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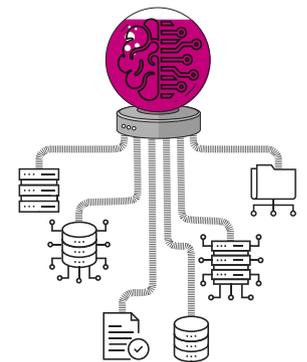
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PAUL KLINT

## Keep this secret, please

**Security by obscurity is known to be an unreliable strategy. The failure of this strategy has now completely corrupted our IT infrastructure. Spoiler: don't expect a happy end.**

Once upon a time in the west, there was a security agency that thought it was a clever idea to actively search for, collect and create a multi-million market for so-called 0-day exploits: security holes in widely used software such as Windows, Linux, MacOS, Chrome, Word, Excel, and many others. These exploits were completely new and had never been exploited before (hence the zero). They are ideal for penetrating the enemy's IT systems. This agency was not just an agency; it was the National Security Agency (NSA), the most secretive of all security agencies worldwide.

In 2013, Edward Snowden revealed the worldwide espionage activities of the NSA, including the unconstitutional espionage on US citizens on US territory. The repercussions for the NSA were dramatic but paled into significance compared to the announcement in 2016 by a group called Shadowbrokers that they had stolen and would make public the entire treasure trove of 0-day exploits collected by the NSA over the years. And they did. Every nation state or criminal organisation worldwide could now use these tools for their own goals, ranging from espionage to cyber extortion. This became standing practice, which exists until today. Russian actors can directly control physical systems from the power grid in Ukraine to nuclear power plants and oil pipelines in the US. North Koreans collect millions of dollars in Bitcoin by encrypting the data of thousands of municipalities and companies worldwide and extorting them. Ransomware-as-a-service is commercially available today, including, unbelievable as it might sound, an ethical code of conduct and a help desk. Actors from China, Iran, and Eastern Europe have been identified carrying out similar activities.

Keeping a secret is hard for many reasons, and in the end, most secrets are revealed. Building your security strategy on secrets presents a significant hazard. The same is true when combatting criminality and terrorism: the regularly proposed (and hotly contested) idea of a government backdoor in our phones and laptops creates another secret waiting to be exposed. Don't do that.

The problem we are facing is so gigantic that it seems to require a complete redesign or at least rethinking of our computing and communication infrastructure. That is not something which can be realised overnight. Research suggestions and clever ideas are urgently needed. If the above did make you nervous, then read the full story about the cyber-weapons arms race in Nicole Perlroth's book entitled 'This is how they tell me the world ends', Bloomsbury Publishing, 2021. This is compulsory reading for anyone involved in IT in a professional, or even better: governmental, role. It is a good, extremely informative read. But beware: there is no happy end.

# STOP FIXING THE WOMEN; START FIXING THE SYSTEM

By Bennie Mols

Images TU/e-Vincent van den Hoogen, UT,  
Istockphoto

**How to improve the recruitment, onboarding and promotion of women in computer science? The IPN working group on Equity, Diversity and Inclusion recently published a report with five practical recommendations.**

Professor Marieke Huisman from the University of Twente had her first child in France and her second in the Netherlands. She was struck by how differently people in the two countries reacted to the announcement of her pregnancy. Huisman: 'In France, the first question people asked me was: "Have you already arranged for a place in the nursery?". The implicit assumption was that you would continue working. In the Netherlands, I was asked: "How many days will you continue to work?" That is typical of the part-time culture among women that is seen as the norm in the Netherlands.'



### Marieke Huisman

'No professor is against diversity, but it's about what's actually being done to make it happen'

Childcare is one of many examples of obstacles for women in science. On behalf of the IPN working group on Equity, Diversity and Inclusion, Huisman and fellow professor Alexander Serebrenik from Eindhoven University of Technology prepared a report on the recruitment, onboarding and promotion of women in academic computer science research. Specifically, they looked at women working as assistant, associate or full professors.

## Five topics

For the report, they spoke between November 2020 and January 2021 with 15 representatives from all Dutch universities with a computer science degree and Centrum Wiskunde & Informatica (CWI). Eleven of them were women and four were men. The result is the report 'Women in Dutch Computer Science: Best Practices for Recruitment, Onboarding and Promotion', which lists five key recommendations (see box). 'Initially, we focused on three topics', Serebrenik explains. 'Recruiting, onboarding and promoting. Two additional topics emerged from the conversations: parenting and awareness of diversity.'

'In terms of diversity awareness, quite a lot is already happening, but we still want to urge the computer science community to do more', says Huisman. 'For example, it's not just about hiring more women; it's also about making them feel included. So, in addition to diversity, it's about inclusivity. Something like maternity

leave should be well organised and not be something one has to fight for.'

Huisman says that while the importance of diversity has really sunk in among department heads, the crux is in taking concrete steps on the work floor. 'No professor is against diversity, but it's about what's actually being done to make it happen.' Often you hear a 'yes, but...', Serebrenik adds. 'Yes, we want more women, but we can't find them. Yes, we want more women, but they don't apply. The blame then always lies with the women, and that is unjustified.'

Serebrenik's scientific specialisation is social software engineering. For example, he studies how diversity in software development teams affects the process and the result. Even though that isn't exactly the same as the functioning of a computer science department at a university, from his research, he nevertheless concludes that diversity makes a substantive difference. Serebrenik: 'In software development teams, we clearly see that diversity positively affects both the process and the outcome. When you invest in diversity, you are indirectly investing in better quality software.'

Advertisements aimed at recruiting women need to be formulated in gender-neutral language, should not emphasise excellence, and should explicitly encourage women to apply. Huisman: 'Research has shown that women are more likely than men to be put off by ads that emphasise a competitive spirit. It's a classic prejudice, yet I often see it in practice. If there is a list of ten requirements that an applicant must meet, a woman is more likely to think "I can only do six", while a man is more likely to think "I meet three, but I'll learn the other seven".'

To feel truly included in a new organisation, many women find it helpful to have a female mentor to show them the way. 'But this mentoring task must then be seen as work', says Serebrenik, 'and not as something that comes as an addition to regular work. If a senior woman is given a mentoring task, then that should automatically mean that something goes off from other tasks.'

## Clear criteria

Decisions about whether or not a person gets promoted need to be made transparent, is another recommendation in the report. Serebrenik: 'Our interviewees indicated that it is not always clear what criteria promotion decisions are based on. On the other hand, sometimes the criteria are explicit, but there are so many that no one can reasonably meet them. Both unclear criteria and too many criteria create a lot of stress and uncertainty. Being clear about the criteria for promotion benefits people of any gender, but because women are less likely to feel that they meet certain criteria, a lack of clarity affects them more.'

## Alexander Serebrenik

'We all benefit from diversity, and we all bear responsibility for it, scientists but also the support staff'



The report 'Women in Dutch Computer Science: Best Practices for Recruitment, Onboarding and Promotion' has been presented to IPN. It will also be distributed to the heads of the computer science faculties at Dutch universities and CWI, and to NWO. Later this year, Huisman and Serebrenik plan to sit down with the department heads to discuss what they plan to do with the report. 'It's not that everyone has to implement everything right away', Huisman says, 'but we want them to think about it and see what they can improve in their own departments.'

Serebrenik wants to emphasise that when we talk about women in computer science, we are not talking about a problem of women: 'It's a problem of the computer science community in the broadest sense. We all benefit from diversity, and we all bear responsibility for it, scientists but also the support staff.'

And though for the current report, Huisman and Serebrenik may have looked specifically at the position of women, the IPN working group on Equity, Diversity and Inclusion certainly wants to look at diversity in a broader sense as well. Huisman: 'Diversity is also about different cultural and ethnic backgrounds, about migrants and about different socioeconomic environments. We want to make it clear that computer science is there for them too.'

## Recommendations

1. Create awareness among scientific and support staff of the importance of diversity among employees of all genders and seniorities.
2. Recruitment messages should be gender-neutral, should not stress excellence and should explicitly encourage women to apply.
3. Mentoring should be a mandatory element of the onboarding.
4. Transparency in tenure and promotion decisions is crucial.
5. Support for maternity leave, parental leave and childcare should be improved.

The report can be found online at [ict-research.nl/edi-working-group/outcomes/](https://ict-research.nl/edi-working-group/outcomes/)

## ALICE AND EVE EVENT

Alice & Eve 2021 is a workshop for celebrating women in computing in the Netherlands. It aims to bring together talents in the field of computing. The first edition took place in 2020. The second edition will be hosted in November 2021 by Radboud University. In addition to keynote talks and posters, there will be an exhibition which portrays women in computing and their most important contributions. For the Alice & Eve exhibition, a booklet is being published that describes the pivotal role of twenty-five women in the field of computer science: Alice & Eve: A Celebration of Women in Computing. Amongst other things, it highlights the work of some well-known Dutch female computer scientists such as Linda van der Gaag, Frances Brazier and Felienne Hermans.

[aliceandeve.cs.ru.nl](https://aliceandeve.cs.ru.nl)

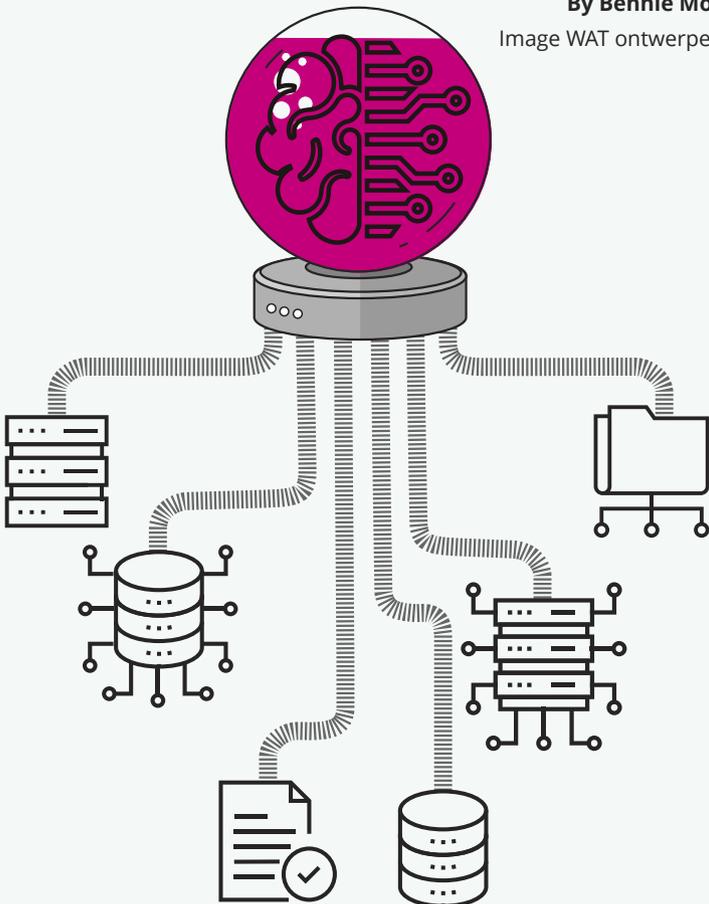


# MODELLING COMPLEX SOFTWARE SYSTEMS

**Önder Babur is developing new techniques to deal with the ever-increasing complexity of software. Instead of working on yet another model to develop software, he is trying to understand, construct and manage the ecosystem of different models as a whole.**

By Bennie Mols

Image WAT ontwerpers



As software systems are getting ever more ubiquitous, larger, more complex and multidisciplinary, they become increasingly difficult to understand and manage. Also, for decades, models have been developed that are specific to a certain domain, such as automotive or cyber-physical systems. During his PhD research at Eindhoven University of Technology, Önder Babur collected hard evidence that this modelling effort itself is getting out of hand. 'The ecosystem of models is getting more and more complex itself', says Babur. 'When I started my research, the experts I talked to didn't even realise that this is a problem. But the evidence I collected from open source software and from software used by companies in the Eindhoven area clearly showed that the modelling ecosystems contain hundreds to thousands of different models in many languages and domains.'

Next, Babur developed techniques inspired by information retrieval and machine learning to understand, construct and manage the growing complexity of the modelling ecosystem. Babur: 'Software models often use bits and pieces from previously developed models. We call this cloning. It doesn't have to be a problem, but it often is. So, I developed techniques that can find, inspect, improve or remove such cloning.'

## IMMERSED IN ASML

During his PhD research, Babur collaborated with ASML, the Dutch multinational that manufactures photolithography machines for the production of computer chips. 'Their machines are huge and very complex', says Babur, 'and so is the software that runs on these machines. Interestingly for us, ASML is a proponent of model-driven software engineering. They use a lot of modelling to handle the complexity of the software. The many models that the company uses span multiple domains and languages, are developed by different teams or outsourced to other companies, and are changing over time. My aim was to explore whether we could analyse this complex ecosystem using the approach I was developing in my PhD research.'

Babur worked for one day a week inside ASML and involved a master's student to help him. The collaboration resulted in some concrete ideas that ASML could use to automate the analysis of their complex modelling ecosystem.

Babur defended his PhD thesis at the start of 2019 and did a postdoc after that. He used the insights from the ASML collaboration to convince colleagues in the field of the importance of his meta-analysis of domain-specific models. 'And recently this approach is indeed getting more attention', he concludes happily.

In April of this year, Babur started to work as a lecturer at Wageningen University & Research, where he applies his expertise in software modelling to the life, agricultural and environmental sciences. 'One of my new collaborations involves a digital twin model applied in the field of nature conservation. In the future, I am also going to focus more on building AI assistants that can help modelling systems.'

## DCYPHER REVITALISED

dcypher, the Dutch cybersecurity platform higher education & research, was discontinued on 1 October 2020. Since then, several government ministries have been setting up a new platform. The recently formed platform board has decided to breathe new life into dcypher and keep the name. In the meantime, a group of researchers announced the establishment of an association for scientists active in the multidisciplinary field of Cybersecurity in the Netherlands. The name of the association is ACCSS (pronounce access, ACademic cybersecurity Society). The association in formation is also continuing a few activities from the former dcypher, such as the annual presentation of the Dutch Cybersecurity Best Research Paper Award.

More information can be found at [dcypher.nl](http://dcypher.nl) and [accss.nl/en](http://accss.nl/en)

## TWO COMPUTER SCIENTISTS ELECTED KNAW MEMBER

The Royal Netherlands Academy of Arts and Sciences (KNAW) has elected 23 new members, including two computer scientists. Thomas Bäck (1963), Professor for Natural Computing at Leiden University, is the founder of evolutionary computation, a subfield of mathematics that draws inspiration from evolutionary biology to find the best solution to a given problem. Rineke Verbrugge (1965), Professor in Logic and Cognition at the University of Groningen devotes many of her publications to intelligent interaction.

She has developed a well-known game that combines logic, game theory and cognitive psychology. They will be installed on Monday 13 September 2021.

## GRANTS FOR SCIENTIFIC INFRASTRUCTURE

NWO is investing 20 million euros in seven projects for innovative scientific infrastructure. These NWO Investment Grant Large awards will be used to acquire high-value equipment, data collections and software. With these awards, NWO is strengthening the scientific infrastructure that Dutch knowledge institutions can make available to the Dutch research community. One of the awarded projects is in the field of digital humanities. The project Globalise, led by Matthias Van Rossum of the International Institute of Social History, will develop new digital research tools for Dutch East India Company (VOC) archives.

## TEN MILLION FOR SOLVING CYBERSECURITY ISSUES

Within the Dutch Research Agenda (NWA) programme Cybersecurity - Towards a secure and trustful digital domain, five proposals have been awarded from consortia that will investigate cybersecurity: three projects will focus on governance, and two will also focus on cryptologic aspects. The total research budget amounts to circa 10 million euros. Research into the governance aspects of cybersecurity focuses on the entire knowledge chain in which all science domains, vital infrastructures and liability regimes are involved. This includes research into legislation and into (international) standards and norms for a more secure cyberspace. For instance, one project will investigate how we can patch security leaks in software on time. Another project will establish ways to stave off the risk of quantum computers cracking encryption schemes.

# PELS RIJCKEN: WHERE ICT MEETS LAW

In data and digitalisation, two aspects are inevitable: technology and law. Those worlds seldom meet. This is, however, not the case with law firm Pels Rijcken in The Hague, which has ICT law among its specialisations. Senior associate Jeroen Naves: 'It is advisable to involve legal knowledge early on in ICT development.'

By Leendert van der Ent Image iStock

'ICT developers and lawyers speak different languages', Jeroen Naves says. 'You can take that literally, as I noticed in a meeting between lawyers and developers on smart contracts some years ago. It took both parties two days of being at cross purposes before the eureka moment of realisation that we were talking about different meanings.'

I always imagined that a smart contract was something like a self-executing contract with the terms of the agreement being directly written into lines of code. However, for blockchain developers, it is the code connected to the blockchain. In that sense, the term is not necessarily describing a legally binding contract. It was quite an eye-opener and taught me that it's useful to learn the developer's language.'

## EARLY INVOLVEMENT

This anecdote underlines the importance of knowing both worlds. 'We have to because we advise our clients on data exchange and innovation. They need to see technology in perspective and want to know about the legal consequences of technological development', Naves comments. 'That is why, for example, we are actively involved in the Dutch Blockchain Coalition, and our managing partner Sandra van Heukelom formerly presided the steering

committee. Likewise, we are involved in ECP, the platform for the information society.' Pels Rijcken also works with TU Delft on blockchain, has projects going on with Tilburg University, and collaborates with TNO, where the law firm is represented in the strategic advisory board (SAR) of the Unit Information & Communication Technology. Apart from consultancy, Pels Rijcken also specialises in licence agreements, guidance of ICT contracts and representation of clients in disputes and trials.

'Typically', says Naves, 'ICT developers start to work on applications without involving lawyers or, if they do involve them, only at a fairly late stage. When these lawyers are finally consulted, they will elaborate on what is forbidden. At our firm, we like to reverse things. We hope to be involved early on so that we can inform developers from the outset about what they need to take into account legally. And we stress the opportunities within the legal framework. If you only look into your rear-view mirror as a lawyer, then you will say "no" too easily. If instead, you look ahead and understand the technological basics, then you can inform your clients about the opportunities.'

When we discuss data, then more often than not, privacy is the key legal issue. That was the case with the Dutch Ministry of Health, Welfare and Sport's app Coronamelder (COVID-19 contact



warning). When you think about storage, encryption, architecture and specialised legal knowledge in a combined approach, you considerably enlarge the chances of success.'

When it comes to blockchain, Artificial Intelligence also comes into play. On 21 April, the European Commission proposed the first-ever legal framework on AI in the world. 'That is incredibly important for all technicians involved in this field. A simple example is that certain applications for face recognition are forbidden, but there are also more complex matters regarding the connection of datasets.'



Jeroen Naves

'If you only look into your rear-view mirror as a lawyer, then you will say "no" too easily'

## SCRAPING DATA

'We often see that data analysts in enterprise and government go after information by combining their own datasets with data "scraped" from a myriad of sources. When many sources are combined, it becomes hard to unravel the precise origin of the data. But personal data can only be used within the framework of the execution of certain narrowly described tasks.'

Furthermore, there are rules on scraping data; you cannot simply use everything you can lay your hands on. So ask your lawyer beforehand about what is and is not allowed.'

Governments using algorithms face challenges in the field of transparency. Naves gives an example: 'Municipalities use tools to define the value of real estate for property tax. In principle, that's fine – but these tools are often commercial. As a result, the developer will not disclose how they work because his business model depends on that remaining a secret. And taxation based on a black-box methodology has been struck down by judges.'

Naves would like to give a general piece of legal advice to ICT developers and policy makers: 'Be as transparent as possible about what you do.'

# Cognitive robotics: intelligence from the network

By Bennie Mols Images Ivar Pel



## GROUP PASSPORT

## RESEARCH FIELD

swarm robotics, cognitive robotics, smart mechatronics, brain-robot interfaces, data science, human and machine intelligence, machine learning, self-organisation

## INSTITUTION

Maastricht University

## EMPLOYEES (as of May 2021)

3 professors,  
4 associate professors,  
3 assistant professors,  
6 PhD students

## FACILITY

SwarmLab for building robots and other embodied AI systems, with the aim to gain a deep understanding of the design and control of biological and artificial intelligent systems.

## WEBSITES

SwarmLab: [www.maastrichtuniversity.nl/research/dke/research/cognitive-robotics-and-complex-self-organising-systems-swarmlab](http://www.maastrichtuniversity.nl/research/dke/research/cognitive-robotics-and-complex-self-organising-systems-swarmlab)

Robots in education: [www.maastrichtuniversity.nl/edmo](http://www.maastrichtuniversity.nl/edmo)

Brain-Robot project: [project.dke.maastrichtuniversity.nl/brain-robot](http://project.dke.maastrichtuniversity.nl/brain-robot)

Automated insect farming: [corosect.eu](http://corosect.eu)

FieldLab Robotics Roermond: [www.fieldlabrobotics.com](http://www.fieldlabrobotics.com)



Rico Möckel



**At Maastricht University, the SwarmLab investigates how to build smart robots and other embodied AI systems from many much simpler components.**



Isolate a single neuron in the human brain, look at it under the microscope and attach the most advanced measuring equipment to it. But whatever you try, you will never understand human intelligence by simply studying isolated neurons. Intelligence arises from the cooperation between tens of billions of neurons. 'Human intelligence can therefore be seen as a kind of swarm intelligence, a swarm consisting of neurons', says Rico Möckel, associate professor for Cognitive Robotics and Intelligent Systems at Maastricht University.

This idea of swarm intelligence is central to the research conducted by SwarmLab, which is part of the Department of Data Science and Knowledge Engineering (DKE) at Maastricht University. Möckel: 'I'm interested in distributed intelligence, like in a swarm of neurons or a swarm of birds. And I believe that if you want to build smart robots and other embodied AI systems, which is our goal, then you must do this according to a similar swarm principle by letting the intelligence emerge from components that organise themselves into intelligent structures and societies.'

At SwarmLab, you can see experiments on swarms of drones, but also work on modular robots for use in education and work on smart prosthetics and brain-computer interfaces. 'We have a broad view on what constitutes a robot', says Möckel. 'As far as we're concerned, a building equipped with sensors and actuators is also a robot.' Starting from the scientific question of what makes a system intelligent, the researchers at SwarmLab look for human-friendly applications. Möckel: 'We aim to integrate our research into concrete products that really benefit people.'

To achieve this, SwarmLab works, for example, with the FieldLab Robotics in Roermond, a knowledge centre for companies, educational institutions and authorities in the field of industrial robotisation. SwarmLab is also working with TU Delft, TNO and the Port of Rotterdam on developing swarm intelligence for the port.

The latest project that Möckel and his colleagues are working on is the European CoRoSect project in which cognitive robotics solutions are being developed for automated insect farms. Möckel: 'The idea is to get rid of the inefficiency and waste in our current food chain by using protein-rich insects. They can provide a lot of food, and that can be done very efficiently if we rear them on a highly automated farm with smart robotics.'

## Control by brain

Kirill Tumanov, who is currently a researcher at Maastricht University within the project Combating Child Obesity, did his PhD research from 2015 to 2019 at SwarmLab. As a teenager in Yaroslavl (Russia), he dreamed of controlling machines using brain signals and building brain-computer interfaces. When he was studying for his master's degree at Maastricht University, he started looking for a PhD project in which he could fulfil his dream. That turned out to be possible at SwarmLab, thanks to a collaboration with the neuroscience team of Bettina Sorger

Lucas Dahl



Kirill Tumanov

and Rainer Goebel at Maastricht University. 'I was using functional near-infrared spectroscopy to read brain signals of participants and see whether they could control autonomous assistive robots. The idea is that in the future, people with a severe physical handicap could use this technology to independently interact with their environment.'

When Tumanov started in 2015, the SwarmLab group was in its infancy. He saw the group gradually grow. One of the keys to creating a sense of belonging in the research group was a journal club. Tumanov explains: 'Every member of the lab would choose a scientific article that he or she thought would be of interest for everybody in the group, an article showing what is happening in the field. We would read the paper and discuss it together. This facilitated crossover between the different research directions.'

## Feeling in prosthetic arm

PhD student Lucas Dahl is a member of SwarmLab. He is doing research on a prosthetic arm. Wearers of current prosthetic arms cannot feel what they are grasping or touching. Dahl wants to take the next step: 'We're investigating how a

prosthetic arm can give a feeling to the wearer of that arm. What is unique about our prosthesis is that it has artificial skin, artificial muscles, and artificial intelligence.'

Dahl is still investigating how to distinguish between different types of tactile information entering the prosthetic arm. 'I have a background in mechatronics. However, I know very little about AI. But that is the beauty of SwarmLab: we have people who are experts in AI, and I can make good use of their knowledge.'

The fact that he can easily supplement his own knowledge with the AI knowledge of other researchers in the SwarmLab was one of the main reasons why Dahl wanted to do his research at Maastricht University. 'If you want to build cognitive robots that are aware of their surroundings, you have to combine mechatronics with AI.'

Besides a great diversity of scientific specialisms, SwarmLab also has a superb mix of nationalities. Dahl: 'We have people from the Netherlands, Germany, China, Russia, India, Iran... One of our most enjoyable joint activities before the pandemic was going to the home of one of our colleagues and cooking something from his or her national cuisine.'



**Ton de Kok** has been the director of CWI since 2020. Before that, he was Professor of Quantitative Analysis of Logistical Management Problems at Eindhoven University of Technology, a position that he now holds part-time. After obtaining his PhD, he worked for 7.5 years as a consultant at Phillips.

# THE STRENGTH OF CWI

Ton de Kok, the new director of the national research institute for mathematics and computer science, Centrum Wiskunde & Informatica, has always taken a keen interest in real-life problems. 'Applying the abstraction of mathematics to the chaos of real life is a challenge, but it yields great results.'

By Reineke Maschhaupt

Image Elodie Burrillon

## How did you end up at CWI?

'After almost thirty years of being a professor at Eindhoven University of Technology, I was asked for this job. Following my PhD, I worked for a while at Phillips. Since then, I have retained a fascination for operational processes in industry throughout my academic career. Since 1946, CWI's mission has been to do fundamental research that benefits society. My approach fits in well with that. I'm not as surprised as others might be when confronted by the chaos of real life.'

## What did you find at CWI?

'My vision is strongly oriented towards thinking as an outsider looking in. But you must first know where your strength lies. In February, we celebrated the 75<sup>th</sup> anniversary of CWI and that was fantastic, despite COVID-19. It was really well organised, in a professional studio. The people who work here are incredibly proud of the institute. I'm really impressed by how relevant the research done here is: cryptography, diagnostics for medics and energy issues. And very basic, but one of the most important challenges within computer science: storage and retrieval of data.'

## How do you see the future of the institute?

'As an NWO Institute, we fulfil a national role within the research community of mathematics and computer science. Some people in that community think that we do not fulfil our national role well enough. I take that criticism seriously. With my management team, I am now making a tour of all mathematics and computer science departments in the Netherlands. I want to itemise the strengths of the entire research community so that I can reshape CWI's national role within it.'

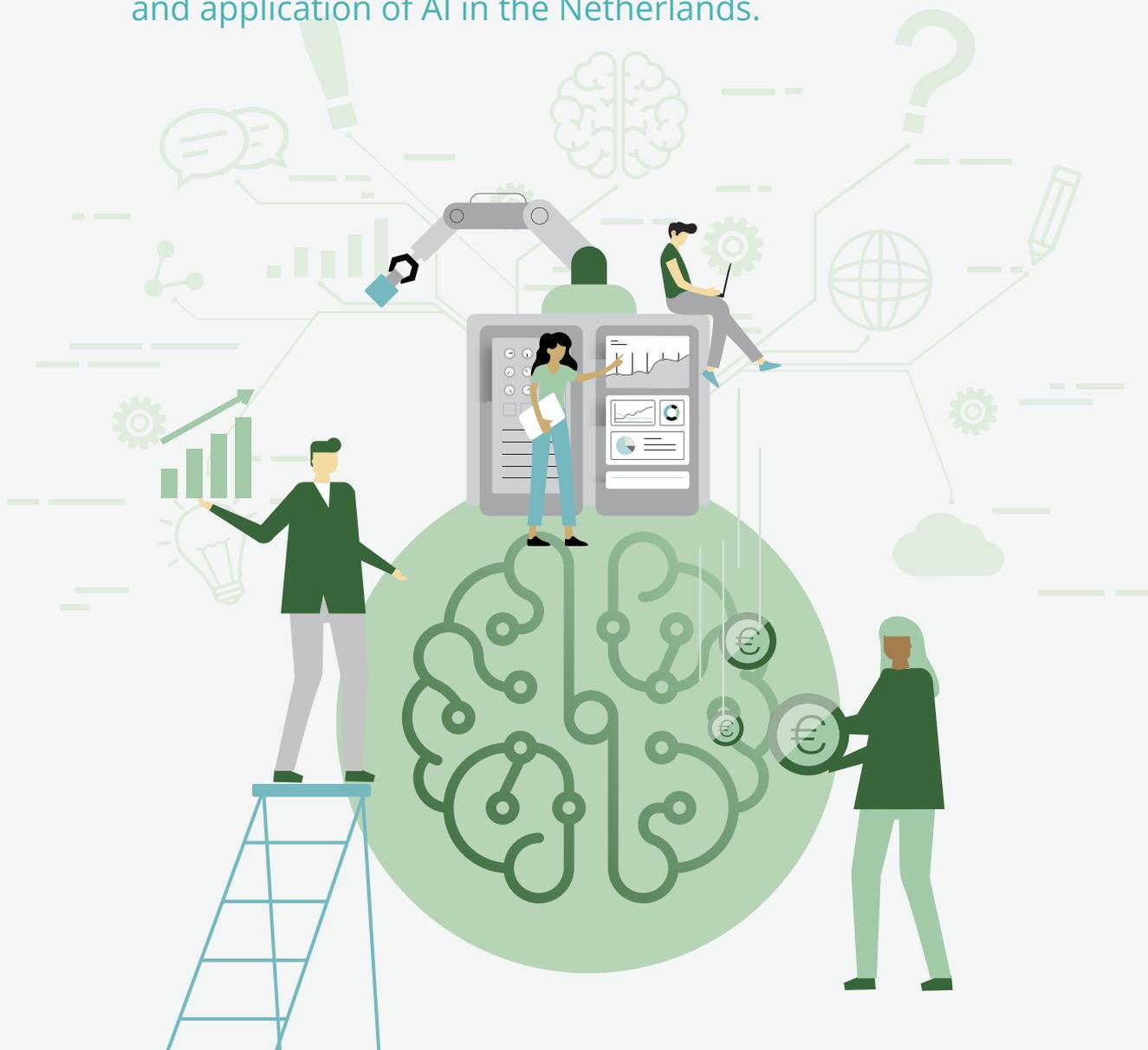
## What are CWI's strengths?

'Quantum computing is currently an important subject. In 2015, CWI and the University of Amsterdam launched QuSoft, a research centre for quantum software. The work of several CWI researchers in the field of machine learning has acquired world fame. The same is true for cryptography and optimisation. In addition, we play a role in attracting young talent, which – after a thorough research training – we subsequently send to the universities too. The Netherlands has many professors of mathematics and computer science who once spent some time working at CWI. We have a genuine incubator role.'

# DUTCH AI GOES FULL STEAM AHEAD

By Sonja Knols  
Image WAT ontwerpers

On 9 April, the Dutch government announced the allocation of 1.35 billion euros from the National Growth Fund to five innovative programmes. One of those is the first phase of AiNed, an ambitious long-term investment plan to accelerate the development and application of AI in the Netherlands.



The multiannual AiNed programme requires a total investment of 1.05 billion euros from the National Growth Fund over the period 2021-2027, with an equivalent sum also being jointly invested by private parties and standard public funds. During the first round of the National Growth Fund, an amount of 276 million euros has been allocated for AiNed's first phase. This is 80 percent of the requested budget.

'For a rapidly developing technology like artificial intelligence, it is impossible to predict what is needed six to eight years in advance', says AiNed representative Inald Lagendijk, explaining the choice for breaking down the investment plan into three different phases. 'So we decided to go for a learning by doing approach and to apply for funding for the first phase with activities starting in the coming two to three years.' From the allocated budget for the first phase, 44 million euros can be spent right away on four dedicated instruments.

## First instruments

To ensure a human-centred, responsible application of AI in society, dedicated ELSA (Ethical Legal Societal Aspects) labs will be set up. In these labs, companies, governmental organisations, knowledge institutes and citizens will work together. 'The focus of these labs is on studying how AI can be introduced into society in a socially acceptable way. Universities, companies and civil society organisations can send in proposals to start up or scale up such labs. We are currently preparing the first call for proposals, which the Dutch Research Agenda will partially fund', says Lagendijk.

The second instrument that will be started soon is a dedicated AI Talent programme. Lagendijk: 'We are still working out the details, but the aim is to attract and retain AI talent for the Netherlands by providing them with attractive start-up packages.' The remaining two instruments are aimed at strengthening the Dutch AI position in Europe. 'We not only want to enable Dutch partners to join initiatives like CLAIRE and ELLIS, but also to strengthen their voices in these types of networks by providing them with some financial resources they can bring to the table.'

## Two additional budgets

If the programme demonstrates that it can spend the first 44 million euros wisely, it will be awarded an additional 44 million euros. The remainder of the 276 million euros allocated to AiNed is a reservation, subject to conditions. The original proposal

describes twelve different instruments, not four. The remaining eight, aimed at ramping up education and establishing a chain approach for AI-innovation, need some additional clarifications before they can be granted.

'For the coming period, we have three priorities', states Lagendijk. 'First, we have to establish a governance model for the programme as a whole. Second, we need to find solid ways of spending the first 44 million wisely. And finally, we will start finetuning our plans for the remaining eight instruments to secure the additional 188 million euros that have been reserved for the AiNed programme.'

Researchers will be among the first to profit from this largest-ever investment in ICT innovation, Lagendijk anticipates. 'I expect we will be able to open up the first calls for research proposals before the end of this year. Although we have not yet decided on the best way to do this, we will obviously make grateful use of existing expertise by involving organisations like the Dutch Research Council or the Netherlands Enterprise Agency. This success is the result of years of hard work by the Dutch AI community, Lagendijk says. 'With the Netherlands AI Coalition (NL AIC) we created a strong network connecting over 400 parties. Together, we published a joint vision on "AI for the Netherlands", which was embraced by the Dutch cabinet and led to its "Strategic Action Plan AI". As a country, we have been lagging behind when it comes to investing in AI. With this funding, we will finally be able to catch up with our colleagues in Europe. Now the challenge is to deliver on our promise and use these funds to position the Netherlands among the worldwide frontrunners in the field of human-centred, responsible AI.'

## BOOST FOR QUANTUM SOFTWARE

In the first round of the National Growth Fund, a total of five proposals for projects designed to boost research and innovation have had € 1.35 billion of funding allocated and set aside for later use. AiNed is not the only ICT-related programme. Also Quantum Delta NL has been awarded 615 million euros to coordinate and realise the Netherlands' National Agenda for Quantum Technology. Besides the Delft research institute QuTech, the Dutch research centre for quantum software QuSoft is also one of the key partners in Quantum Delta NL, which will translate this grant into a tremendous boost for quantum software research.

# Shortest route to proper care

By Leendert van der Ent Image iStock

Providing elderly people with the care they need within the healthcare network is incredibly complex. Therefore, this challenge is ideally suited for a modelling and analysis approach – tightly connected to domain expert input. The ‘Data-driven Optimisation for a Vital Elderly Care System’ project (DOLCE VITA) is starting to untangle the spaghetti.

In the Netherlands, 800,000 people aged over 65 years arrive at hospital accident & emergency departments annually. Many cases could have been avoided – if proper care had been given at the right time, at the right location. The mismatch between care supply and demand not only impacts patients. It also leads to unnecessarily high costs and discouraged professionals.

***‘We are convinced this project will result in more regional grip on the healthcare system’***

All parties in a health network, from general practitioners to municipal health services, ambulance services and hospitals, have limited capacity. Parties are interdependent: interaction between two parties impacts all others. When a hospital closes – as happened in Amsterdam in 2018 – it forces all network actors to rearrange their activities.

Involved parties are well aware of this interdependence but do not know how it plays out. The DOLCE VITA project aims to unravel the supply and demand problems within the network. It does that by building an integral model for data

analysis to answer “what if” questions that impact the system. The model should enable system tweaks to cut waiting lists or to forecast the necessary future building and bedding capacity.

The inspiration for this research came from a previous project, in which Rob van der Mei and his team at CWI, together with TU Delft and VU University Amsterdam, developed an algorithm to minimise ambulance response times. Van der Mei, senior researcher and manager research and strategy at CWI and full professor in applied mathematics at VU University Amsterdam, comments: ‘We are aware that DOLCE VITA isn’t a mere mathematical exercise. We also need domain knowledge. Success depends on mutual learning. As scientists, we need to grasp the dynamics within the healthcare network.’

Oscar Smeekes, resident geriatric internist & PhD candidate at Amsterdam UMC adds: ‘It’s about building bridges. From our humanities/social sciences perspective, we learn how to look at the problem more logistically. It’s inspiring to learn to speak each other’s language.’ Van der Mei: ‘The first year has taught all parties how to observe and define the network. That’s vital. Whether a model is about patients, water or container flow, you have to understand how actors in it behave. Now we understand that, we can introduce domain knowledge in mathematics.’



### DOLCE VITA FACTS

Duration:	4 years total, 3 ahead
Budget:	€1,900,620
Researchers:	10 – 15 researchers involved
Project partners:	CWI – project lead and beta perspective Amsterdam UMC – alpha/gamma perspective Sigra – spider in the web, sees to embedding in the sector and project adjustment Amsterdam Health Technology Institute (AHTI) – modelling and data analysis Fifteen healthcare institutions and health insurance companies – users

## Timing is crucial

“The elderly” are a diverse group with fit and healthy pensioners alongside people with mental, physical, social and health literacy problems. Smeekes: ‘This is highly relevant for healthcare demand. An affliction that keeps active elderly in bed for some days leads to long-term hospitalisation for the less healthy. The right timing of care prevents people from sliding from the fit and healthy group to the group with much higher demand. Waiting lists can have harmful effects, and temporary solutions only increase demand. We know these things in general, but the actual consequences of specific interventions are unknown. The model will help to change that. We will know the shortest route to appropriate care.’

Quality of patient care is leading, and comes with bonuses, says Smeekes. ‘Effective healthcare is much cheaper and keeps healthcare professionals happy too. Proper care means having sufficient time to do what is needed. These factors are therefore inextricably linked. ‘And

what’s more’, Van der Mei adds, ‘it’s easy to copy. Any other region can introduce its specific parameters in the model. That’s the beauty of it.’ ‘The challenge of delivering the right care at the right moment at the right location is immense and complex’, concludes Robert Thijssen from project partner Sigra, the collaboration network for healthcare institutions in the Amsterdam, Zaanstreek-Waterland and Noord-Holland Noord regions. ‘We are now one year into DOLCE VITA and everybody involved is enthusiastic. We are convinced this project will result in more regional grip on the healthcare system: shorter waiting lists, and less administration.’

# HACK LIKE AN ACADEMIC

By Sonja Knols

**‘Researchers find major vulnerability in Intel chips.’**  
**‘A new wireless hack can unlock 100 million Volkswagens, scientists say.’**  
**These are just two fairly recent headlines that described how Dutch academics exposed major ICT security issues. But what happens if you find such serious flaws in ICT systems?**

When it comes to scientific hacking, Bernard van Gastel, assistant professor in the Digital Security group at Radboud University, has a gripping story to tell. It all started with the proverbial Friday afternoon experiment. ‘We decided to take a solid-state drive (SSD) apart, just to see how it worked. My colleague Carlo Meijer soldered some wires to the processor of the SSD to read it out, and told me he had found A, and B, and a password check routine, ... I immediately knew that could be bad news. A password check routine is an indication that the password or key could be stored on the drive itself, which poses a major security threat. And indeed, within 1.5 hours, we had hacked ourselves in: we could decrypt all the data on the SSD without knowing the actual password.’ In the months afterwards, it turned out that the same problem occurred in drives of multiple manufacturers, which covered about two-thirds of the market.

‘As scientists, we are mainly interested in gaining new insights’, says Van Gastel as he explains why

security researchers are actively searching for these types of vulnerabilities in the first place. ‘For the SSDs, there had been a suspicion that its hardware encryption might not be very robust and could be bypassed. We were the first to demonstrate this.’

## Combining attack and defence

Cybersecurity scientists can essentially be divided into two groups, he states. ‘Simply put: the defenders and the attackers. I come from the defence side. My PhD thesis, for example, describes how to prove that a piece of software is free of errors. Since Carlo is more of an attacker, with skills to attach wiring to hardware and readout chips, we complemented each other nicely.’

When searching for possible security leaks, you need a broad set of skills, Van Gastel says. ‘First of all, you need to know how software engineering works in practice to get an idea of typical mistakes one could make while developing an ICT system.’

## ATTACK TO DEFEND

The most recent version of National Cybersecurity Research Agenda explicitly mentions developing attacks as a key component of Dutch Cybersecurity research. The Agenda argues that we cannot defend ourselves unless we understand what our weaknesses are and that designing attacks is essential to test designs and defensive measures. On the other hand, attacks can be used as defensive measures themselves when exploited to disrupt criminal activities. That is why Dutch researchers who work on defending our ICT and cyber-physical systems are just as busy developing attacks as they are designing defensive measures against malicious actions.

For this, it is a major advantage if you have experience in implementing specifications. You should also be able to decompile software code to reverse engineer what it does. And you need some hardware skills so you can read out hardware and adjust the software it is running.'

### Patience and perseverance

If you want to convince manufacturers to fix potential leaks, then this skillset is not complete without loads of patience and perseverance. The SSD issue was discovered in 2016. It took until 2019 before the researchers were able to academically publish their findings. 'As soon as we found the SSD problem, we contacted the National Cybersecurity Centre. That is a move I would recommend to anyone in our position. The NCSC took the heat off us and guided all of the negotiations with the manufacturers. Initially, the companies involved only knew us as person A

and person B. They didn't even know where we worked.' That was no exaggerated luxury since instead of welcoming you with open arms, manufacturers aren't very happy with people who expose their flaws. 'Our research group here in Nijmegen has been facing multiple lawsuits after exposing vulnerabilities in the chipcards produced by NXP that are used in access cards for buildings and public transport, and in the car keys from the Volkswagen Audi Group. These lawsuits have led to hundreds of thousands of euros in legal costs',

One of my former colleagues involved in the car key research moved to the UK, where he was sued for the work he did here. That should not be possible.' And in the context of the current recognition and rewards discussion, there is room for improvement as well, he says. 'Disclosing ICT vulnerabilities takes up a hell of a lot of time, which reduces your output in terms of publications. But if research that prevents sensitive data from being stolen by the bad guys isn't beneficial to society, what is?'

### 'Simply put: there are the defenders and the attackers'

Van Gastel says with regret. For many companies, their first reflex still is to sue anyone who makes them aware of security issues. 'In the Netherlands, if you give a company time to fix the problem before you go public with it, you are fairly safe. But in many other countries, that is not the case.



**Clarisa Sánchez has been Professor of AI & Health at the University of Amsterdam since October 2020. Previously, she worked as an associate professor at the Department of Radiology and Nuclear Medicine at Radboud university medical center. Since 2019, she has also been the scientific director of Thira Lab. Sánchez received her PhD in telecommunications engineering from the University of Valladolid in Spain.**

## SYMBIOSIS BETWEEN DOCTORS AND AI

By Reineke Maschhaupt Image Ivar Pel

**The recently formed qurAI research group is a unique merger of the Informatics Institute of the University of Amsterdam and the Amsterdam Medical Center. 'To change the system, you have to be part of it', advocates co-chair of the group Clarisa Sánchez.**

'During my former research, I noticed a disconnection between the fundamental research in artificial intelligence (AI) and its implementation in clinical practice. There was a lot of miscommunication about what is clinically useful. That was the reason to connect these fields in the qurAI group. We do not want to develop just solutions; we really want to incorporate those into the healthcare system too. I want patients to receive the best treatments possible. Right now, we are mainly focusing on the medical fields of ophthalmology, cardiology, oncology, radiology and intensive care.

Doctors are increasingly open to the use of AI, but there is still a lack of knowledge. For example, there is always a fear of the system making an error. Then who is responsible? And what is the effect on the patient? The next step for doctors is to understand more about the technology. And to feel that they participate in the creation of AI models. The biggest misconception that AI experts have is that only data is important for creating a solution, whereas in reality, so many things must be taken into account to create clinically meaningful models.

### BUILDING BRIDGES

The biggest challenge right now is connecting the many players involved in our research. These are not just AI experts and doctors but also software engineers, legal and ethical experts, regulatory bodies and insurance companies. The process of designing, developing, validating, testing and integrating novel technology has to become both easier and faster. One example of how we try to do that is the co-development of a Grand Challenge platform with Radboud university medical center, where all the different parties can meet, access the data and work together on the perfect solution. It is also a place where doctors can evaluate AI algorithms that mimic what is happening in clinical practice.

In the future, I would like to see AI becoming integrated into clinical practice in perfect symbiosis with the doctor. Patients shouldn't even notice the presence of AI. It would be good if mergers like we have achieved in our research group, would happen more on a national level. Working in separate units is not the way to go.'