Current Perspectives on
the Internet of Things

Techno-Animism

Are We Being Smart?

Privacy & Security

Data & the Self

Next Economy

Inclusive Society

The cover of this publication contains an NFC tag. NFC is short for Near Field Communication, a wireless communication technology.

Hold your smartphone against the tag to open the online version of this publication. If your phone does not support NFC tags, scan the QR code above.

In 2017 and 2018, the 6th and 7th editions of the International Internet of Things Day Rotterdam were hosted by Creating 010, a Research Centre of the Rotterdam University of Applied Sciences. Some years ago, when the very first edition of this event was held, the IoT was still a relatively new phenomenon. This is clearly no longer the case, though the promised scenario of humans and things seamlessly connected through intelligent networks is still very much under development. On the topic of intelligence, one of the main focal points of the current discussion regarding digital innovation is in fact artificial intelligence, which is also a recurring theme within this publication. Still, Creating 010 has deliberately chosen throughout recent years to maintain this 'internet of things' designation, despite the many new phenomena that have emerged and peaked in much-discussed hype cycles. We believe that the concept of the IoT still serves as a useful catch-all phrase for the wide variety of digital innovations involved, and that we as a Research Centre focusing on digital transformations can continue to meaningfully give shape to this concept.

This publication consists of concise summaries of all of the keynotes and lectures given during the IoT events which took place in 2017 and 2018, on and nearby April 9. In addition to these keynotes and lectures, we also organised a number of thematically related workshops, while future pioneers had the opportunity to enthusiastically experiment in the IoT Hackathons. These activities all fall outside of the scope of the present publication. What you will find in this publication, however, are powerful interventions by experts, either from Creating 010's extensive professional network, or directly affiliated to our Research Centre, all addressing crucial themes related to the IoT and to other digital innovations and developments. As a Research Centre, we see it as a key task and mission - alongside our own activities in the fields of education, the professional practice, and the applied sciences in general - to build and provide content for platforms where knowledge and experience can be made accessible, and where new insights emerging through interaction may arise. The Internet of Things Day Rotterdam is such a platform. The main goal of this publication is to record and make accessible the knowledge and insights provided during these events. This is also why, on April 9, 2019, we will once again be organising such an event, to which we are already very much looking forward to welcoming you. Hopefully, the content of this publication will already provide you with inspiration in this regard.

Paul Rutten
Programme director, Creating 010

Part One:
The Human
Perspective

ARE WE BEING SMART?
LORNA GOULDEN - APRIL 10, 2017

Lorna Goulden, a founder of the Eindhoven Internet of Things community, is also director of the consultancy agency Creative Innovation Works. Goulden invited the audience to consider, among all the talk of 'paradigm shifts' and 'disruption', how easy it is for us to forget the human perspective: what do all of these spectacular new developments actually mean for us as people? As we surround ourselves with increasingly 'smart' objects and environments, are we really being as smart as we would like to think?

Disruption and progress

Of course we've heard it all before: 'technology is taking away our jobs'. In fact we've been hearing this for generations, and though old jobs indeed continue to disappear, new jobs (usually less boring and back-breaking ones) are also constantly being created. That's not disruption, it's progress. But what if this time it's actually different? What if we've finally reached the point where humans no longer need apply for whatever 'jobs' still might be created?

New hypes always come with their own new buzzwords, such as 'connectivity' – which is no longer a verb, the act of connecting, but a noun, the state of being permanently connected: anytime, anyplace, to anyone, and now also to anything, and even to any animal. Cows in the field have their own wearables, their own ingestibles, constantly monitoring their location and body functions, thus increasing efficiency and profitability (and perhaps even sparing an occasional thought for the living conditions of these creatures).

Big hypes also come with big numbers, such as the 'billions and billions' of devices that are now, or will soon be, connected to the internet. But again, what does this actually mean for us as humans? Goulden plays a promotional clip by IBM from 2010 (back when the 'internet of things' was still a relatively novel concept) that ends with the rather lofty pronouncement that the planet has now 'grown a central nervous system'. What this in fact means is that we are now able to access information that has always been there, but which is only now being made available, not only through a proliferation of sensors but more importantly through the ways in which all these devices are interconnected, and the massive amounts of data that are being generated, collected and analysed, thus providing us with new information and new insights. In other words, the internet of things is really not about the 'things' – it's all about the data.

More big numbers: petabytes of data, translating into trillions of dollars… And once again, what does this mean for us as people, and what is our role within these systems, beyond that of passive and thus ultimately expendable consumers? Are we indeed reaching the point where 'humans need not apply'?

From a business perspective, the value being created is usually expressed in terms of increased efficiency, new products and services, and improved user experience. From a technological perspective, the focus is mainly on increased control: the ability to automatically and remotely switch, adjust, react upon and thus continually improve various processes. But once again, what is the value that is being created from a human perspective? At its best, the internet of things can provide us with new insights and increased control of our living and working environments,

our homes and cars, our cities, our planet and even our own bodies, in ways that would have seemed unimaginable just a generation ago. But perhaps it would be a good idea to sometimes stop and ask ourselves: what is the value that is potentially being destroyed?

Another buzzword in the context of the internet of things is 'disruption', which Goulden admits is something of a personal favourite of hers. Creative people by nature tend to challenge the status quo, often by stepping back and asking inconvenient questions. Why are we doing what we are doing? What are we actually trying to achieve? Can we perhaps come up with something no one ever even thought of, rather than simply attempting to mimic or replace something that already exists? An interesting case in point is the robotic vacuum cleaner, which ended up taking an entirely different form than the once-futuristic vision of a humanoid robot with arms and legs pushing around a traditional vacuum cleaner…

Considering the example of some of the most disruptively innovative businesses of recent years (Airbnb which owns no actual real estate, Uber which owns no taxis, Alibaba which has no inventory, etc.), the common factor between all of these companies is that their focus is entirely on the customer interface, which in turn is determined by the massive hoards of data they are busy collecting from all of their customers.

Privacy and ethics

Addressing only briefly the complex and thorny issue of privacy and ethics, Goulden questioned the common wisdom that 'people don't care about privacy'. It turns out they actually do (even though their superficial behaviour may indicate otherwise), if only you ask them the right questions, for example by making them read out loud the license agreements of their mobile phone apps. Also, it turns out that people are constantly adjusting and censoring their behaviour, finding ingenious ways of bypassing or cheating those aspects of products or services which they don't enjoy or don't trust, and that fail to provide them with the value they are actually seeking. This means that any business model that relies on users producing only commercially desirable behaviour soon turns out to be actually very weak (the widespread use of ad blockers is a case in point).

In the EU, the General Data Protection Regulation (in effect since May 2018) may offer a glimmer of hope to anyone concerned with privacy issues, since it not only allows individuals to find out who is collecting their data and what is being done with it, but perhaps more importantly also to opt out of such data collection systems by default. Then again, our data is already in countless databases, and anyway government regulation tends to always be a few steps behind ongoing developments; a much more serious concern

may well be the algorithms and models being applied to our data, which are now used for everything from job applications to jail sentencing. Though these models are often based on little more than assumptions, opinions and even downright prejudices, they are embedded in complex mathematics that make them effectively incomprehensible, if not outright invisible to citizens and lawmakers alike. Still there is some room for optimism, if only because people naturally tend to be disobedient, particularly in a culture such as ours that promotes creativity.

Wearable devices were the 'next big thing' just a couple of years ago, until it turned out that 50% of users stopped using them in the first six months. But why? Research has shown that

Ingenuity of users

Goulden ends her presentation by playing another video in which an elderly gentleman finds equally ingenious ways of cheating the smart fork, smart cane and smart bed provided by his well-meaning children in order to monitor his eating, walking and sleeping behaviour. The message for designers is clear: never underestimate the ingenuity of your users, particularly in finding ways of not producing the behaviour you intended them to produce.

Perhaps it would be more effective to design in a way that actually gives people the agency they are so obviously seeking – what Goulden calls 'disobedience by design'. As our living and working environments become increasingly

Any business model that relies on users producing only commercially desirable behaviour soon turns out to be actually very weak.

when we start tracking and quantifying the things we enjoy, they start to feel like work and we stop doing them – or we start finding ways of bypassing the constraints they impose upon us. Goulden cites the example of a philanthropy programme that rewarded children in wealthy countries for being more physically active (as measured by a smart armband) with matching donations by IKEA to UNICEF. However, it soon turned out that the children were finding ingenious ways of cheating the system: from constantly moving nothing but their lower arms, to attaching the armband to a vibrating electric motor. The children saw no wrongdoing: 'But we're feeding hungry children! And anyway IKEA is paying for it!'

'smart', perhaps the really smart thing to do would be to consider how we can integrate into our designs typical human behaviours and abilities such as critical thinking, social intelligence, ethics and trust, humour, fun and serendipity – all of which are unlikely to be replaced by technological solutions any time soon.

INTERNATIONAL INTERNET of THINGS –Rotterdam

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CITIZENS AND CITY MAKING

GIJS BOERWINKEL - APRIL 9, 2018

Gijs Boerwinkel is a community manager at the Amsterdam-based civic research institute Waag (until recently known as Waag Society), where he works on projects that focus on the role of technology in society. His presentation addressed two distinct but related topics: citizen engagement and data sovereignty.

Waag aims to make technology more open, fair and inclusive, by demystifying the black boxes of technology - the data and algorithms that everyone uses and that make decisions that affect all of us. *If you can't open it, you don't own it.* Waag is also sceptical of smart cities - ambitious, top-down, data-collecting, efficiency-oriented initiatives - and places its hope instead in smart citizens.

Empowering citizens

On the topic of citizen engagement, Waag has been developing a number of initiatives such as the Amsterdam Smart Citizens Lab, Making Sense and Urban AirQ, all of which focus on empowering citizens to collect their own data and map their own environments, which allows them to engage in a more fact-based dialogue with local governments and to push for change where necessary.

The Urban AirQ project was designed to tackle the problem of air pollution in the city of Amsterdam, using high-quality sensor technology which has become increasingly affordable in recent years, allowing concerned citizens to generate their own reliable data. Where governmental agencies tend to focus on city-wide averages and long-term predictions, a citizen-driven project such as Urban AirQ makes it possible to zoom in to the level of individual streets, where the air quality levels in fact do not meet the established norms on a day-to-day basis.

Crucially, Waag was also able to secure the cooperation of relevant governmental agencies in the fields of public health, environment and meteorology – initially in the development and calibration of the sensors, and later also in the certification and analysis of the measurements.

Positioning sensors

The next step was to determine together with participating residents the best strategies for positioning the available sensors. By measuring the differences between higher or lower floor levels, the front and the back of buildings, or even from two streets away, citizens were able to generate extremely precise data, actually allowing them to monitor in real time the quality of the very air they were breathing. Besides providing quantifiable answers to the concrete questions of residents, the project also helped raise awareness among the general population who saw the sensors popping up in their streets; allowed local policymakers to engage in a more constructive dialogue with residents; and contributed to a positive shift in mentality among governmental research agencies regarding the potential value of

working together with engaged citizens. Finally, the project developed valuable open source knowledge in terms of processes of citizen engagement and the required technology for sensing and data collection.

Data sovereignty vs. business models

The concept of data sovereignty is usually defined from the perspective of nations, borders, governments and jurisdictions; for Waag however, the real issue at stake here is the fact that individual citizens are not the owners of their own data. Instead, data is a commodity that can be bought, sold and handled in ways that are anything but transparent, with little or no regard for personal privacy or communal rights. In fact, the extraction and monetisation of personal data has become the dominant business model for today's most successful and powerful corporations. Besides data voluntarily provided by citizens using social media, private communications or shopping platforms, this also includes sensor data from internet of things applications, and even data from public surveillance systems. This is why

Waag is closely involved in a project called Decode, which aims to find ways of restoring personal sovereignty of private data. Decode, which stands for a *DEcentralized Citizen-Owned Data Ecosystem*, sees data instead as a common resource and infrastructure that should be shared according to enforceable rules of common governance. If the current model can be summarised as *we produce the data, they own it*, the way forward should focus instead on the *shared benefits of data sharing*. If this sounds impossibly idealistic, one should consider recent examples of how the global traffic in personal data has been be hijacked, not just to make a few extra bucks, but in fact to manipulate and subvert major political, social and economic institutions, with potentially disastrous consequences.

Localised networks

Another good example of individual data sovereignty put into practice is *Gebiedonline* ('area online'), a cooperatively owned platform that facilitates local communities in improving the quality of life of their own street, neighbourhood, village or city. Rather than organising, exchanging or meeting through a global commercial website such as Facebook, users of this platform can be active across a variety of localised networks, choosing which of their personal attributes they wish to share or reveal in each particular context – exactly as we do in real life, where we are not necessarily the same person at work as we are with our friends, neighbours or family. Also, unlike Facebook where you're never quite sure who someone is, Gebiedonline makes it possible for users to be verified by their peers, while still deciding what they wish to share in which

Discussion

Some questions from the audience. First, how can we maintain the engagement we have managed to generate among citizens for what are often by nature short-term projects? Boerwinkel replied that this is really a crucial point, beyond the initial challenge of getting people engaged in the first place; fortunately, more and more people are starting to see what has now become the essence of the internet, which is all about huge corporations collecting massive amounts of data, and these people are increasingly looking for long-term alternatives. Perhaps the key to successful sustainable engagement is to not focus too much on building only interesting applications and projects that die when the funding ends, but more importantly on creating structures, ecosystems and open source knowledge that other people can build upon.

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context. Perhaps crucially, Gebiedonline is also hosted on local private servers, rather than on global cloud-based services that end up selling your data to the highest bidder. Incidentally, the Decode project also includes a registration platform called Decode Wallet, which allows users to login to other platforms (including local communities based upon the Gebiedonline infrastructure), again with the option of choosing which personal data to reveal in which setting.

On the topic of citizen-based sensor data collection, what was the effect of asking the municipal government of Amsterdam to do something about the air quality in the most polluted streets? Did anything actually change? Boerwinkel replied that a number of 'smart' objects called CityTrees were indeed installed; unfortunately, later measurements indicated that they were not very effective. One can only hope that these good intentions will eventually lead to further policies that actually make a difference.

The next question was about data sovereignty, and more specifically the boundaries between private and public data in the smart city and the internet of things: who gets to decide, and how does this work in practice? Boerwinkel replied that citizens should always be provided the opportunity to make informed choices, and that we will have to find some way of achieving a proper balance between individuals, governments and industries, which is only really possible when data is seen as a cooperatively owned public resource, rather than a commodity such as oil or gold.
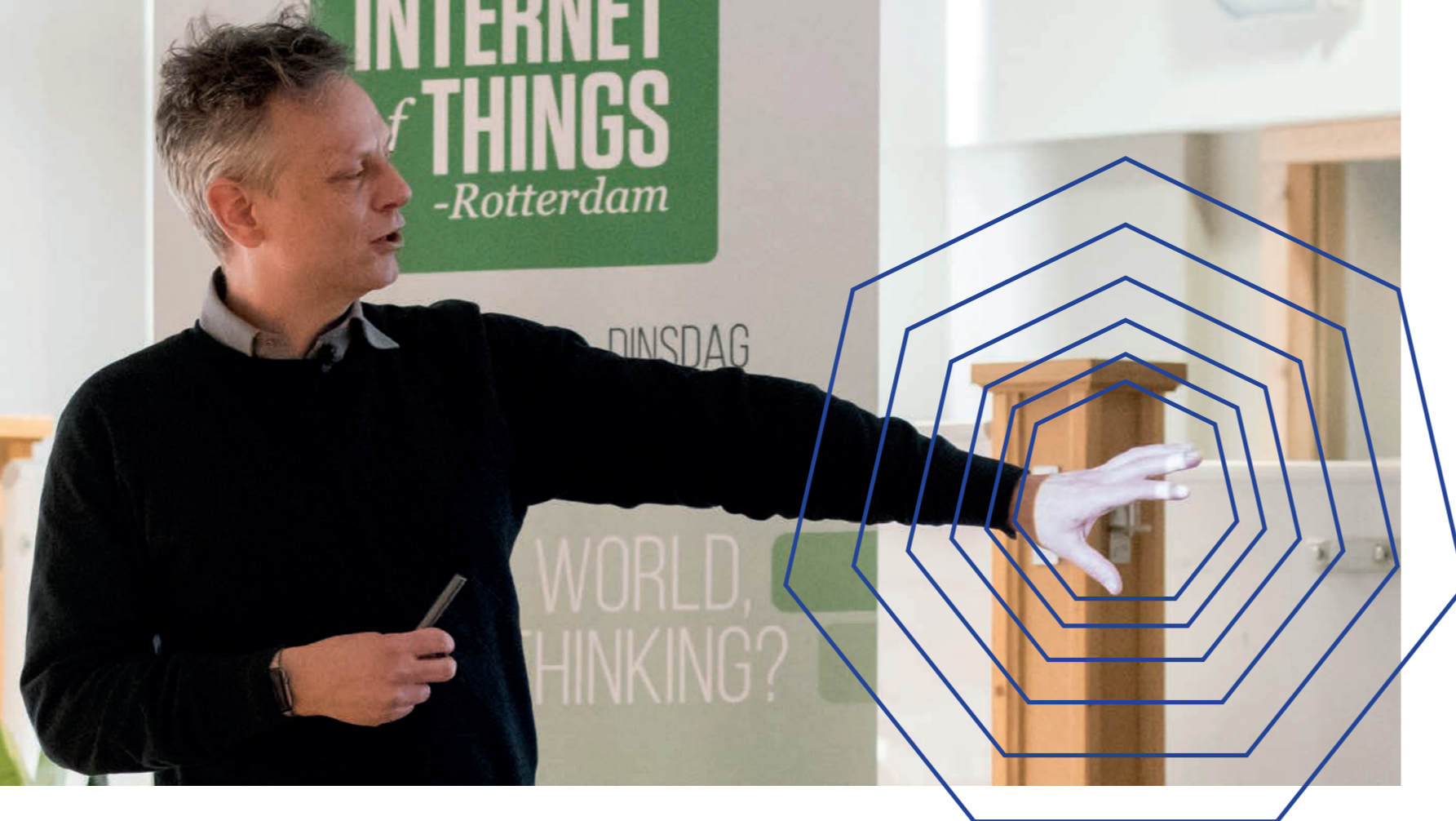
Another question about data ownership: what about all the data that we've already entered into Facebook and Google? Even if we all switched to more citizen-friendly platforms, don't they already know everything about us? Boerwinkel replied that, although he certainly understands the pessimism – it's too late, they already have all my data, why should I even bother to hide – these platforms in fact haven't been around that long, nor are they likely to remain forever. By already starting to think about a shift in terms of citizen agency and sovereignty, and developing initiatives in that direction, we can prepare ourselves for the kind of future we wish and deserve. Discussion

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DATA AND THE SELF

ISKANDER SMIT - APRIL 10, 2017

Iskander Smit is head of LABS, the innovation lab of the internet agency *info.nl*, and also a visiting professor at the Delft University of Technology. Smit discussed a number of new and ongoing developments in how personal data and networked data are being combined to generate new profiles and identities, and how we are increasingly able to connect to electronic devices through a variety of new (and often still experimental) physical interfaces that potentially provide a far more immediate connection and interaction than the traditional screen-and-buttons experience which we have grown so used to, but which is in fact anything but natural or even intuitive.

Haptic

Looking back across the past two decades or so, we have seen the internet evolve from a vast collection of relatively static documents connected through hyperlinks, to dynamic and mostly socially-oriented platforms filled with content generated by users, to the most recent development in which electronic devices ('things') are becoming increasingly integrated into our living and working environments – and on to the near future, in which our connection with these devices will become much closer and more personal, not only in terms of the nature of the data being exchanged but also of the physical interface between humans and machines (or between humans and other humans, brought together in new ways across space and even time through the intermediary of machines).

A key concept in this regard is 'haptic', meaning that tactile sensations and bodily responses will increasingly provide the output and input between humans and software applications. A few examples that are already commercially available or are currently under development include:

• Wristwatches, wristbands and armbands that generate commands based on the user's movements or muscle contractions, and provide feedback in the form of vibrations, pressure or warmth;

• Close-range radar that tracks the position and shape of a user's hand moving through thin air, and again translates these gestures into commands;

• A tactile feedback enhancement for self-driving cars that makes the experience more interactive by allowing the driver/passenger to physically sense what the car's next move will be, and possibly also to intervene;

• Artworks in which the audience is invited to manipulate – whether on location or remotely – a robotic limb worn by the artist, or to generate contractions of the artist's facial muscles;

• Clothing that responds to tactile gestures, or to the data of sensors detecting anything from the quality of the air, to the proximity of surveillance cameras, to the physical posture or even mood of the person wearing the device (or of other people, whether nearby or far away), and that provides feedback by changing the colour, transparency or shape of the garment, or by applying a physical sensation – essentially 'touching' the person who is wearing it;

• Bracelets or sleeves that allow the wearer to feel a stroking, squeezing or other touching gesture applied remotely by someone else.

Human touch

Research has shown that touch, particularly human touch, generates feelings of well-being and promotes mental and physical health. This in itself is hardly surprising; however, anyone doubting whether such knowledge is of any economic value should consider the simple fact that waiters in restaurants who make physical contact with their customers, tend to get bigger tips. Touch of course also expresses emotion, and these emotions can be conveyed at least to some degree through technology mimicking the associated gestures. Again unsurprisingly, the slower and gentler the touch, the more positive the emotion, and vice-versa. Emotions at the extremes of the spectrum are the easiest to distinguish and to mimic, while those in between are much more subtle and thus much more difficult to reproduce.

Levels of agency of devices

Smit describes three different roles, or levels of agency, which devices can assume: as a *collector* of data (for example, sensors in an industrial or other process), as an *actor* (a system that is able to apply the collected data in making decisions and intervening in processes), and as a *creator* (a system that is able to repair, assemble, expand and possibly even design itself).

What is clear is that the relationship between humans and technology is shifting from disconnected *interaction*, toward ever closer *integration*. This means that the devices that surround us are increasingly becoming a part of us, as functional citizens of our smart cities and as extensions of our own physical bodies. And as these objects become increasingly responsive to their environments, interacting with us in ways that integrate with and even mimic our own ways of thinking and communicating, we will inevitably start to see in them (or project upon them) human qualities such as personality, awareness, consciousness and even stubbornness. Who among us has never had the slightly disturbing feeling that a computer, a car or even a 'dumb' toaster indeed had a 'mind of its own'?

Discussion

Anne Nigten, research professor at Creating 010, responded to Smit's presentation, first by observing that, as the interaction between humans and technology is evolving from traditional screen-based interfaces towards more physical (and more networked) relationships, and as the objects that surround us are increasingly programmed to have their own agendas and even their own interests, perhaps we should be focusing not only on streamlining these experiences, on making them more efficient and more comfortable, but also on highlighting those aspects that are less purely functional – the playful, critical and often even confrontational approach that is such an important dimension for artists and designers.

Nigten then turned to the topic of ownership and responsibility: how do we approach these issues when the behaviour of devices is increasingly determined by our personal data, yet we seem to have less and less control over what is actually being done with this data? Smit replied that this is indeed a dimension that has still not been thoroughly considered, either on a practical or an ethical level: we still don't really know, for example, who is responsible for the actions of a self-driving car. And what about a device that is able to sense when it will break down: who decides what should be done with this information, and for whose benefit? The consumer who purchased the product, or the manufacturer who may profit by selling the user a spare part, or indeed a whole new device?

Finally, Nigten asked about the implications of devices interacting with humans in ways that affect or magnify our emotions – how does this work out when we leave these decisions to artificial intelligence, to the 'things' rather than the person? Smit agreed that this is an important design challenge, and followed up on that thought by wondering out loud about the implications of designing, rather than a finished product or service, something that continues to grow and change as it is used by people as well as by devices, based on a set of rules established by the designer – does that mean that in addition to human-centred design, we will soon also be thinking in terms of a things-centred design?

A question from the audience: we have seen here many different examples of technologies for haptic interfaces. Are some of these inherently better than others? Smit replied that we have already become quite familiar during the past decade or so with vibrations, which was probably a good place to start since the technology is in fact relatively simple to implement. But as we become increasingly familiar with using such interfaces, we will inevitably find more and more refined ways of communicating with our devices, and of having them communicate with us.

Part Two: Robotics and Artificial Intelligence

INTEGRATING SOCIAL ROBOTS INTO PERSONAL CARE AND LIVING ENVIRONMENTS

MARK NEERINCX - APRIL 9, 2018

Mark Neerincx is a researcher in the field of robotics at TNO, the largest institute for applied scientific research in the Netherlands, and professor of human-centered computing at the Delft University of Technology. In both of these capacities Neerincx is a key player within Project Pal, an ongoing large-scale European research and development project which was also the topic of his presentation.

The main focus of Project Pal is the development of a 'social robot' that provides support in the form of knowledge, motivation and companionship to children with type 1 diabetes. However, Neerincx also stressed that the models and concepts he would be explaining here today are also being applied in a variety of other contexts, for example in elderly healthcare. Neerincx had intended to bring a demonstration robot with him today, but was prevented from doing so by a sports injury. Ironically, he explained, bringing the care robot in this particular case would only have been a burden. Hopefully in the near future we will be developing robots that can also provide assistance to people in situations such as these...

Variety of technologies

As in many other contemporary fields of application, Project Pal is something that would have been impossible just a few years ago, since it relies heavily on ongoing developments in a variety of technologies, as well as new ways of combining all of these technologies. These include, besides the internet of things and sensor technology, also artificial intelligence and of course robotics.

The not-too-distant future scenario we are now contemplating is one in which different types of robots, connected to each other and to humans through information networks, can provide and enhance care in a variety of contexts and environments. The data collected and shared through these technologies and information processes can be combined, automated and physically embodied in ways that allow for human and non-human agents – such as social robots – to actually work together as partners.

This is fundamentally different from simply having an e-help app on a mobile phone that provides some form of personal support, since the focus here is on carrying out joint activities within a networked social context – in this case, the child, the robot, the parents, the healthcare professionals and the developers of the project all work together as a team. And so, rather than being merely users of this or that technology, on the passive end of a one-way transaction, humans in fact become partners with the non-human agents, sharing with them specific goals and values: in this case, maintaining the children's health and enabling them to learn essential skills, while simultaneously providing valuable data to an ever-growing shared database of information and experiences.

Diabetes

Type 1 diabetes, which currently affects nearly 150,000 European children, is a chronic disease characterised by a deficiency of the hormone insulin, resulting in unstable blood sugar levels and requiring complex lifelong care: patients must follow a diet, continuously monitor their own blood sugar, and inject themselves with the right amount of insulin at the right time, also taking into account a variety of other highly individual and context-sensitive factors such as physical activity and emotional stress. The disease can also lead to feelings of social exclusion when patients are restricted from participating in certain activities or enjoying certain types of food.

Young children who are diagnosed with diabetes are cared for throughout their childhood by their parents and healthcare professionals. However with the onset of puberty, suddenly nothing is the same anymore: besides physiological changes such as the balance of hormones including insulin, patients also experience psychological changes in their attitude toward their parents, their healthcare professionals, and of course their disease. Therefore one of the most important goals of Project Pal is to help these children develop the knowledge, skills and attitude necessary for managing their own disease before the disruptive period of puberty. The companion robot and screen avatar developed by Project Pal are designed to

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provide day-to-day support to these young patients in the form of learning and motivation. The physical robot, which is presumably quite expensive, is deployed mainly during traditional social activities in hospitals and diabetes camps, while the virtual avatar of this robot allows the children to further develop at home the relationship they have established with the physical robot. Children can play educational games, answer quizzes, fill in a diary and carry out other educational and motivational activities with the robot or avatar, while the underlying networked system continuously supplies parents and healthcare professionals with up-to-date information on the child's health and progress.

Design principles

Neerincx also provided the audience of professionals assembled here today with an overview of some of the design principles being implemented within Project Pal – which can be described as an ongoing, iterative, incremental co-design process. Neerincx highlighted four key principles applied by his team in designing human-agent partnerships: these are *common situated objectives, a shared knowledge base and shared experiences, adaptive policies for collaboration,* and *mutual uptake and learning by explanation and feedback.*

agent, for example in dealing with privacy and safety issues, addressing value tensions, and deciding when to inform the parent or healthcare professional of a potentially hazardous situation. Again, these policies are always individualised and context-sensitive.

Uptake and learning by explanation and feedback means learning from each other, understanding each other's behaviour, and providing advice when needed. An important distinction in this context is that between a goal-based explanation ('It's important that you learn...') and an emotion-based explanation ('I would be happy for you if you learned...'), and how to establish the proper balance between the two in various situations.
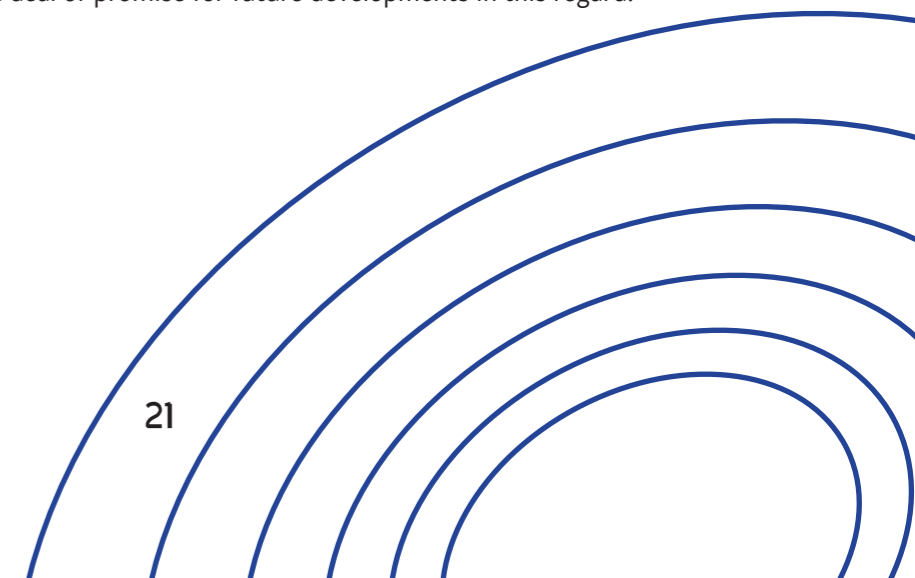
Discussion

Some questions from the audience. Neerincx briefly mentioned at the beginning of his lecture that he was also involved in a similar project for elderly healthcare. Obviously, the gamification factor plays a key role in getting children to interact with the robot. How does this work with elderly people, or any other people for that matter? Neerincx replied that in fact, children as well as senior citizens are the easiest to work with, since they tend to accept the robots at face value, without getting too much tangled up in questions about the underlying technology.

Paul Rutten, research professor and programme director at Creating 010, followed up on this question by asking about the differences in the specific design challenges between the two user groups. Neerincx said that, as far as the general models are concerned, there really is not that much of a difference. For example, the principles of co-design remain the same, even though there may be important distinctions in the specific co-design activities, as well as in the details of the actual interactions between the user and the robot.

Another question from the audience: was it the design team's original intention to develop the screen avatar in parallel to the physical robot, or was this something that evolved during the design process? Neerincx replied that the avatar was in fact a product of necessity, since it was simply not feasible to supply each child with their own physical robot providing support on location for extended periods of time. Interestingly however, it turns out that the relationship which the children establish with the robot transfers quite easily to the avatar.

One last question: the project presented here focuses very much on knowledge. How about helping patients to learn physical actions? Neerincx said that the technology that would make this possible is still very much in an early stage of development. However, if we observe the tactile interaction which the children already have with the robot, we can see a great deal of promise for future developments in this regard.

Common situated objectives simply means having shared objectives (for example, increasing the child's autonomy) which are specific to each individual as well as each particular situation (at school, in the evening, during a holiday, at a party, etc.). Also, there is a clearly defined hierarchy in which a general objective is expressed in terms of specific achievements (such as safely having a sleepover at a friend's house) which consist of goals (such as knowing how to inject oneself with insulin) which in turn are defined by a number of concrete tasks (such as successfully completing a quiz on how to properly perform an injection). *A shared knowledge base and shared experiences* are models of how information, events and experiences should be defined, represented

and communicated. This could be general information about the disease (for example, the medical terminology being used), but also personal information disclosed by the child in a specific context. This information is then categorised according to a number of characteristics such as its general topic, whether the information has a positive or negative emotional value, and the level of intimacy of the disclosure. The non-human agent should then respond to the child at the same level, also taking into consideration the relationship they have already established together.

Adaptive policies for collaboration are formal specifications of the norms and agreements that govern the behaviour of the non-human

WHY ARE CHATBOTS SO HUGELY POPULAR TODAY?

FRANK SMIT - APRIL 9, 2018

Frank Smit is Chief Innovation Officer at OBI4wan, a software company that provides services in the field of media monitoring and online customer contact. According to Smit, the big question which is also the title of his presentation can be answered on two different levels. The first obviously has to do with the 'coolness' of being able to conduct a more or less natural conversation with a machine. And the second is related to ongoing developments within the different technologies that make such a conversation even possible - particularly artificial intelligence.

Conversational communication and artificial intelligence

Today's chatbots are designed to perform specific tasks together with a user, through conversational communication and taking into account various contexts such as the user's continuously updated profile or external conditions such as the weather. Chatbots can also work side-by-side with human customer service professionals, obtaining as much information as possible from users so that the humans on both end can more efficiently complete the transaction. A chatbot can also answer questions asked by users on a broad range of topics, rather than requiring them to dig through huge and complex websites to find the information they need.

Chatbots have actually been around for more than half a century, and have evolved from simply responding to keywords found in

Artificial intelligence can be defined as a multidisciplinary field of research for developing machines that mimic human intelligence.

messages entered by users, to recognising increasingly complex patterns within these messages. Also, the emphasis for designers has gradually shifted from engineering every single desired feature, toward providing the machine with huge amounts of data which it can compare to new messages, while continuously improving itself in ways that the designers may not always fully understand. However, Smit emphasised that each new development also builds upon earlier achievements, meaning that a good contemporary chatbot combines older rules-based and pattern-based models with more recent developments in artificial intelligence, particularly natural language processing.

Artificial intelligence can be defined as a multidisciplinary field of research for developing machines that mimic human intelligence. But what is it exactly that makes humans intelligent? Performing complex calculations, for example, is something that computers have been doing much better than us for a long time now. Artificial intelligence thus focuses on complex topics such as experience-based learning, natural language processing, planning, decision-making, image recognition, translating speech to text, and robotics.

Machine learning as a black box

Natural language processing allows a chatbot to understand a message by extracting any relevant information: what does the user intend to achieve with this message? And: does the message include all the necessary information for further action, or does the chatbot first need to obtain additional information from the user?

Machine learning is something of a black box: no one really knows how the machine has learned the model, because we didn't engineer it, we just gave it examples, in much the same way as a spam filter learns to detect spam messages by comparing them to previous spam and non-spam messages. This black-box model may not be too much of a problem as long as the machine is only interpreting messages; however, when it starts making decisions that can have an impact in the real world, we might wish to exercise more control.

Designing a specific chatbot is an open-ended, iterative, agile process that starts with defining the relevant tasks (what does the chatbot need to do?), followed by training (providing it with data and examples), implementing rules, connecting systems, defining responses, testing, deploying, and again applying all of the experience gained during this process for ongoing improvement.

Discussion

A question from the audience, about storage and privacy: what happens to all of these chats, and particularly to the personal data entered by users? How can we trust they will be handled properly? Smit replied that this is really a strategic question, rather than a technological one. If the chatbot is being run on a website, then this is something to be decided by the organisation that owns that site. However, on communication channels such as Facebook Messenger or WhatsApp, it can be very difficult to control what happens with the data once it has been entered into the system.

Another question: who designs the application programming interfaces at the back end of the chatbots produced by OBI4wan? Smit replied that OBI4wan have in fact designed their own; first of all, because the platforms designed by the likes of Microsoft, Google and IBM don't provide Dutch-language support, but also because OBI4wan wishes to control the entire design process, including what is being done with all the data that is collected.

ASIBOT: SYNTHETIC LITERATURE: WRITING SCIENCE FICTION IN A CO-CREATIVE PROCESS

BEN BURTENSHAW - APRIL 9, 2018

Ben Burtenshaw is a Ph.D. candidate with the Computational Linguistics Group at the University of Antwerp. Burtenshaw's research group was recently commissioned by the CPNB, a non-profit organisation for the promotion of the Dutch book industry, to 'write a story about robots, using a robot, in relation to *I, Robot'* - Isaac Asimov's visionary science-fiction novel which addresses themes such as the place of robots in society, and what distinguishes robots from humans.

The research group's proposal was to develop an artificial intelligence (AI) environment that would co-creatively write the story together with a human, in this case the well-known Dutch author Ronald Giphart. This would also provide the researchers with opportunities to test and improve some of the concepts and tools they have been developing, for example by studying how the human author edited the AI-generated texts; and also to observe the writing process of the human author, and envision how an AI system might emulate that process.

Computational creativity

Today's natural language processing systems are quite good at generating words and sentences, but struggle to retain any form of narrative coherence for anything longer than that. Also, research has shown that people are suspicious of AI systems that turn out to be less autonomous than they might seem, and in fact rely upon some form of human guidance or collaboration. Science fiction, however, is an inherently welcoming genre for a project of this nature, if only for the fact that readers will be much more forgiving of the limitations of the AI than they would be in the case of a romance novel for example. Co-creativity, an important concept within the subfield of AI known as *computational creativity,* can be defined as a collaborative process involving a computational system and producing a result that is greater than the sum of the parts – which is fundamentally different from merely having the computer perform all of the boring, repetitive tasks, and then reaping the benefits.

There are different roles which the AI system can be assigned within this process. At the highest level, the AI is seen as a colleague, a competent agent that provides a vital and verifiable contribution to the end result. On the other end of the spectrum, the AI is merely a subordinate agent that provides inspiration or assistance, or generates random material for the human to use where they see fit, but does not challenge them in any meaningful way. There are also different levels on which an AI system can work with a human on writing a story. The *structural diagrammatic approach* considers the overall narrative structure of the story, generating possible sentences based on a

author has further edited the text.
The next step for the research group will be to open up this same co-creative environment to the general public, and again to learn more from that. The challenges for the near future will be to further evaluate and improve the AI models, and also to develop tools for a more quantitative evaluation of the AI-generated texts; current methods are quite crude, measuring for example the number of keystrokes the human author has entered in further polishing the text, thus failing to distinguish between superficial changes such as verb tenses, and more comprehensive edits.

Today's natural language processing systems are quite good at generating words and sentences, but struggle to retain any form of narrative coherence for anything longer than that.

framework developed together with the author. However, this approach risks imposing upon the writer a rather artificial format, which may not be compatible with the writer's own process. The second is the *auto-completion approach,* which works on a more intuitive, hands-on level by offering the writer possible next sentences; here, the risk is that the AI will be reduced the role of mere assistant.

Neural network language model
The model applied by the research group for this project, described as a *recurrent neural network language model for text generation*, produces the most probable next string of words based upon the previous ones, after being trained upon a database generated from thousands of Dutch-language novels, and further refined to write in a genre-specific way – in this case, like a science-fiction writer. The human author is also provided with a visual feedback system of highlights and annotations, allowing them to see not only which particular version of the model has generated which sentence, but also the degree to which the

Discussion
A question from the audience: What is the ultimate goal of all this research? Surely not to replace creative authors with machines? Burtenshaw replied that, besides developing potentially powerful new tools for human literary production and analysis, the knowledge gained here can also help improve the aesthetic quality of autonomous text generation in other fields such as industry and business. In other words, making AI less dull, more creative and more surprising.

Part Three: Networks and Innovation

THE SMART DIGITAL DELTA
BERRY VETJENS - APRIL 11, 2017

Berry Vetjens is business director at TNO, the largest institute for applied scientific research in the Netherlands. Vetjens is also involved in an initiative called the Roadmap Next Economy, set up by the Metropolitan Region Rotterdam The Hague (a platform for consultation and collaboration between 23 municipalities with a combined population of 2.2 million) in order to prepare the region for the potentially game-changing effects of this emerging economic paradigm.

Scenarios and initiatives for regional economic development

After presenting several examples illustrating the current state of affairs in the field of information and communication technology (ICT) and the new applications made possible by these developments, Vetjens outlined a number of scenarios and initiatives for regional economic development in the upcoming years and decades, specifically in the context of the major shifts that are expected to radically transform the global (and local) economic landscape.

First of all, what exactly is this 'next economy' we keep hearing about? Obviously, there is more than one way to define or approach such a broad concept, depending on the specific requirements of any given business model, economic sector or geographical region. In the case of the Metropolitan Region Rotterdam The Hague, the focus is mainly on growth, jobs, and sustainability. Also, when discussing concepts such as a 'digital internet of things platform', one should always keep in mind the language barriers of professional jargon: for example, even the term 'platform' means something completely different in urban planning than it does in ICT. The framework for the Roadmap Next Economy is largely based upon concepts proposed by the American economist and political advisor

Jeremy Rifkin, particularly his theory of a 'third industrial revolution' made possible (or even inevitable) through a historical convergence of a number of new technological and social developments. According to Rifkin, major economic transitions have historically always been driven by a combination of equally major changes in three key sectors: communication, energy, and mobility – which is exactly what we see happening today. Vetjens described several new developments and technologies that demonstrate the power of combining the internet of things and other mobile devices with previously unimaginable amounts of computing power:

• Augmented-reality smartphone games that are able to generate mass crowd movements through actual space (Pokémon Go);

• Single-function, single-button devices for instantly and effortlessly purchasing common products online (Amazon Dash);

• Using networked sensor data from windscreen wipers in order to generate a much more efficient and accurate map of rain patterns than that which can be achieved through traditional radar technology;

• Lampposts that are increasingly evolving into multifunctional sensoring stations, including electric charging functionality;

• 360-degree cameras that allow us to completely virtualise our physical world (while of course generating humongous amounts of data);

• 'Electronic noses' that measure air quality by analysing changes between consecutive samples of the air as a whole, rather than having a different sensor for every single substance to be measured.

Computing power

The common factor between all of these applications is that they are made possible by the fact that we now have access to much more computing power than ever before. But how much more exactly? Here Vetjens addressed the (surprisingly widespread) misconception that the explosive growth and evolution of ICT may somehow be slowing down or even coming to an end – or that we are now able to do pretty much everything that can possibly be done through computing. In fact, we currently have 100 million times more computing power at our disposal than we did just a bit more than a decade ago, with all indicators pointing toward a long-term continuation of this exponential trend. The

key technology in this regard is distributed and parallel cloud computing, meaning that computing power is now in theory endlessly scalable, limited only by the price one is willing to pay.

This makes it possible not only to compute the same things much faster, but also to compute things that simply would not have been possible previously, particularly in the field of ongoing decision-making based on real-time processing of incoming sensor data. For example, generating a real-time map of the traffic intensity and air quality of a city, based on a relatively small amount of actual measurements by various types of strategically located sensors, while 'filling in' the picture through computational interpolation – just ten years ago, generating a single 'snapshot' of the city would have taken months of computing, meaning in effect that it isn't real-time anymore, since the data is already grossly obsolete by the time it is computed. Today, the same computation can be done in a second.

Re-imagining products and services

In order to fully appreciate the new opportunities provided by such developments, what is often required is a shift in perspective, even a willingness to completely re-imagine the very nature of a product or service. When we start thinking of a car, a dairy farm, a greenhouse or even a whole seaport

as a remotely upgradable software system, rather than solely from the perspective of the externally visible hardware, then we begin to see entirely new possibilities. For example, the locally developed expertise of efficiently growing food and flowers can now be provided as a remotely managed and optimised service, rather than being physically bound to locally grown products. Also, the knowledge and technology developed in automatically loading and unloading container ships can be further expanded toward processing the containers through customs (at 100 km/h, no less) and deploying driverless transportation networks that bring the goods further inland in the quickest, safest and most sustainable way possible.

The initial focus of the Roadmap on these two cases, the greenhouse industry and the seaport, are clearly driven by the huge importance of these two sectors for the local economy. Other fields of current research and development include automated mobility, smart industries, and smart matching of new skills with the changing requirements of the labour market.

Urgency and opportunity

The initiative for the Roadmap Next Economy for the Metropolitan Region Rotterdam The Hague originated from a sense of urgency as well as opportunity: truth be told, this region is not performing very well economically compared to other European urban regions. On the other hand, the Roadmap is also designed from the start to capitalise on the region's surprisingly strong position in terms of research and development in the field of ICT, while also addressing the challenge of turning more of this knowledge and expertise into actual economic activity within the region. The Roadmap also identifies a number of specific measures and initiatives for making the best possible use of the new abundance of data toward stimulating economic growth in the region: improving data networks, not only by investing in new network capacity, but also through smart sharing of the huge amounts of excess capacity that are already available; making data readily accessible, rather than locked in applications within specific sectors,

in a way that is clearly standardised and suitable for business transactions, while also addressing the inevitable security and privacy concerns; and establishing 'free zones' in which businesses as well as individuals can experiment with 'big data' and internet of things technologies with relatively few regulatory barriers.

Discussion

Some questions from the audience. First, this Roadmap focuses quite a lot on growth, jobs and big businesses, which doesn't really sound all that different from the 'old' economy. What is the role of citizens in all of this? Also, will the new jobs being created mostly be in ICT-related sectors? And how can the 'next economy' help us to address sustainability issues, for example the huge amounts of food being wasted by industry as well as consumers?
Vetjens replied that, though growth and jobs

competing for the same jobs. This is why the Roadmap also includes a plan for smart matching of skills, in contrast with traditional employment policies which focus mainly on formal education.
Regarding the role of citizens, Vetjens points out that a key aspect of the next economy is that data, skills and opportunities are becoming increasingly accessible to everyone, not just big companies but also small businesses and individuals.
On the topic of sustainability, the biggest challenge for the region is clearly the transition of the Rotterdam seaport from a fossil-based energy economy to a more sustainable model, though Vetjens admits that this is not something he has been directly involved in, and is thus outside of his area of expertise. With regard to food and waste, however, Vetjens points out that there is in fact a great deal of expertise in the Netherlands for growing food

The key technology in this regard is distributed and parallel cloud computing, meaning that computing power is now in theory endlessly scalable, limited only by the price one is willing to pay.

will indeed remain crucial components of the next economy, this will certainly not be the case for life-long jobs (or educating people for such jobs). The question of whether advances in ICT lead to a loss of jobs has never been answered conclusively. What is clear, however, is that demand is shifting towards jobs that require more skills and a higher level of education, and also that people from different educational backgrounds are increasingly

with scarce resources. Another 'next economy' concept known as the 'circular economy', a kind of hyper-recycling in which waste materials from one industry become valuable resources for another, has the potential to greatly reduce unnecessary waste. Food, however, presents particular challenges, since legislation prohibits directly reintroducing food waste back into the food chain, so that other, usually more creative, applications need to be found.

THE FOURTH INDUS-TRIAL REVOLUTION AND INNOVATION

BEN VAN LIER - APRIL 10, 2018

Ben van Lier, research professor at Creating 010, discussed a number of philosophical, geopolitical, and everyday-life perspectives related to the notion of a 'fourth industrial revolution' - an emerging, technologically-driven transformation of nothing less than the entire economic world order. Besides his work at Creating 010, Van Lier is also a research professor at the Steinbeis University in Berlin, and Director of Strategy and Innovation at Centric, a Dutch ICT company also active in countries such as Belgium, Norway, Sweden, Germany and Romania.

Essence and impact of technology

The German philosopher Martin Heidegger (1889-1976) had some remarkable insights related to what we now know as the internet of things – from the question of what exactly constitutes a 'thing', to the essence of technology and its impact on humanity, to how the constituent parts of a whole can only be understood in their context within this whole. This last idea is closely related to the biological concept of the ecosystem, which considers a dynamically interconnected whole as being more than the sum of its (living and non-living) parts. We also observe within such ecosystems, and within other complex systems such as machines, a process known as homeostasis: the tendency of the parts of the system to collectively self-compensate towards a new balance or stability in response to any internal or external changes affecting the system. The Austrian-American economist Joseph Schumpeter (1883-1950) considered economic and social development in similar terms: as an interconnected whole that evolves in response to changes (such as technological innovation) which usually arise from within, rather than as random disturbances from outside the ecosystem. Schumpeter also saw capitalism as a process of ongoing creative destruction; once the equilibrium of the ecosystem has been disrupted, there is no certainty as to how the ensuing struggle for adjustment might play out, and what kind of new equilibrium this may lead to.

Our relationship with devices

Van Lier illustrated these concepts with a few contemporary examples: WhatsApp, which started out as a relatively simple piece of software and ended up having a huge and unexpected impact upon the field of telecommunications; virtual assistants such as Apple's Siri, which allow us to talk *to* our phones, rather than only *through* them, thus completely changing our relationship with these devices; and 'smart' household appliances such as refrigerators, that not only help us decide what we should eat and buy, but increasingly are also taking on the role of a central information hub within the household – a bit like the traditional refrigerator with paper notes fixed to the door by magnets, but connected to the internet, and with a touchscreen that is bigger and better than that of an iPad.

More than two-thirds of the world population currently own a mobile phone. In Asia and Africa in particular, money transfers through mobile phones are quickly replacing cash as the primary means of payment: China, which already has more mobile phones in circulation than the United States and the European Union combined, has even announced the ambition to become entirely cashless by 2022.

In 2013, a company called DeepMind (later acquired by Google) developed artificial intelligence software that could teach itself to play simple computer games, based only on the images displayed on the screen and the instruction to maximise its score. In one case, after just a few hours of training, the program not only became an accomplished player, but also figured out the best strategy for winning the game – one which most human players would never even have thought of.

In 2016, DeepMind's software succeeded in beating the world's best players at Go – arguably the most difficult board game ever invented, with more possible configurations than there are atoms in the universe. During the second game, the software made a key move that was universally described as unexpected, elegant and even innovative. And in 2017, two different artificial intelligence programs were able to beat the world's best players at poker – which, unlike chess and Go, includes elements of chance, hidden information, speculation and misdirection, where purely rational methods do not normally lead to a winning strategy. In other words, computers are increasingly able to do things that even the engineers who design them do not fully understand.

Computing in everyday life

Ubiquitous computing, a term somewhat related to the concept of the internet of things, means that computing technology is no longer confined to a specialised box on a desk, but instead becomes a part of everyday life, integrated within other networked technology, from refrigerators and clothing to self-driving cars, entire buildings, and complex factories.
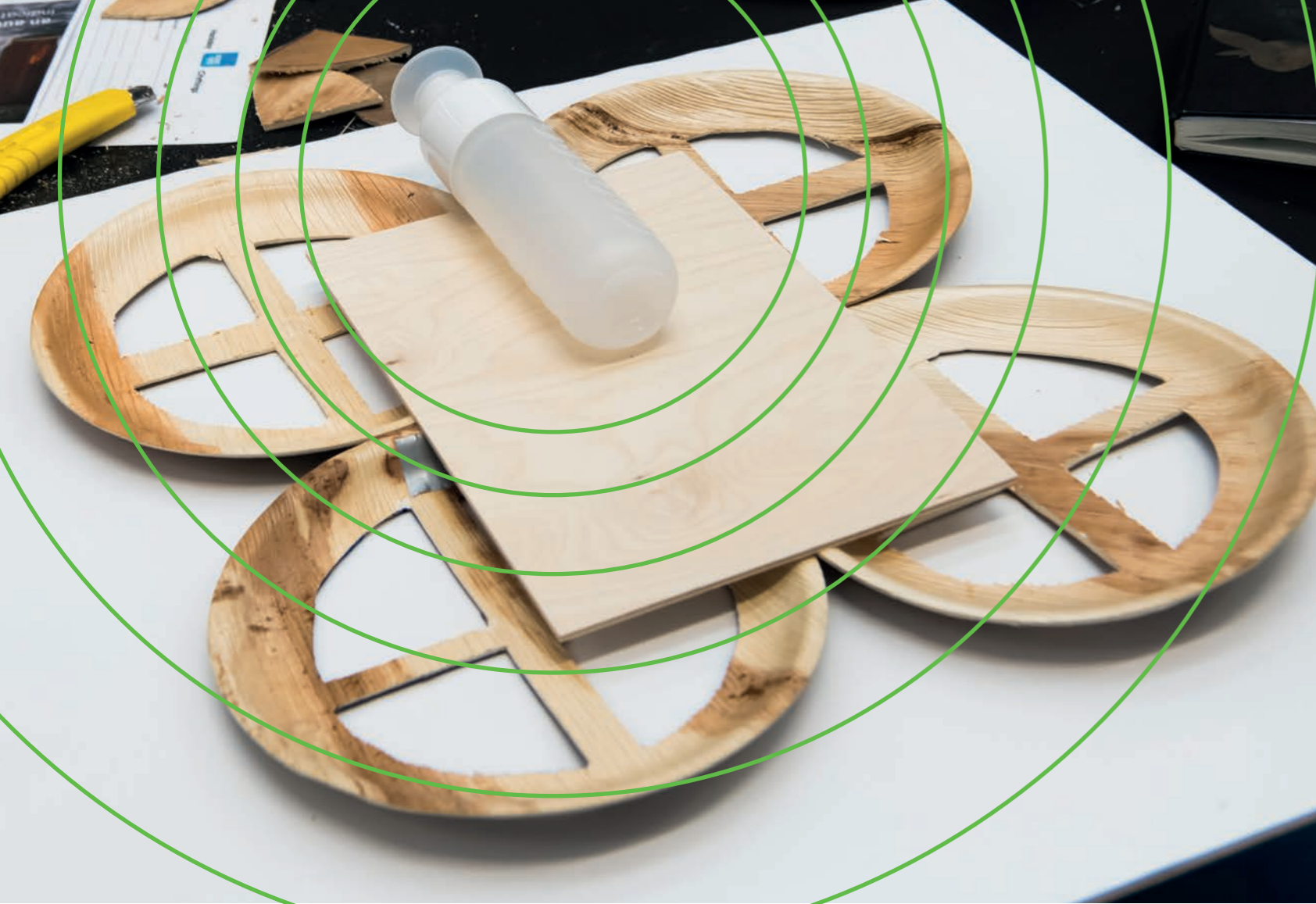
Another related concept in this regard is that of cyber-physical systems (and systems of systems): the integration of computation, networking and physical processes into ever more complex, distributed and autonomous systems. Autonomy in this context is defined as the ability for a system to be self-configuring, self-healing, self-optimising and self-protecting, and also to 'know' on some basic level that it is a machine which is expected to perform a function.

Strategic policy documents by the governments of the United States, China, the European Union, and several of the EU's member states, all stress the need to remain at the vanguard of developments in fields such as artificial intelligence, computing power, intelligent manufacturing, nanotechnology, biotechnology, sensor technology, and autonomous transportation, while also addressing the many challenges raised by these developments for global economic networks, labour markets, and geopolitical relations.

New paradigm

Klaus Schwab, chairman of the World Economic Forum (best known for its annual meeting of political, industry, academic and media leaders in Davos, Switzerland) famously coined the term 'fourth industrial revolution' to describe this new paradigm of accelerating innovation, disruption, connectivity, automation, artificial intelligence, and new business models based on providing 'information goods' at virtually zero costs for storage, transportation and replication. And, returning to Schumpeter's ideas about creative destruction and the uncertainties of a new equilibrium: no one really knows how all these transformations will unfold, or indeed how our leaders will deal with the huge responsibility of somehow working together to define new strategies and policies for addressing these transformations.

Discussion

Creating 010's Paul Rutten, responding to Van Lier's presentation, admitted to having mixed feelings every time he hears Van Lier speak: on one hand, the macro-global picture painted here can be quite overwhelming, making us feel rather insignificant in our little country on the edge of Europe; on the other hand, there's also cause for optimism, since there's so much to be done in terms of research, development and creativity. Regarding the idea of the ecosystem, Rutten wondered what would be the best strategy for Rotterdam and the Netherlands: to focus on the local European context, or to think instead in less geographical terms, seeking out like-minded partners wherever we can find them?

Van Lier replied that, in terms of optimism and pessimism, the greatest danger would be to underestimate the magnitude of the technologically-driven macro-developments that are already starting to radically transform our economy and society. As to the question of where we should be seeking partnerships and allies, Van Lier noted that the Netherlands is really a very small fish in an increasingly large pond, a fact which many of our policymakers do not seem ready to accept. If we wish to have any impact whatsoever, this can only be in the context of partnerships, indeed starting with our immediate neighbours.

the perspective of our tiny country of 17 million people, in thinking that we know better than 1.4 billion Chinese which political system is the best one for them – particularly taking into consideration the tremendous increase in well-being that this system has been able to realise for the vast majority of its citizens.
Another question from the audience, about the much-hyped moment of technological 'singularity' – isn't there a danger that we humans will end up making ourselves redundant? Van Lier replied that the first question we should be asking ourselves is: have we not already been working toward that moment of singularity for many decades now? And, perhaps more importantly, shouldn't we be thinking about how we are already changing our very understanding of what it means to be human? As Heidegger noted more than sixty years ago, the crucial question is not how we should develop technology, but rather how our technology is changing us as humans. Once we start implanting intelligent electronics inside our brains, which is already happening in the field of medicine, who is to say where is the boundary between human and non-human?

More than two-thirds of the world population currently own a mobile phone.

A question from the audience, about how all these innovations could end up having a de-humanising effect upon society. Isn't it ironic, for example, that China is able to make such huge technological advances, often at the cost of ethical and democratic norms? Van Lier replied that we should be very careful, from

TRADING IN PEER-TO-PEER ELECTRICITY USING THE INTERNET OF THINGS

HANS STAVLEU - APRIL 11, 2017

Hans Stavleu is a research professor at the University of Applied Sciences Leiden, and co-founder of the consultancy firm Curiozy / Academy of Value. Stavleu discussed a number of current and future developments in the energy sector, particularly the transition towards a sustainable energy economy and a decentralised energy market, in which individuals will no longer be dependent on traditional energy providers, and may also prefer to opt out of public infrastructure projects, though it remains to be seen to which degree they will actually be allowed to do so.

Doing things

Stavleu began his presentation by looking back upon the American space programme of the 1960s, particularly the famous motivational speech by President John F. Kennedy which is often quoted these days in the context of climate change and the need to transition to a sustainable energy economy: 'We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard.'

A less universally known figure in this story is Katherine Johnson, an African-American mathematician who played a key role in calculating spacecraft trajectories and other critical data for space missions. Johnson was initially employed as a 'computer', a job description that was soon made obsolete by the new electronic devices we now know as… computers. Fortunately, she was also a pioneer in terms of understanding the need to learn how to programme these new devices that were threatening to take her job – in other words, in being able to correctly assess the situation and adapt to a changing reality.

The speed of technological innovation has of course only increased since then, leading to hugely disruptive transitions in a variety of economic sectors, from manufacturing and healthcare to agriculture and energy. The fact that all of these transitions are deeply interconnected, and further accelerated by parallel developments such as the ongoing urbanisation of the world population, also means that none of the resulting challenges can be solved by themselves, but must be addressed through integrated strategies.

The three main challenges currently facing the energy sector can be summed up as: the need to transition to a renewable energy economy; the increasing role of small-scale and localised production and trade; and the new applications made possible by ongoing developments and technologies such as the energy internet and the internet of things.

The traditional business model for the energy sector has always assumed a monopoly of large centralised organisations, often owned or otherwise highly regulated by governments. In this model, energy is produced on a massive scale at dedicated locations, distributed across vast infrastructure networks and marketed to industrial clients and individual consumers. Such transactions are strictly one-way: the customer consumes the energy and pays the monthly bills (and, since a decade or so, is also able to choose between different energy providers).

demands placed upon this infrastructure when more and more people start charging their cars every evening after they come home from work? A massive transition towards locally produced solar and wind power requires equally massive investments in buffers and batteries for storing the surplus energy when the output is greater than the input, or for trading it on the energy market.

Currently available technologies already make it possible for individuals to produce, store, share and trade energy, whether locally or remotely – for example, using peer-to-peer software applications, with blockchain-based systems to ensure reliable transactions (for a description of blockchain technology, see the presentation by Eric Pauwels elsewhere in this publication).

All of these new technologies bring with them new challenges in terms of security and privacy, in addition to the aforementioned (and potentially highly disruptive) unpredictability in how and when the energy network is being used.

Major challenges

The first of the major challenges facing the energy sector is of course the need to transition to a sustainable model (in the Netherlands, the current target set by the government is to transition to 100% renewable energy by 2050). In terms of infrastructure alone, this is by no means straightforward, if we consider for example the fact that almost all of the country's seven and a half million households are connected to a natural gas network, and rely almost exclusively on this gas for heating and cooking.

The next challenge, the increasing role of small-scale independent production and trade by 'prosumers', is also expected to strain the limits of the current infrastructure, which was originally designed to deal with well-established patterns of use, including predictable peak hours. Consider also the increasing market share of electric vehicles: what will be the

Another important challenge is how to determine the price of energy within a marketplace that is in a state of constant change. Also, how many people will actually be willing to spend the time and effort needed for all this smart trading of energy? Presumably, individual 'prosumers' will be provided with software applications that will help them manage these transactions, as seamlessly and invisibly as possible. Otherwise, there is a real danger that this new opportunity may turn out to be just another misguided neoliberal assumption about citizens operating in a perfectly rational manner within the marketplace – if only they didn't have anything better to do.

Brave new world

Perhaps to dispel such apprehensions, Stavleu at this point played a video called 'Life in 2030' depicting a brave new world in which energy, water, communication, mobility, food, shopping and healthcare are all interconnected and optimised using smart networked technologies, saving everyone precious time and resources and thus improving the quality of our lives, not only by providing us with better products and services but also by giving us more free time to do the things we really want to do.

Current developments pointing towards this future scenario include solar cells that can be incorporated in any surface, from asphalt roads to glass windows; increasingly compact thermal batteries for long-term storage of excess heat; houses packed with sensors that measure everything from light and temperature to noise and air quality, remotely controlled by mobile apps that generate individual profiles based on the actual behaviour of residents; the ability to monitor the energy use of individual devices, which in turn makes it possible to programme certain energy-intensive devices to automatically turn on at night when prices are low; and smart thermostats that can determine whether anyone is actually in the house by detecting the presence of mobile phones. Of course, all of these new technologies bring with them new challenges in terms of security and privacy, in addition to the aforementioned (and potentially highly disruptive) unpredictability in how and when the energy network is being used.

Power to the people

A number of current or proposed initiatives by governments and corporations to address the challenges described above involve huge infrastructural investments, for which consumers will inevitably end up paying the bill. The question is whether these consumers, who increasingly have access to technologies that allow them to be essentially self-sufficient, will still be interested in subscribing to the resulting services. For example, there is currently an effort to redirect at least part of

the huge amounts of residual heat produced by the Rotterdam seaport and industry towards powering a district heating network – and also to legally require citizens to purchase this service, whether they actually use it or not. Though such recycling of residual heat may on first sight seem like a 'sustainable' solution (since people are no longer burning fossil fuels in their homes), we should also remember that this heat is still being produced by highly polluting industries. Perhaps it would be a better idea to focus on changing the industry first instead?

Stavleu concluded by remarking that, as the market becomes more liberalised and as individuals are increasingly able to produce, store and trade energy, we should always remain sceptical of any effort to compel us to subscribe to programmes that may not be in our own, or indeed the planet's, best interests. As always when there's a revolution going on, there are also vested interests that may not be so enthusiastic in embracing change. Stavleu's closing words, a familiar slogan with a new twist: power to the people!

Discussion

Justien Marseille, research professor at Creating 010, responded to this last point by noting that educational institutes in fields such as design or information and communication technology should be asking themselves how they can best include these challenges in their curriculum, without inadvertently participating in business models that help perpetuate the fossil fuel industry – a point to which Stavleu wholeheartedly agrees.

A question from the audience: what will become of the major energy providers in this new scenario – surely they won't just give up and disappear? Perhaps their business model will gradually become like that of Uber and Airbnb, focusing almost entirely on providing a customer interface, rather than selling an actual product or service? Stavleu replied that this is in fact a near-perfect description of the current situation – though not many people seem to realise this, the truth is that a company such as Eneco, the biggest energy provider in the Rotterdam region, does not actually produce any energy.

NETWORKS OF TRUST: BLOCKCHAIN TECHNO- LOGIES AND DISTRIBU- TED COMPUTING

ERIC PAUWELS - APRIL 10, 2017

Eric Pauwels is a researcher and head of the department of Intelligent and Autonomous Systems at the Centrum Wiskunde & Informatica, the Netherlands' national research institute for mathematics and computer science. Pauwels explained how mathematical and computational techniques can be used, for example, to establish trust and reliability in distributed networks without any central regulatory authority, and how mathematical randomness and chaos can be surprisingly powerful tools for generating structure and order within information systems.

Pauwels began by mapping out some of the practical applications and contexts in which such seemingly abstract techniques and models can play a very effective role, specifically in the context of the internet of things: the explosion of connectivity (the 'billions and billions of devices' which Lorna Goulden referred to in her keynote presentation, included elsewhere in this publication); the increasing prevalence of highly dynamic networks, which may exist only briefly to perform a certain task and then disappear again; and the fact that in such situations, centralised networks quickly become unmanageable on a practical level, or highly problematic in terms of privacy issues for example. However, as the nodes in these networks become increasingly 'smart' (in terms of their computational and communication capabilities), it turns out that many of these problems can be best addressed using decentralised solutions.

Blockchain technology and distributed computing

Pauwels' lecture focused mainly on a technical description of two key computational techniques: blockchain technology and distributed computing. Blockchain technology (most famously applied in the peer-to-peer cryptocurrency Bitcoin) can be described as a consensus mechanism for establishing trust in value transactions, using various computational techniques and organised according to a decentralised, distributed model.
In the traditionally centralised approach, trust and thus value is guaranteed by a well-established central authority (such as a bank or a government) that keeps track of all transactions. In the distributed approach however, there is no central authority; trust is instead generated and distributed within a peer-to-peer network.

No single node possesses all the information, and nodes can join and leave the network at any moment without any information being corrupted or lost.

For this to work, there obviously need to be very reliable protocols in place to prevent tampering. The basic idea is that transactions are implemented in the form of a chain of data blocks, each of which contains a tamper-proof summary of the entire previous history of the chain. But how exactly is this implemented?

Computational elements

Blockchain technology relies on three main computational elements, the first of which is known as the *cryptographic hash function*. This is a computational function that generates a unique code of fixed length based on an input message of any length. A key characteristic (and closely related to the mathematical concept of chaos) is that the tiniest change in the input will result in a completely different output. Also, the hash code can be easily computed from the input, but it is almost impossible to re-create the input from the generated hash code. In the second computational element, which *generates the actual blockchain,* the hash code generated for each message is merged with the entire body of the next message to generate the next hash code. This makes it extremely time-consuming (in terms of computational resources) to attempt to tamper with existing messages. The third element, called a *proof of work*, specifies that the computational decision of accepting a new block as part of the blockchain is delegated to a random node in the network. This is done by requiring participating nodes to solve a computational problem in such a way that each node in principle has a more or less equal chance of solving the problem first. The solution is then immediately broadcast to the other nodes in the network, who can easily verify that the proposed solution is indeed correct, after which the data block is considered reliable and added to the blockchain. The combination of these three techniques makes it virtually impossible (in terms of computational power) to introduce malicious transactions that might corrupt the blockchain.

Gossiping algorithms

The second part of Pauwels' lecture focused on the concept of distributed computing, and more specifically how certain computational techniques make it possible to reliably extract valuable global information from a network without any centralised computing or gathering of information.

If we consider a dynamic network of nodes that are not centrally registered, and that may only communicate with their immediate neighbours, but that do possess computational and memory resources, there are in fact a number of techniques for reliably computing the answer to various globally relevant questions using nothing but local information: for example, the number of nodes in the network, the maximum distance between two nodes, the highest numerical value associated with any node, the sum of all values associated with all nodes, and so on.

The computational techniques for solving such problems are known as 'gossiping algorithms', in which information that is exchanged, compared and calculated only between immediate neighbours generates new information which then spreads like an infection across the network, eventually providing all nodes with the desired information. No single node possesses all the information, and nodes can join and leave the network at any moment without any information being corrupted or lost. Interestingly (and somewhat surprisingly), it is also possible to generate very accurate information about certain global properties by locally exchanging and processing values that are in fact generated randomly.

Discussion

Ben van Lier, research professor at Creating 010, asked whether we may now be facing a new paradigm in computing, in which agency and decision-making are moving from centralised systems toward the nodes of networks – perhaps even to the degree where these nodes may end up becoming truly autonomous? Eric Pauwels replied that it may soon prove impossible to continue to rely on centralised solutions for dealing with the literally uncountable devices that are rapidly populating the internet of things. Regarding the possible autonomy of such devices, however, it would be wise to remember how data, once it has been collected, often ends up being used for other purposes entirely, and also that any devices that may be programmed to pursue their own goals and even set their own agendas might also find ways of using this data that will not necessarily be beneficial to us, their human creators.

Ben van Lier's next question addressed the role of research in understanding and addressing the potential problems related to these emerging technologies. Eric Pauwels replied that such technologies are almost by definition a field of ongoing research and development: for example, the idea that solving the 'proof of work' component of blockchain technology should be rewarded in a way that actually encourages participants to expend computational power in solving the problem, is actually quite new. And, looking toward the future (which may well be much nearer than we think), how tamper-proof will such technologies still be when faced with the incomparably greater computational power potentially made available through quantum computing? Also, the computational methods for establishing trust and value in blockchain systems are in fact extremely subtle and complex, so if we start fiddling around with these algorithms without first properly researching the consequences, there is no end to the problems we might be creating in the long term.

Finally, Van Lier asked what a university of applied sciences might contribute to what seems like an extremely theoretical field of research and development. Pauwels replied that the underlying theory, however interesting and promising it may be, always needs to be tested in real-life cases; that the theoretical work is often inspired by practical problems; and finally, that the specific applications often turn out to be much more complex and interesting than the general theory.

Part Four: Cultural Analysis and Artistic Critique

TECHNO-ANIMISM AND THE INTERNET OF THINGS

RONALD VAN TIENHOVEN - APRIL 11, 2017

Ronald van Tienhoven is a freelance artist and curator, and a tutor of fine art at the Willem de Kooning Academy in Rotterdam. Van Tienhoven proposed a vision of the internet of things that has little to do with the latest trends in digital technology: the idea that humans have always been communicating with things, and that in our minds at least, there is really no such thing as an inanimate object. In other words, the internet of things is nothing new: it has been with us for thousands of years.

Van Tienhoven began by showing a video of a man dancing and ritually interacting with stones and other mysterious objects in a garden of dead trees in the middle of a desert. He then described how, as a child, he used to collect various small objects which he felt were communicating with him on some level, even though he was well aware that what he was hearing was the echo of his own thoughts. Animism is, at its core, a very simple and straightforward relationship with our environment: the sense that everything, whether living or non-living, is connected and animated on some universal, fundamental level. Or as the saying goes among the Ojibwe tribe of North America: 'The world is full of people, only some of whom are human.'

It is precisely this blurring of boundaries between ourselves and the 'others', whoever (or indeed whatever) these may be, that is increasingly becoming a key concept in information and communication systems, particularly in the context of the internet of things. Returning to the man in the desert (an Iranian shepherd named Darvish Khan Esfandiarpour) and his stone garden, what we see here is an intricate network of objects

that all have stories to tell: a hyper-localised internet of things. Van Tienhoven's vision of the internet of things can be summed up in three main concepts: *dispersion & serendipity, condensation & proximity,* and *oblique strategies & oblique communication.*

Dispersion & serendipity

To illustrate the first concept, *dispersion & serendipity*, Van Tienhoven showed a series of snapshots of another garden, this time in the forests of Switzerland, where a hermit named Armand Schulthess spent decades creating his own highly subjective encyclopaedia, implemented in the form of lids of paint cans nailed to the trees of the forest and inscribed with texts on a wide variety of topics (though psychoanalysis seems a recurring interest). Walking through this garden of information, one can not only read about the things Schulthess happened to thinking about, but also pick up a suggestion: 'read a book', in much the same way as an online service such as Google or Amazon might suggest an unexpected and serendipitous course of action (though Amazon's suggestions tend to be rather more specific). Schulthess also

The internet of things is nothing new: it has been with us for thousands of years.

established relationships between the various bits of information by connecting them with wires, as a kind of primitive physical hyperlinks. As the trees grew, the wires would often break and the connection would need to be re-established, which also provided an opportunity for them to be reconsidered or improved.

Condensation & proximity

The second concept, *condensation & proximity*, can be illustrated by the *tefillin*, the small leather boxes containing miniature scrolls inscribed with verses from the Torah, which pious Jews often wear for prayer. In addition to the complex and intricate system of leather straps connecting the two boxes with the person's arm and head in a constant flow of symbolic energy, the tefillin can also be understood as highly condensed carriers of information – an intense, mysterious and miniaturised representation of a huge, complex and ancient body of religious and philosophical knowledge, at the closest possible physical proximity to the 'end user'.
The parallel here with modern technology is that, as the hardware becomes smaller, more ubiquitous and thus also more invisible, we find ourselves increasingly enveloped in a cloud of information condensed within many different objects, including objects we no longer immediately see or recognise as carriers of information.

Oblique strategies & oblique communication

The third and final concept, *oblique strategies & oblique communication*, questions the dogma of efficiency as a leading principle for our relationship with information and technology. As this technology is increasingly able to guide itself, and even to guide us, it may be useful to reconsider how we communicate and share information with each other and with the objects that surround us.
Consider for example the *I Ching,* the ancient and influential Chinese book of divination, which presents the reader with a complex system of highly detailed messages; yet, the process of finding out which message one should consider in a given context is determined entirely by chance, while the interpretation of the message in question is far from straightforward, and relies on the

reader's own effort, knowledge, wisdom and imagination. The Ancient Greek Oracle of Delphi, a priestess in a cave filled with intoxicating vapours, would provide similarly cryptic answers to whatever question was put before her – including questions of life and death, such as whether to start a war.
A more contemporary example is Brian Eno's *Oblique Strategies,* a deck of cards designed to similarly promote what we now call 'lateral' or 'out-of-the-box' thinking in various decision-making processes. The common factor here is the need to approach problems in a way that bypasses the limitations of a purely functional, utilitarian perspective, hopefully leading to deeper hidden possibilities one would otherwise never even have considered.

Perhaps the key difference between traditional and technological animism is that the objects are now actually, and increasingly, capable of some degree of self-agency, rather than merely being the passive carriers of whatever message humans choose to project upon them. However, one thing that has not changed is that there are still 'priests' and 'shamans' (Google, Facebook, Amazon, etc.) who control the objects, who tell us what these objects have to say to us, who determine the algorithms and decide which parts of the essential information should remain hidden from the rest of us.
Van Tienhoven is also involved in an initiative called the Parliament of Things, a platform that gives a voice to objects both living and non-living, from micro-organisms to mountains. Since the objects in question cannot be expected to express their needs and grievances verbally or in writing, they may be represented by scientists, artists, or delegates from indigenous populations. Van Tienhoven cited a related example from New Zealand, where a river has recently been declared by the state to have the same legal rights as a person, based on a claim by a local Māori tribe.

Discussion

Paul Rutten, research professor and programme director at Creating 010, asked whether, among all the talk of disruptive breakthroughs and paradigm shifts, it may be more accurate and more useful to think of a continuum in how

information algorithms and communication networks continue to develop, from the stone garden in the desert to the internet of things? Van Tienhoven replied (rather obliquely) that, if we are talking of paradigm shifts, the biggest change he sees possibly happening in the near future is a return to the early, idealistic vision of the internet as a place for free and open exchange, rather than the current capitalist paradigm in which a few people are making billions and all the others who provide the labour and data are getting nothing.
Rutten then linked Van Tienhoven's reply to the theme for this morning – the 'next economy' – and the need in this context to invest in decentralised networking and lateral connections, rather than automatically relying on established hierarchies and 'major players'. Van Tienhoven replied that, although he considers himself an eternal optimist, he also sees a lot of wishful thinking in this regard, and that the problems that will need to be addressed should not be underestimated.

A question from the audience: as we discuss oblique strategies in the context of information networks, should we also consider including more diverse sources in these strategies, in order to escape the information monopoly of Google, Wikipedia and the mainstream news services?
Van Tienhoven replied that the issue of trust, which is essential in selecting information, also includes trust in ourselves, in developing the flexibility and depth that are necessary for making these choices – rather than simply consuming whatever is coming our way, without having to make an effort or negotiate with our surroundings.

Consider for example the homes designed by the artists Madeline Gins and Shusaku Arakawa, who were obsessed with immortality: for them, the only way to live forever was not to get too comfortable, but rather to struggle through an environment that presents you with obstacles and challenges – for which the only possible solution will always be an oblique strategy.

RADICAL OBSERVA-TIONS AND ARTISTIC PROTOTYPES IN THE FIELD OF IOT

RODOLFO GROENEWOUD - APRIL 10, 2018

Rodolfo Groenewoud is Business Director at In4Art, a social innovation and incubation platform for young creative practitioners operating on the intersection between science, technology, society, business and art. The speculative prototypes developed by these 'innovatist' artists are all actual products, services and apps that people can see and interact with, and which reflect upon the development, application and impact of technology in the near future.

Groenewoud started by pointing out the broad consensus regarding the importance, impact and unpredictability of ongoing developments related to the internet of things, whether from a business perspective (huge new markets and disruption of traditional production processes), a societal perspective (unprecedented challenges and opportunities for labour markets, transportation, communications and governance) or a political perspective (concerns by policymakers that the internet should be more human-centred, so that the internet of things does not end up becoming the internet of no people).

All of the artistic prototypes presented here are related to recent and ongoing developments in key technologies including artificial intelligence (AI), facial recognition, speech recognition, interactive technologies, social networks, biometric data processing, blockchain technology, natural language processing, mobile communications, autonomous transportation,

3D printing, sensor technology, and augmented reality. Most of these prototypes can also be directly connected to current developments in the real world; interestingly, as the speed of technological progress continues to increase, the time delay between these speculative prototypes and their practical implementation becomes shorter, so that most of the applications presented here are now just a few years ahead of what is actually available on the market.

Twelve examples of artistic prototypes
Groenewoud discussed twelve examples of artistic prototypes which In4Art has facilitated, gradually scaling up during the course of his presentation from the level of the individual citizen (body area networks), to interpersonal relations within working, living and consuming environments (local area networks), to transportation, the city and the region (wide and very wide area networks):

1. Ruben van de Ven's **Emotion Hero** is a mobile phone game where players score points by successfully producing facial expressions to match seven different emotions, from joy to disgust, progressing through levels with titles such as 'let's talk business' and 'smile like you mean it'. If this seems somewhat whimsical, consider that Facebook has filed pre-patents that involve reading and responding to facial expressions, not only to show the user more 'likeable' content, but also to select advertisements based on a potential customer's responses.

2. Fei Liu's interactive installation **The Qualified Life** submits visitors to a fictitious job interview based exclusively on facial recognition and social network data, in which a robotic human resources manager presents the user with increasingly confusing and stressful tests and assignments. Meanwhile in the real world, a company called Blippar already uses similar technology in an app that allows users to identify who might be worth approaching and networking with at professional events.

3. The artist Jonas Lund uses blockchain technology to allow anyone to become a **voting shareholder in** the further development of **his own artistic practice;** cryptocurrency tokens can be obtained by purchasing his artworks, inviting him to speak at an event, etc. Considering how difficult it is for start-ups to obtain funding in their critical early stages, the scheme proposed here shows how venture capitalists could choose to invest in the career of a promising entrepreneur, rather than in a specific project.

4. Jonas Elte's **Lost in Computation** is an attempted conversation between two AI chat-bots, one speaking Swedish, the other Italian, communicating through the intermediary of Google Translate. Though the results are (still) predictably laughable, one should not underestimate the resources Google and other companies are pumping into this holy grail of natural language processing: every time a video is uploaded to YouTube for example, the neural network algorithms are fed new examples for learning the dark arts of speech recognition, translation, interpretation, and even lip reading.

5. Jasper van Loenen's track-and-hack device **Linger** collects and then corrupts the identification signals sent between mobile devices and Wi-Fi access points, storing the fingerprint of all devices that pass by and later rebroadcasting them, essentially rendering the data meaningless. In fact, there are real concerns that this kind of tracking information, which is already being used to follow people's movements in shops and airports, could be used for questionable purposes, for example changing in real time the pricing of articles based on the behaviour of consumers.

6. Helena Nikolone's **Deus X Mchn** hacks into private surveillance cameras, then records and samples the voices it hears, and later makes these same voices unexpectedly start reciting gibberish texts (generated from a mashup of religious scriptures) through the device's loudspeakers, before filming the confused victims as they end up ripping the device from the wall. Meanwhile in China, a software company called SenseTime proudly tracks its employees in their own free time, with the stated goal of increasing productivity by providing them with real-time advice, perhaps spoken through nearby surveillance devices.

7. James Bridle's **Autonomous Trap** examines flaws and contradictions in the rules that define the behaviour of driverless cars: for example, by 'trapping' a car using simple road markings that allow it to enter, but not exit, a perimeter (Bridle has also released open source code and hardware instructions for making any car drive autonomously). In fact, accidents involving driverless cars or cars on 'autopilot' mode are often caused by inaccurate, inconsistent or confusing road markings.

8. Matthieu Cherubini's simulation game **Ethical Autonomous Vehicles** allows the user to choose between three different policies (protect all humans equally, prioritise the safety of the car's occupants, or choose the best financial outcome for the user's insurance policy) in order to determine the behaviour of driverless cars in different simulation scenarios. Incidentally, Groenewoud could find only one country (Germany) whose government has formulated ethical guidelines for upcoming legislation, even though there are already driverless cars on the roads.

9. Peter Reichard's **NOxmas** is an illuminated tree that changes colour based on real-time levels of air pollution detected by built-in sensors. Concerned citizens can also follow daily patterns on a website. Beside the predictable peaks during rush hours, developers noticed the patterns inexplicably changing after the tree had been in place for some time: it turned out that people started avoiding the tree when it was red, choosing other itineraries instead. An image really is worth a thousand words – actually seeing pollution levels in real time has much more impact on our behaviour that simply reading about it.

10. MX3D, an Amsterdam-based company specialising in robotic additive manufacturing, is expected to install the first completely 3D-printed footbridge in Amsterdam sometime in 2019. Besides the predictable technical challenges, the makers also had to deal with completely new challenges in terms of funding, safety regulations, engineering requirements and urban planning, since this was the very first project of its kind.

11. Jordan Seiler's **NOAD** is a mobile app which, when pointed at street advertising posters, shows the ad replaced by an artwork. If this seems idealistic, consider how the same technology can also be used to personalise outdoor advertising, or any other information for that matter. In fact, the newest 'smart' electronic billboards on London's Piccadilly Circus use a combination of technologies to generate profiles of whoever happens to be passing through the square, and to select advertisements accordingly.

12. Finally, the multimedia installation **Kitty AI** by Pinar Yoldaş speculates on a more distant future (2039) in which the city is ruled by AI algorithms, personified by a cartoon avatar – not some frowning Big Brother, but a cuddly cat who loves us and wants to care for us. Actually, a small number of companies are already experimenting with giving AI algorithms a vote in boardroom meetings, while a recent survey showed that most executives thought it was a good idea. And, as the boundaries between corporate and public governance become increasingly blurred, maybe 2039 is closer than it seems…

One of the schemes proposed here shows how venture capitalists could choose to invest in the career of a promising entrepreneur.

Part Five: Privacy and Security

Discussion

A question from the audience: many of the prototypes presented here include elements of dark or dystopian humour. But do you also have people come up to you and say: this is amazing, how can we make this happen as soon as possible in reality? Creating 010's Paul Rutten followed up on this question by noting how media art often falls into one of two categories: either angry protest and provocation, or optimistic promotion of alternative social models. Yet most of the works presented here seem to fall somewhere in between. Is this a conscious choice?

Groenewoud replied that In4Art indeed prefers to work with artists who not only critically reflect on important themes, but also seriously research the underlying technology, develop actual working prototypes, and then leave it to others – policymakers, businesses, citizens – to draw their own conclusions as to whether something is dystopian or utopian, and how the technology should best be applied. On one hand, we expect artists to be critical and even provocative; on the other hand, it might be more convincing to let the technology speak for itself, without explicitly voicing a personal opinion. You can always agree or disagree with opinions, but facts are harder to dismiss.

THE DIGITAL GOVERN-MENT, SECURITY AND PRIVACY

PIETER DE GROOT - APRIL 10, 2018

Pieter de Groot is the Personal Data Protection Officer for two Dutch ministries (Justice and Security, Interior and Kingdom Relations) and for the government agencies charged with implementing the policies of these ministries. De Groot invited the audience to reflect upon the evolving concept of privacy, from its (surprisingly recent) origins to the specific new challenges resulting from the ongoing digitisation of practically all information streams, including government services.

Gutter journalism

Privacy is one of those complex topics on which everyone seems to be an expert, or at least have a strong opinion – and it is precisely these topics that inevitably turn out to be the most challenging to legislate and enforce. Privacy is typically understood as the right to be left alone, and to not have to justify one's own personal life. However, this definition of the term 'privacy' is in fact a relatively new cultural construct: the earliest privacy laws were formulated in the 1890s in the United States, as a response to the unrestrained 'gutter journalism' of the first mass-media newspapers (and with obvious parallels to our own digital age, from the debates and scandals of mass surveillance and the boundaries of free speech, to fake news, data leaks, manipulation of democracy and revenge porn).

In 2011 already, policymakers were shocked to hear that the average Dutch citizen was then already registered in some 800 databases, which are also increasingly interconnected.

Privacy is also closely related to the concepts of bodily integrity and home inviolability, and how such individual rights must be balanced against the greater good of society – questions that shape legislation on topics ranging from breathalyser tests and organ donation to incarceration and search warrants. De Groot also pointed out the distinction between horizontal privacy (between citizens, including professionals in positions of authority such as educators and healthcare providers) and vertical privacy (between governments and citizens). For the purposes of this presentation, De Groot would be focusing explicitly on vertical privacy, and more particularly data privacy.

A case in point: a municipal government recently decided to send a letter to all of its low-income residents, informing them that they were eligible to claim a financial bonus for the holiday season. However, there was a concern that people with a low income tend to throw away any letters from the government. And so someone came up with what seemed like a great idea: to print on the envelope, '€ 50 for you inside!' One resident, whose letter ended up by mistake in a neighbours' mailbox, disagreed, and filed a complaint. Rightly so – or not? De Groot invited the audience to ask themselves what they would have done in a similar position. Often the best way to address dilemmas such as these is to follow what is known as the Golden Rule: if you wouldn't appreciate it happening to you, maybe you should assume that others won't appreciate it either. How would you feel if your neighbour found out that the government thinks you're poor? Furthermore, isn't it each citizen's own responsibility to decide whether to open a letter or not?

Purpose limitation

Rather than propping up his lecture with the usual PowerPoint presentation, De Groot instead pulled out of the pockets of his suit jacket (with fine comedic timing) a few simple objects: a rag doll embodying the citizen who just wants to be left alone, a set of scales for weighing individual privacy against societal interests – and an abacus with beads representing the different privacy factors to be considered in formulating data policy.

For example, how sensitive is the information in question? A simple name and address, for instance, are relatively trivial compared to someone's medical records. Also, what would be the consequences for the citizen if the data were to be used by another agency than intended – or leaked to the public? Was the data obtained with the citizen's explicit permission, or were they legally required to provide this information? Which guarantees and security measures have been put in place? Are these measures appropriate to the sensitivity of the information in question?

Another important concept here is *purpose limitation*: data should be used only for the purposes for which it was obtained. For example, an employee's access badge cannot suddenly be used as a punch card, just because your supervisor wants to know whether you were at work on time. Similarly, security camera footage should only be used when an incident actually occurs, and not to keep track of what citizens might be doing on the streets.
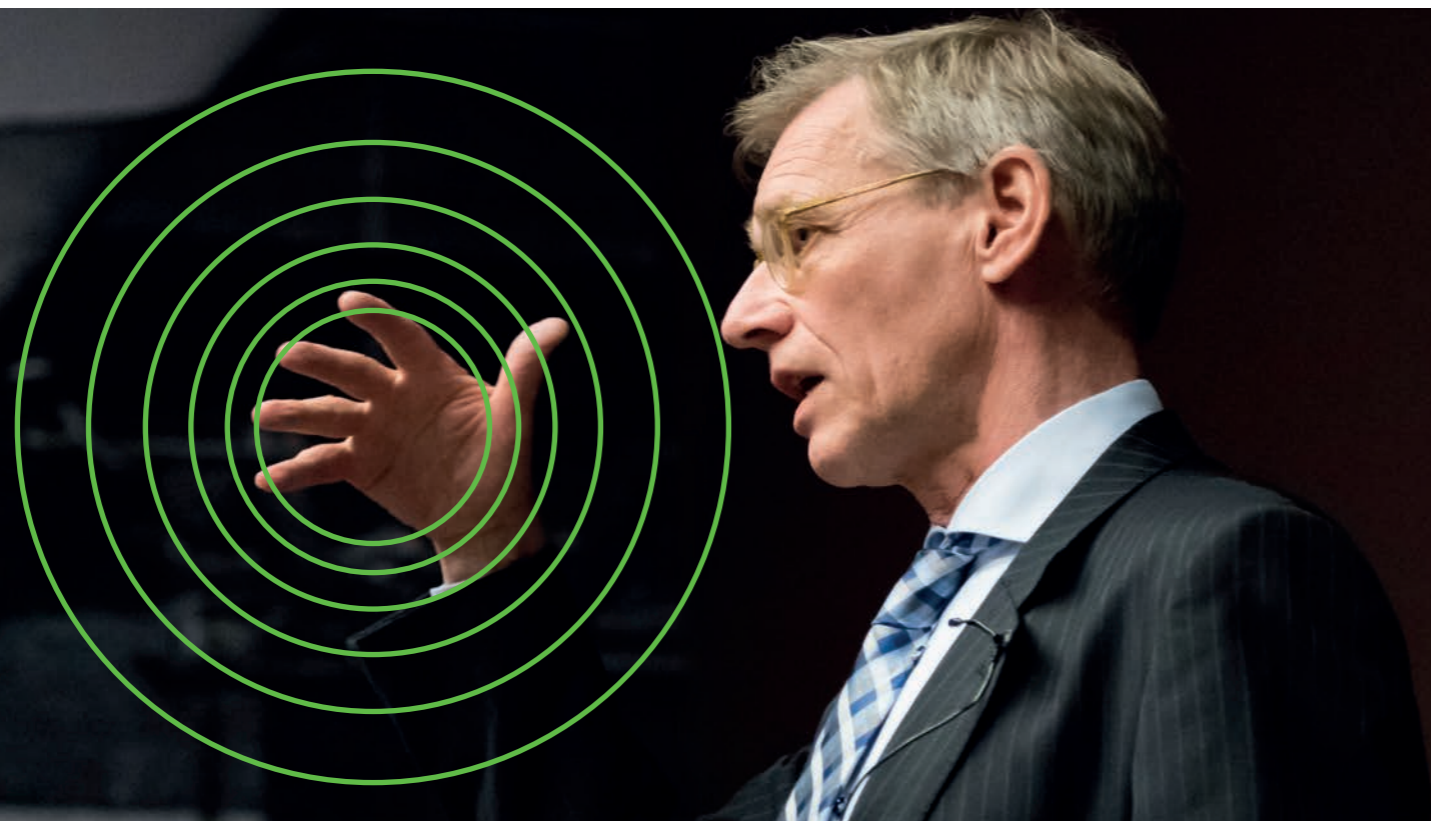
Driving, anchoring and procedural forces

In 2011 the Dutch Senate held a widely-publicised debate on the topic of data privacy. Policymakers were shocked to hear that the average Dutch citizen was then already registered in some 800 databases, which are also increasingly interconnected. This Senate debate is still seen as a key step in raising consciousness on this topic within the Netherlands.

A subsequent report by the Netherlands Scientific Council for Government Policy *(Wetenschappelijke Raad voor het Regeringsbeleid)* identified three main, and conflicting, types of forces that define data privacy policy. The first are the *driving forces:* the need for ever more speed and efficiency, in both the private and public sectors. In the days of the 'paper office', documents often needed to be submitted in triplicate: nowadays, of course, once the data has been entered into the information system, it can be endlessly copied, relinked and re-networked.

The second type of forces shaping data privacy policy are the *anchoring forces*, where questions are asked such as: what do our laws have to say about all these grand new schemes? How long will the data be kept? Is all of this data actually necessary for the intended goal? Finally, there are the *procedural forces,* which address topics such as transparency, documentation and accountability.

Privacy Impact Assessments

Another consequence of the 2011 Senate debate was the introduction of *Privacy Impact Assessments*, which require the formulation and implantation of step-by-step plans for all new and ongoing projects which make use of personal data. These assessments include a description of facts and an analysis of processes (which data is being collected, how is it being used, how is it linked to other data); an evaluation of requirements (why is all this data necessary); an assessment of the risks involved (what happens if, or when, something goes wrong); and a description of guarantees and security measures (what is being done to minimise these risks).

Since January 2017, data leaks must be reported to the Dutch Data Protection Authority. Thousands of reports are filed each year in relation to government services. Most leaks are due to human error, the kind of thing that can happen to anyone, like sending an e-mail to the wrong recipient – except that in this case, there was sensitive information involved. The procedure for civil servants in such cases is: report the error to the Data Protection Authority, apologise to the citizens affected, and take any possible measures to prevent the same thing happening again.

The consequences for the civil servant may be significantly more severe when the leak is the result of a lapse in judgment, or a disregard for regulations: for example, an official document brought outside of the office against protocol, which is then lost or stolen; the contents of security camera footage revealed for personal reasons to third parties; or even a paper file read by a civil servant in a public place in a way that might be seen by others (in this last case, interestingly, there has still clearly been a data breach, even though the data has not been copied, but only potentially seen).

De Groot concluded his presentation by inviting the audience to reflect upon their own behaviour: we all like to think we could do a better job than the government, but how critical are we in considering our own actions? For example, when we post something on Facebook, how often do we stop to wonder whether we might be intruding on the privacy of friends and strangers?

ABOUT CREATING 010

Creating 010 is a Research Centre of the Rotterdam University of Applied Sciences that focuses on transformations in society that are related to ongoing digitisation and to developments in the field of information and communication technology. Creating 010's research always considers people within their social context. Designers, developers and appliers of technology all play an important role in this regard; the choices they make allow them to address the often difficult challenges posed by technology, for example by opting for secure data storage and open source software. They are also in a position to shape future developments, by considering the needs of users, stakeholders and society at large in the design of not only products and services, but also shopping districts and cities.

The main sectors we consider are the creative industry and ICT, both of which play a key role in defining the form and content of transformations in sectors such as social care and healthcare, entrepreneurship, retail, and urban development. Creating 010 collaborates closely, though by no means exclusively, with the Institute for Communication, Media and Information Technology (CMI) and the Hub: Technology (HR WERKplaats Techniek).

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CREATING

The research themes of the Centre are:

Design in the 21st Century
Designers are increasingly called upon to address a wide variety of often complex challenges, while relevant stakeholders participate more frequently and intensively in design processes. At the same time, there is a growing awareness of human values and the social impact of design, as the role of digital technology continues to expand. This research theme focuses on how designers are currently approaching new challenges and opportunities, and which methods are most suitable in this regard.

Mapping Creative Rotterdam
The creative industry and creative professionals play a defining role in the development of Rotterdam's innovative urban environment. Creative professionals in particular may also benefit from a more systematic understanding of emerging social and cultural trends. This research theme applies quantitative and qualitative research in order to compile a current overview of Rotterdam's creative sector and opportunities for creative talent.

Communication in the Networked Society
Communication professionals require strategies that allow them to bring organisations and individuals together more effectively. The projects within this research theme focus on how these strategies can be applied within today's networked society, characterised by increasingly horizontal organisational structures and individual bonding. The project focuses specifically on the effectiveness and applicability of online content and influencing behaviour, both essential considerations in today's interconnected world.

Data Driven Society
The internet of things functionally connects not only objects but also people, and links them both to powerful applications of algorithms and software, resulting in cyber-physical systems. This research theme addresses the new manifestations of technologically connected people and things, focusing on themes ranging from big data analysis and blockchain technology to privacy and security, as well as the related technical, ethical, social and design challenges.

Business Model Innovation in Creative Industries
Though the creative industries are usually associated with innovation of products and services, they also play a pioneering role in creating, providing and claiming value: the innovation of business models. Here too, the creative industry can serve as an inspiration to other sectors. The goal of this research theme is to identify, based on qualitative research, patterns of innovation in how actors within this sector are designing their business models – particularly, though not exclusively, within the sharing economy and the circular economy.

Maker Education and Contextual Learning Environments
Combining the maker movement's constructionist educational model with the paradigm of socially structured learning within communities of practice, provides us with an excellent starting point for educational innovation within an institute such as the Rotterdam University of Applied Sciences. In this research theme, educators develop and research their own educational practice through the methodologies of action research; they implement concrete changes in their professional activities within their own educational contexts, while also researching these activities and contexts.

#iotrotterdam

The internet of things has been playing an important role in our thinking and doing for some time now, not only in visualising how digitisation is changing our world, but also as a focal point of technological development in education and research.

This publication consists of a series of concise and richly illustrated summaries of the keynotes and lectures given during the 2017 and 2018 editions of the International Internet of Things Day Rotterdam, both hosted by Creating 010, a Research Centre of the Rotterdam University of Applied Sciences. These interventions were provided by a diverse group of experts, from scientists and entrepreneurs to activists and artists.

We have grouped these current perspectives according to five themes that reflect the multidisciplinary approach that is characteristic of the International Internet of Things Day Rotterdam. The Human Perspective primarily considers the IoT from the point of view of users and citizens, while Robotics and Artificial Intelligence focuses on the ever-increasing power and potential of technology. Digitisation has clearly demonstrated the power of networks and the countless resulting opportunities for transformation: Networks and Innovation. Cultural Analysis and Artistic Critique are key aspects of Creating 010's specific approach to the IoT, casting a critical light not only on contemporary technological developments, but also on how these are framed and interpreted. Another approach toward considering the possible negative implications of a data-driven society is the perspective of Privacy and Security, specifically the role of governments.

This publication provides a valuable contribution to the discussion on the role and meaning of the internet of things and digital transformations, while also providing a solid groundwork for upcoming editions of the International Internet of Things Day.