using communication between households and companies to achieve reductions in energy consumption.



'WE ARE ALSO TRYING TO FIND OUT WHICH MODEL DELIVERS THE BEST PREDICTIONS'



Adjunct professor Casper Albers (Academic project leader) and PhD student Maliheh Namazkhan
Faculty of Behavioural and Social Sciences at the UG

'Our 'black box' models use big data that Energie Cirkel B.V. has collected about numerous households. This enables us to predict a green investment's payback period as accurately as possible. In this regard, we don't focus solely on average households, instead we tend to highlight households where things are either going very well or not so well. Energie Cirkel B.V. already uses models that make predictions about average energy consumption. These 'expert-driven' models explore various characteristics of houses and households, and ways in which these are interrelated (according to the experts). In the framework of the ENPREGA project, we will also attempt to determine whether the black box model is a better predictor than the expert-driven model.'

Projectpartners
University of Groningen, Energie Cirkel B.V., Uneto-VNI, EnergySense, Rentalsplit B.V. and Qurrent

Extra information
In 2016 the ENPREGA project was awarded a grant of € 1.3 million from the Netherlands Enterprise Agency

Big data: what determines customer satisfaction?

Details of the study

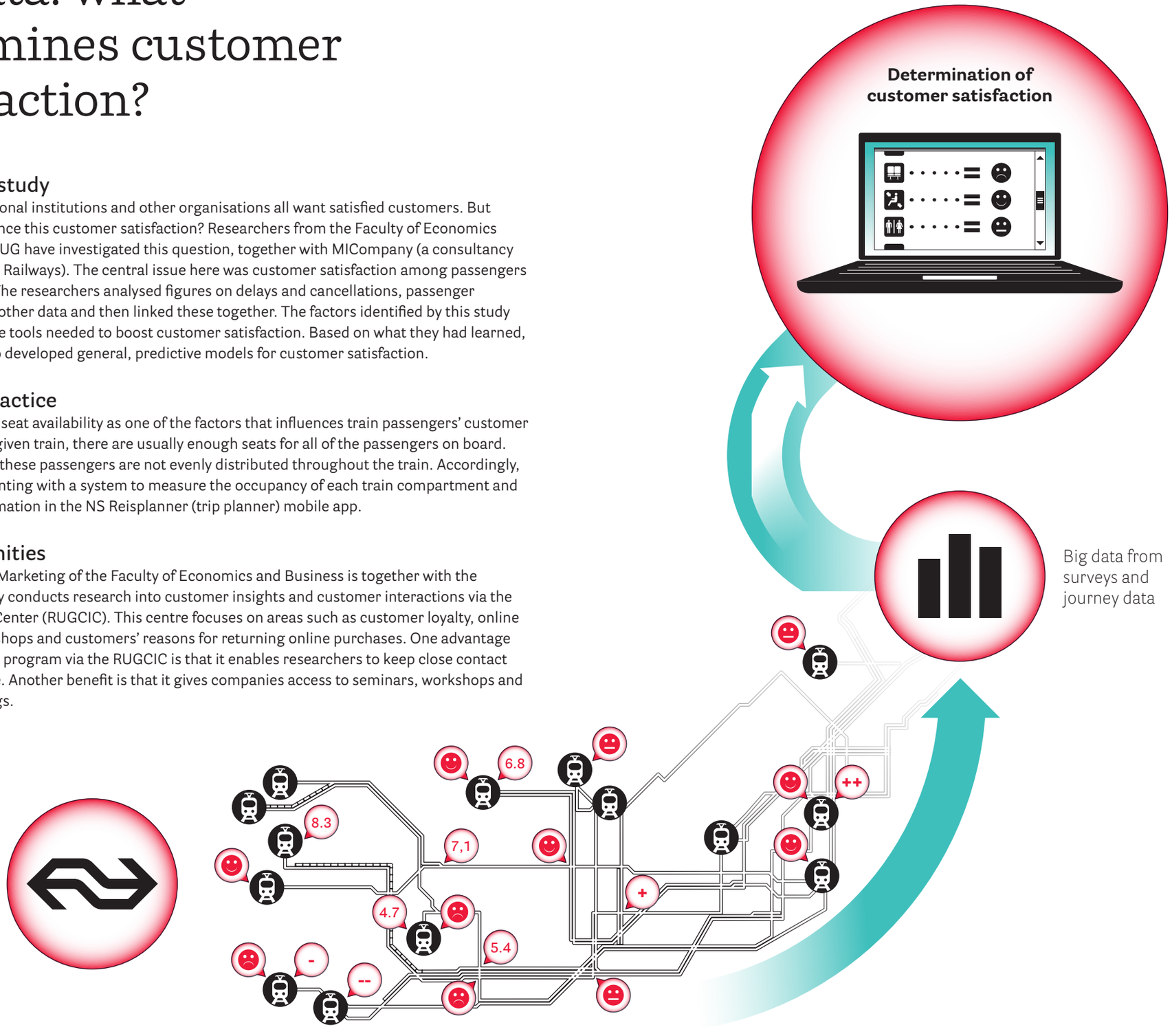
Companies, educational institutions and other organisations all want satisfied customers. But which factors influence this customer satisfaction? Researchers from the Faculty of Economics and Business at the UG have investigated this question, together with MICompany (a consultancy firm) and NS (Dutch Railways). The central issue here was customer satisfaction among passengers travelling with NS. The researchers analysed figures on delays and cancellations, passenger questionnaires and other data and then linked these together. The factors identified by this study provided NS with the tools needed to boost customer satisfaction. Based on what they had learned, the researchers also developed general, predictive models for customer satisfaction.

In everyday practice

The study identified seat availability as one of the factors that influences train passengers' customer satisfaction. In any given train, there are usually enough seats for all of the passengers on board. The problem is that these passengers are not evenly distributed throughout the train. Accordingly, NS is now experimenting with a system to measure the occupancy of each train compartment and to display this information in the NS Reisplanner (trip planner) mobile app.

Joint opportunities

The Department of Marketing of the Faculty of Economics and Business is together with the business community conducts research into customer insights and customer interactions via the Customer Insights Center (RUGCIC). This centre focuses on areas such as customer loyalty, online experiences of webshops and customers' reasons for returning online purchases. One advantage of this collaboration program via the RUGCIC is that it enables researchers to keep close contact to everyday practice. Another benefit is that it gives companies access to seminars, workshops and round table meetings.



'ASSESS THE PRACTICAL REALITY OF ANY RELATIONSHIPS FOUND'



Professor Peter Verhoef
Faculty of Economics and Business at the UG

'Given the complex jumble of data involved, it is not always easy to work with big data. Sometimes, this data comes from a range of different sources or information is missing. It can also be difficult to identify real-world phenomena that correspond to relationships found in the data. If necessary, we adopt a different approach – such as alternative research methods – to confirm that the relationships found actually exist in the real world. With the NS, for example, we included additional questionnaires and feedback from railway staff in the study.'

Projectpartners
University of Groningen, NS and MICompany

Extra information
In 2016, this research project was one of five nominees for the Gary Lilien ISMS MSI Practice Prize, a prestigious marketing award



The Faculty of Medical Sciences is located at Universitair Medisch Centrum Groningen (UMCG) area. The UG and the UMCG offer three academic medical studies: Medicine, Dentistry and Human Movement Sciences.

Research and Education

3

At the University of Groningen, big data is firmly rooted in both research and education. Aside from research projects (a selection of which can be found in Chapter 2), various UG research centres also focus on aspects of the digital society, including big data. There are also numerous degree programmes in which big data plays an important role. Not only for students, but also for professionals employed by companies and other organisations.

Research at the UG: Collaboration brings innovative solutions

Developments in academia often occur at the intersections of disciplines. Thus, the University of Groningen brings parties from different disciplines together to engage in multidisciplinary and interdisciplinary research. Together, they can make a difference and find innovative solutions to societal challenges related to the UG focus areas of 'energy', 'healthy ageing' and 'sustainable society'.

Support

Multidisciplinary and interdisciplinary research that leads to innovative solutions – what does this require? First of all, the University of Groningen (UG) creates a varied, international setting in which divergent points of view and different research methods can be combined. The University also makes up-to-date IT infrastructure available, as this is key to assessing large amounts of data in a broader context. And finally, the UG makes every effort to foster an entrepreneurial spirit. It supports researchers who have novel, high-risk ideas and helps them to establish strategic partnerships.

Research centres

The UG's research centres are an important cornerstone of the University's multidisciplinary and interdisciplinary research activities. These centres offer facilities, networks and other amenities to academics who, together with other parties (government bodies, companies, non-profit organisations, knowledge institutions and members of the public), are engaged in question-driven fundamental research. The subject of big data is a common thread running through research centres such as the Groningen Engineering Center, the Groningen Centre for Digital Humanities, and the Groningen Cognitive Systems and Materials Center.

Would you like to know more about the organisations that collaborate with these centres? You can find a summary, listing many fascinating examples, at www.rug.nl/industry-relations.

RESEARCH CENTRES

GRONINGEN COGNITIVE SYSTEMS AND MATERIALS CENTER (CCS&M)

THE PARTNERS INVOLVED
The UG's Faculty of Science and Engineering.

WHAT DOES IT HAVE TO OFFER?
The CCS&M pools expertise from physics, chemistry, materials science, mathematics, artificial intelligence and computer sciences. Together, the researchers involved are exploring new materials and systems for the development of a cognitive computer. In other words, a computer that operates like the human brain.

GRONINGEN ENGINEERING BUSINESS CENTER (GEBC)

THE PARTNERS INVOLVED
the UG's Groningen Engineering Center (GEC) and various cooperatives from the northern region of the Netherlands, representing around 150 technologically-oriented companies.

WHAT DOES IT HAVE TO OFFER?
The GEBC directly pairs research questions from the business community with the range of teaching and research services offered by the UG. This ensures that a research question from industry is immediately taken up by the GEC research group that is best equipped to handle it. It also means that any students who are on the lookout for an internship or graduation project can more quickly find a company in the northern region of the Netherlands that matches their field and area of interest.

GRONINGEN DIGITAL BUSINESS CENTRE (GDBC)

THE PARTNERS INVOLVED
The UG's Faculty of Economics and Business and Faculty of Science and Engineering, and the Noordelijke Online Ondernemers (Northern Netherlands Online Entrepreneurs).

WHAT DOES IT HAVE TO OFFER?
Operating within the framework of the GDBC, the University of Groningen and the Noordelijke Online Ondernemers are helping to strengthen the structure of the digital sector in the northern region of the Netherlands. This involves knowledge development, training young professionals for careers in this sector, and sharing knowledge with companies in the digital sector.

GRONINGEN CENTRE FOR DIGITAL HUMANITIES

THE PARTNERS INVOLVED
The UG's Faculty of Arts, Faculty of Philosophy, and Faculty of Theology and Religious Studies.

WHAT DOES IT HAVE TO OFFER?
This UG interdisciplinary institute specialises in digital research methods. It encourages innovative research projects that link the humanities with computer sciences and information sciences. The Centre provides research infrastructure for various academic themes, ranging from media studies to archaeology. Since 2016, this institute has also been offering students a Master's degree programme in Digital Humanities.

DATA SCIENCE & SYSTEM COMPLEXITY (DSSC)

THE PARTNERS INVOLVED
The UG's Faculty of Science and Engineering.

WHAT DOES IT HAVE TO OFFER?
The DSSC brings together various Faculty of Science and Engineering disciplines, such as computer sciences, engineering, artificial intelligence and astronomy. Its objective is to collaborate on research into new developments in the area of big data and complex systems. In addition to translating research results into tangible innovations, the DSSC also trains data experts for careers in the academic, private and public sectors.

Education at the UG: research-driven, focused on professional practice, and interdisciplinary in nature

The University of Groningen offers top-quality education and internationally renowned degree programmes to students and professionals from all over the world.

Bachelor's and Master's degree programmes

Students can choose from more than 45 Bachelor's degree programmes, some of which have a range of variants (tracks), and more than 100 Master's degree programmes. The degree programmes feature a research-driven approach, in which students learn to put the knowledge and research skills that they have acquired into practice. They are given the opportunity to solve complex challenges in a practical situation, by means of guest lectures, assignments and internships. UG students also contribute to pioneering and socially relevant research projects.

Learning communities

Interaction and the mutual transfer of knowledge are essential ingredients of the education provided by the UG. This is exemplified by the learning communities, which illustrate this point very effectively. These are groups of students and lecturers who collaborate on assignments in which they are challenged to share their expertise and, in so doing, learn from one another. These communities regularly collaborate with companies and public organisations, which raise specific issues or provide knowledge and expertise.

Supplementary programmes

The UG's Graduate Schools offer a range of research programmes and top Master's programmes. In addition, the Honours College offers highly talented students a more rigorous programme that enables them to add an extra dimension to their existing knowledge and skills. University College Groningen offers students the opportunity to work in interdisciplinary teams, and to acquire knowledge by means of project-based education. In all of these degree programmes, students usually work on datasets or issues taken from everyday practice. Finally, the UG also offers post-Master's programmes at institutions such as the University of Groningen Business School.

Which of the UG's other degree programmes link to big data? You can find a summary at **www.rug.nl/industry-relations**.

BIG DATA IN DEGREE PROGRAMMES

The UG offers a range of degree programmes in which students are introduced to the subject of big data. Here are a few examples:

BACHELOR'S DEGREE PROGRAMMES:
- Econometrics and Operations Research
- Communication and Information Studies
- Informatiekunde
- Applied Mathematics
- Artificial Intelligence
- Astronomy
- Rechtsgeleerdheid – variant IT-recht

MASTER'S (AND RESEARCH MASTER'S) DEGREE PROGRAMMES
- Econometrics, Operations Research and Actuarial Studies
- Communication and Information Science (including Digital Humanities)
- Computing Science
- Mathematics – Statistics and Big Data variant
- Artificial Intelligence
- Human-Machine Communication
- Astronomy
- Recht en ICT
- Governance and Law in Digital Society

OTHER EDUCATIONAL OPTIONS

UNIVERSITY OF GRONINGEN BUSINESS SCHOOL (UGBS)

THE PARTNERS INVOLVED
UG researchers.

WHAT DOES IT HAVE TO OFFER?
The UGBS supports professionals in their professional development. To this end, it offers three Executive Master's degree programmes, four Executive courses (learning pathways) and in-house training courses. The Executive Master's degree programmes are primarily focused on accounting and finance. The Executive courses offer their participants academic insights into the areas of healthcare management, energy transition and marketing-data analysis. The 'MultiCompany Course: Inspiring Data Scientist' deals with topics associated with machine learning, modelling, text mining and data-based prediction.

UNIVERSITY OF GRONINGEN CENTRE OF ENTREPRENEURSHIP (UGCE)

THE PARTNERS INVOLVED
The University of Groningen, plus start-ups and existing companies in the north-eastern region of the Netherlands

WHAT DOES IT HAVE TO OFFER?
UGCE is the academic player in the area of innovation and entrepreneurship in the north-eastern region of the Netherlands. It disseminates academic knowledge by advising and supporting start-ups and existing companies. UGCE also trains students, PhD students, professionals from the business community and other interested parties. This can take the form of degree programmes, courses or training courses, for example. The Centre also conducts research into innovation and entrepreneurship, based on questions from the business community.



The Duisenberg Building at the Zernike Campus accommodates the Faculty of Economics and Business.

Infrastructure and facilities

4

When it comes to big data, the University of Groningen offers its researchers and knowledge partners high-quality infrastructure and a wide variety of facilities. These range from data management to field labs, and from virtual reality to a campus that brings knowledge institutions, companies and other organisations together. Anything is possible, even (sometimes) the seemingly impossible!

The CIT: a reliable and innovative partner for big data



The Center for Information Technology (CIT) is a centre of expertise in IT at the University of Groningen (UG). Providing expertise and high-quality services to the UG, companies and other parties, the CIT is one of the leading academic parties in the field of big data.

The CIT has a long tradition of expertise in the area of big data. This means that it is able to offer innovative solutions for large-scale data storage and processing. The CIT also coordinates the Data Federation Hub, which supports the UG's many data facilities and makes them available to users. This includes the use of data files and public files by various research groups, support for projects by experts in the area of data use, and high-performance computer facilities for a range of applications. The CIT is leading various projects in which these facilities are also being made available to private parties.

Geodienst and Reality Center

Within the CIT, the Geodienst offers support in the area of geographical information. It provides geographical data, software (Geographical Information Systems or GIS) and training courses, as well as performing analyses and troubleshooting. The Geodienst also carries out innovative projects with various partners, both from the University and elsewhere.
The Reality Center has unique, powerful and advanced virtual reality facilities. The CIT uses these facilities to conduct innovative research in various academic fields. It also uses them to create simulations for companies and government bodies.

Collaboration

The CIT is engaged in numerous collaboration programs with other parties, both public and private, often via the Samenwerking Noord IT networking organisation. Exaples include a 3D visualisation for the new Wildlands Adventure Zoo in Emmen and interactive maps for use with public transport and public transport bikes for the Groningen/Drenthe public transport agency, as well as powerful simulations of the boundaries of the universe for the Netherlands Institute for Radio Astronomy (ASTRON). There are also various projects related to medical data, involving the University Medical Center Groningen and various national partners. The CIT is also one of the partners involved in the 5Groningen initiative, which is testing the new generation of mobile communication equipment. Together with Statistics Netherlands (Centraal Bureau voor de Statistiek, CBS), the CIT has established the first Academic Data Center. This makes Statistics Netherlands' data more accessible for scientific research.

The Center for Information Technology (CIT) facilitates among other things advanced virtual reality facilities and is located at **the Smitsborg** at the Zernike Campus Groningen.

Leeuwarden

1 Frysk Datalab

Campus Groningen

2 Zernike Campus Groningen

3 Healthy Ageing Campus

Groningen University Library

4 University Library Inner City

5 University Library Zernike

6 Central Medical Library

Groningen, other locations

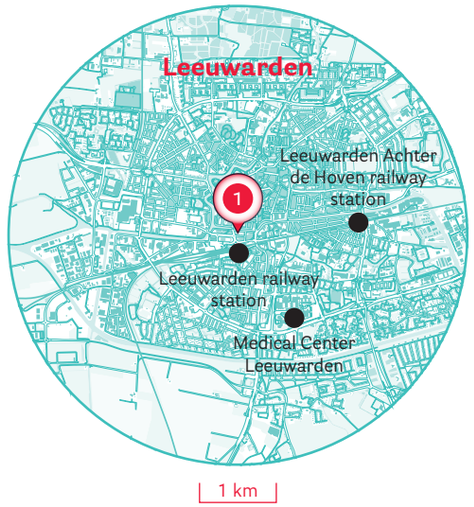
7 dHealth Lab

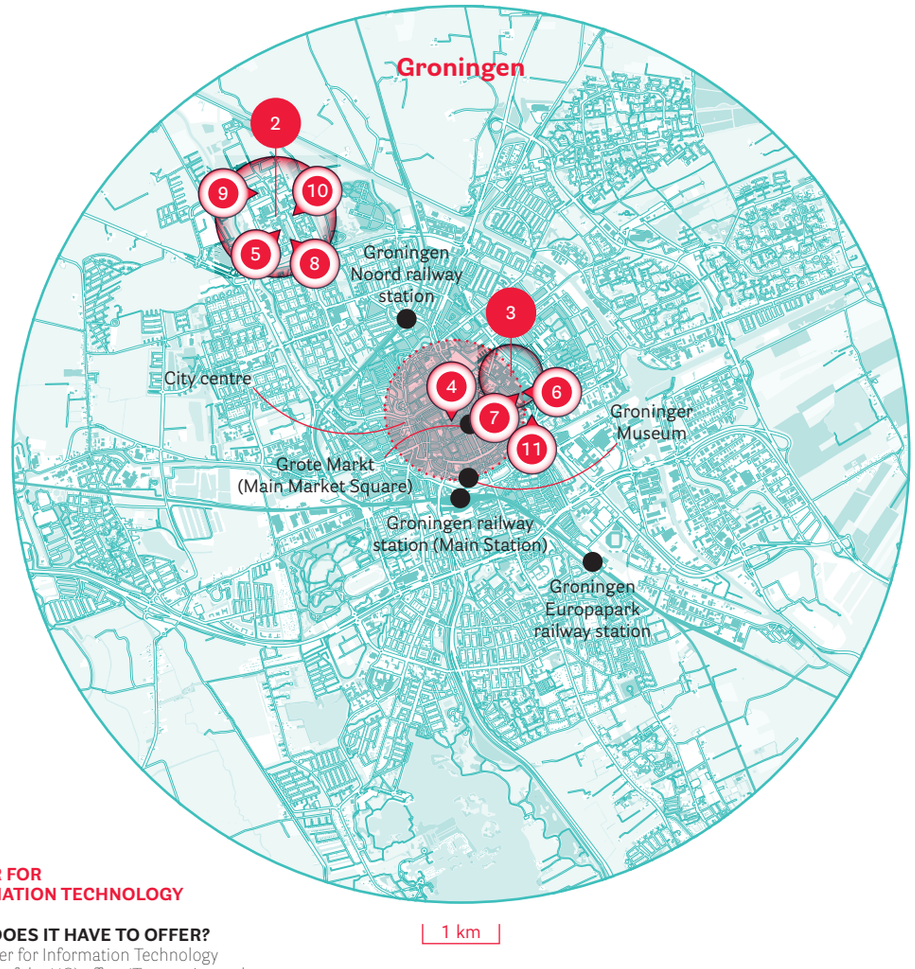
8 Center for Information Technology

9 Northern Knowledge

10 Energysense

11 Carduso Capital





1
FRYSK DATALAB

THE PARTNERS INVOLVED
the University of Groningen Campus Fryslân, NHL Stenden University of Applied Sciences and Van Hall Larenstein University of Applied Sciences.

WHAT DOES IT HAVE TO OFFER?
The Frysk datalab helps Frisian companies, knowledge institutions, government institutions and non-profit organisations to analyse the big data that they collect. This enables the UG, together with these parties, to conduct world-class research into big data and to create value for the organisation and for science. Once construction work on the datalab is complete, researchers and students will be able to analyse data by means of cutting-edge techniques.

2 3
CAMPUS GRONINGEN

THE PARTNERS INVOLVED
University of Groningen, University Medical Center Groningen (UMCG), Hanze University of Applied Sciences Groningen and more than 190 companies (such as Siemens, AVEBE, Target Holding, Diagnoptics and Syncom) and facility providers (such as Innolab Chemie Groningen, the Zernike NanoLab Groningen, Energy Academy Europe and Cube050 – an incubator)

WHAT DOES IT HAVE TO OFFER?
Campus Groningen is the innovation engine for the northern region of the Netherlands. It targets public-private partnerships – with links to the region – that focus on growth. The campus has two adjacent locations, the Healthy Aging Campus and the Zernike Campus Groningen, both of which are managed as a single ecosystem for the purposes of collaboration. It is a place where knowledge institutions, companies, facility providers and students can encounter one another. The natural growth of this campus is sustained by ongoing increases in scale, by the professionalisation of business park management, by the acquisition of companies and by attracting large investment funds.

4 5 6
THE UNIVERSITY LIBRARY (UB GRONINGEN)

WHAT DOES IT HAVE TO OFFER?
UB Groningen (part of the UG) operates as a partner to those engaged in study and research. It is the principal information and study centre for students, UG academic and support staff and members of the public in the northern region of the Netherlands. The library can be subdivided into the University Library City Centre, the University Library Zernike, and the Central Medical Library.

7
DHEALTH LAB

THE PARTNERS INVOLVED
University of Groningen, University Medical Center Groningen and Hanze UAS Groningen, as well as Wildsea and Reconcept (IT companies).

WHAT DOES IT HAVE TO OFFER?
At dHealth Lab, companies, students, researchers, healthcare professionals and end users engage in collaborative projects aimed at testing healthcare innovations. They use both virtual and physical environments for this purpose. If an innovation proves is successful, it is then rolled out for end users (such as members of the public, patients, business people or healthcare professionals).

8
CENTER FOR INFORMATION TECHNOLOGY

WHAT DOES IT HAVE TO OFFER?
The Center for Information Technology (CIT; part of the UG) offers IT expertise and services to the UG, to companies and to other parties. It is also one of the leading academic parties in the field of big data.

9
NORTHERN KNOWLEDGE

THE PARTNERS INVOLVED
University of Groningen, University Medical Center Groningen (UMCG) and Hanze University of Applied Sciences Groningen.

WHAT DOES IT HAVE TO OFFER?
Northern Knowledge is a 'knowledge transfer office' for knowledge institutes and companies in the northern region of the Netherlands. For this purpose, the UG, the UMCG and the Hanze UAS Groningen have joined forces in the areas of valorisation and entrepreneurship. Northern Knowledge's services focus on patent management, expertise in the area of intellectual property, screening and scouting, facilitating business people and supporting business development.

10
ENERGYSENSE

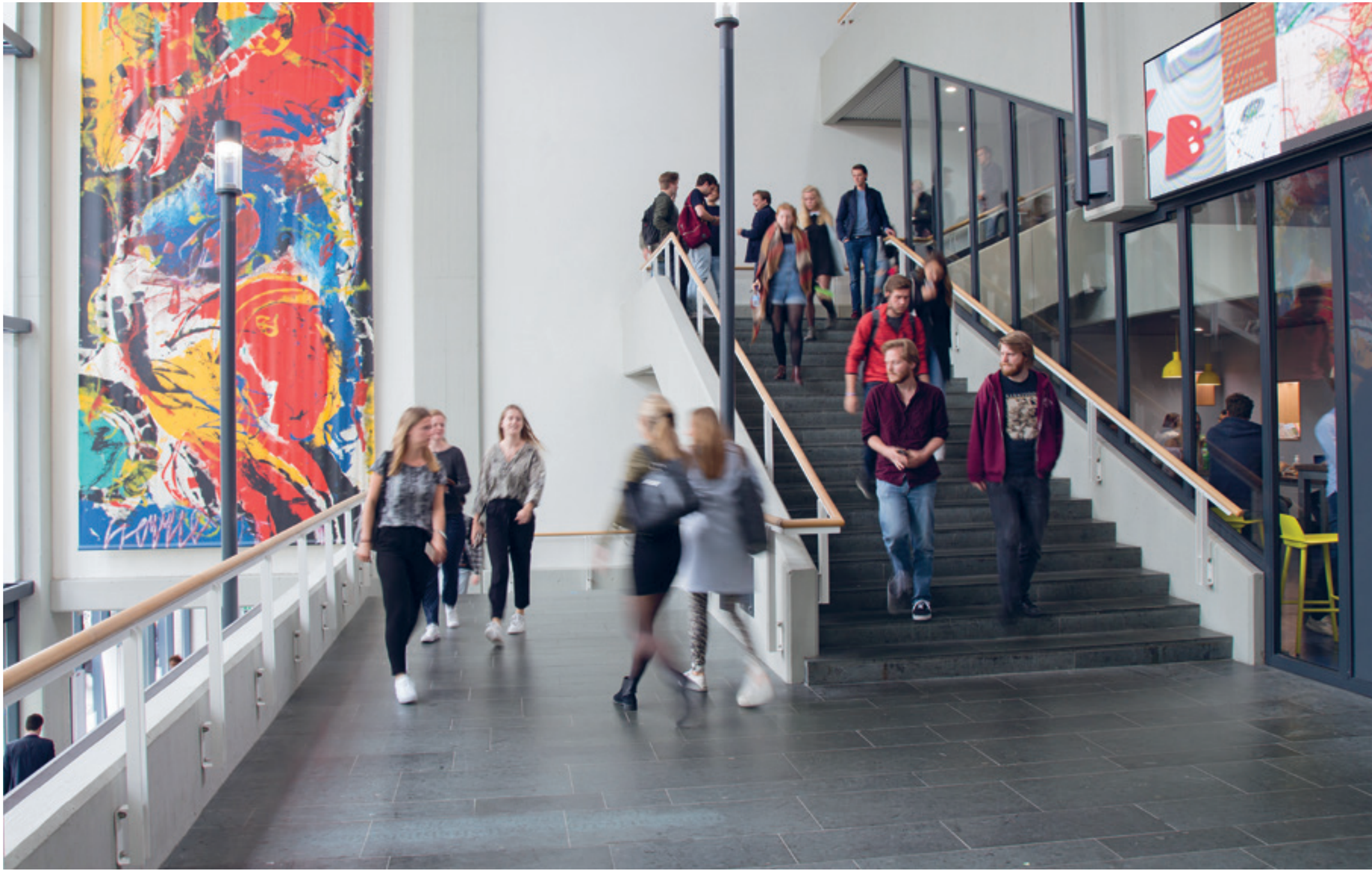
THE PARTNERS INVOLVED
University of Groningen, Hanze UAS Groningen, EnTranCe, Energy Academy Europe and 10,000 Dutch households

WHAT DOES IT HAVE TO OFFER?
EnergySense facilitates the collection and storage of energy-use data from 10,000 Dutch households. This data specifically relates to factors such as attitudes and behaviour. Researchers, companies, government bodies and public organisations can access and use this big data for the purpose of research. They also have a special testing ground, where they can develop and test innovative products. This all has the same common objective – energy solutions for a sustainable future.

11
CARDUSO CAPITAL

THE PARTNERS INVOLVED
University of Groningen, Energy Academy Europe, Innolab Chemistry Groningen, EnTranCe, Carbohydrate Competence Center (CCC) and WaterCampus Leeuwarden

WHAT DOES IT HAVE TO OFFER?
The business climate around the UG and the University Medical Center Groningen has fostered a growing number of initiatives by technology start-ups. These promising businesses are seeking venture capital that will enable them to grow. Carduso Capital gets involved in companies like this. In addition to funding, it also provides management support and strategic expertise.



In the centre of Groningen city, opposite to the Academy building, the **University library** is located. The University library is the central information and study center for students, UG employees and the public.

About the University of Groningen

5

The UG in numbers



11
FACULTIES
Economics and Business, Behavioural and Social Sciences, Theology and Religious Studies, Arts, Medical Sciences, Law, Spatial Sciences, Science and Engineering, Philosophy, University College Groningen and Campus Fryslân

5,900 FTE
IN STAFF

OF WHICH
3,000 FTE
IN ACADEMIC STAFF
(1/3 FROM ABROAD)

>120
NATIONALITIES
STUDYING OR WORKING
AT THE UG

400
PROFESSORS



30,000
STUDENTS
20% FROM ABROAD

48
BACHELOR'S DEGREE PROGRAMMES

167
MASTER'S DEGREE PROGRAMMES



6,000
ACADEMIC
PUBLICATIONS *

500
PHD STUDENTS *

22
PATENT APPLICATIONS *

* in 2016



The Academy Building is the main building of the University of Groningen and located at the Broerstraat. In this ceremonious building, the UG organises university ceremonies like PhD defences and inaugural lectures.

Awards



NOBEL PRIZE
Ben Feringa
Chemistry
2016

2016
SPINOZA PRIZE
Lodi Nauta
History of Philosophy

SPINOZA PRIZE
Bart van Wees
Applied Physics
2016

2015
SPINOZA PRIZE
Cisca Wijmenga
Human Genetics

SPINOZA PRIZE
Theunis Piersma
Migratory Bird Ecology
2014

2004
SPINOZA PRIZE
Ben Feringa
Chemistry

SPINOZA PRIZE
Dirkje Postma
Pathophysiology of Breathing
2000

1996
SPINOZA PRIZE
George Sawatzky
Physics



NOBEL PRIZE
Frits Zernike
Physics
1953

Trivia

After Leiden University, the University of Groningen (1614) is the oldest remaining university in the Netherlands.

In terms of size, the UG is the third largest university in the Netherlands, and – after the University Medical Center Groningen – it the largest employer in the province of Groningen.

Did you know that the UG also has degree programmes whose graduates are awarded the title of 'ir.' (ingenieur)? One example is Industrial Engineering and Management, others are Applied Mathematics and Biomedical Engineering.

The University has some famous alumni, such as Aletta Jacobs (the first female student graduated in the Netherlands), Job Cohen (a politician), Hans and Wim Anker (lawyers), Wubbo Ockels (the first Dutch astronaut) and Wim Duisenberg (the first President of the European Central Bank).

The UG has 432,500 m^2 of facility floorspace, including high-tech laboratories, study facilities and IT facilities (Center for Information Technology).

When it comes to universities that best prepare their students for the digitisation of society, the UG ranks fifth in the world. That was the conclusion of the annual Global University Employability Survey of businesses. The respondents were given a list of 150 universities to choose from.

CONTACT

The www.rug.nl/industry-relations website gives brief descriptions of the research projects being carried out by UG researchers and students, in collaboration with other knowledge institutions, the business community, government bodies, non-profit organisations and members of the public.

Here, you can also find more information about the Industry Relations team.

If you have questions, comments, or suggestions please get in touch with the team of Industry Relations.

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The team of Industry Relations

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In compiling this portfolio book, every effort has been made to ensure that the material it contains is as accurate as possible. The University of Groningen is not liable for any errors (or printing errors) or omissions.

