CONNECTED**REALITY**2025

The next wave of digital transformations

A TREND STUDY from Z_punkt

punkt The Foresight Company

CONNECTED **REALITY**

Forget everything you have heard so far about the 'digital revolution'. New Economy, Web 2.0 and mobile Internet were just the beginning. In the next few years, the Internet will fuse with our surroundings to create something totally new: a 'super convergence' of networked everyday objects, intelligent sensors, autonomous machines and computers that can be accessed from any location. This next wave of digital transformations will change our daily lives, create new markets and become a game-changer for businesses. Welcome to Connected Reality.

"...THE BIGGEST THING IN (THE NEXT 20 YEARS) WILL BE THE COMPLETION OF PERVASIVE COMPUTING: VISION, SPEECH, HANDWRITING, GOGGLES, EVERY SURFACE, INFINITE MACHINE LEARNING, INFINITE STORAGE, INFINITE RELIABILITY, AT ESSENTIALLY NO COST."

BILL GATES (IN WIRED, 16.4.2013)

"Everything is becoming a SENSOR."

RENÉ OBERMANN, MEMBER OF THE SUPERVISORY BOARD OF THYSSENKRUPP AG

"The Internet of Things, sometimes referred to as the INTERNET OF OBJECTS, will change everything – including ourselves."

DAVE EVANS, CISCO

"REALITY IS ONE

of the possibilities I cannot afford to ignore."

LEONARD COHEN

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THE NEXT WAVE OF DIGITAL TRANSFORMATIONS

#1

The World Wide Web began a technological and cultural revolution in 1989. E-commerce, social media and mobile Internet have since then radically changed our daily lives and the way business is done. Hindsight could lead to the erroneous conclusion that the success story of digitalisation has already reached its conclusion. Are the central claims located on the Net? Will it be simply 'more of the same' from now on?

Just the opposite. It is likely that the digital transformation of business and society is just beginning. New technologies, which are growing more rapidly and converging, are being developed all the time, sometimes with breathtaking speed. Their disruptive effects have already been felt in some sectors, where they call traditional business models into question and open up new markets, creating new winners and new losers.

Yet, networking continuous to grow exponentially, at the global, local and microlocal level; and it is set to end with an IT 'super convergence'. The Net of the future will link people with people, things and machines with other things and machines, people with things and machines, and vice versa. It will result in an 'Internet of Everything' – with far-reaching effects.

The juxtaposition of the physical, tangible reality and a cyberspace into which we can peer only by means of display screens, as if through the windows of a sweet shop, is disappearing. Cyberspace is expanding into the offline world, affecting everyday objects, bringing data sets into our surroundings. Reality is not only extending its reach, its very fabric is also becoming more digital.

Trends and Drivers of Connected Reality

The super convergence in information technology sector is driven by increased networking, miniaturisation and the improved performance of processors, memory stores and sensors. This development is reflected in **five technological trends**.

The Internet of Servers is being expanded to create an **Internet of Things**, to which machines, equipment and products are also linked. The information that they produce and which is processed in the cloud using Big Data methods integrates new characteristics and services into our surroundings, creating a **ubiquitous intelligence**. New interfaces such as goggles (optical head-mounted displays), which represent the next qualitative development after smartphones, will enable rapid and direct use of this new technology. They will open up augmented-reality applications for the mass market in the next decade. The further development of 3D printing and other decentralised manufacturing techniques is shortening the path from virtual design to physical realisation. Smaller, faster networks are competing with large-scale production units; cyber-physical systems are preparing to revolutionise industry. Efficient **digital production** is on the rise. It is supported by **autonomous systems**, such as intelligent manufacturing robots and software agents.

These technological trends go hand-in-hand with **social innovation drivers**. The **digital lifestyle**, which has, up to now, been characterised by the consumption of new media content and network communication, is becoming more intense. Health and fitness are moving into the field of vision, but so too is the exchange of products and services in the 'sharing economy'. More and more consumers are using new tools to discover the desire to do things themselves, a **new spirit of autarchy** is challenging manufacturers and service providers. They, in turn, are setting the pace at which they sell to clients in the **real-time economy**, not just for products but also new services. These drivers, which affect business and society, are challenged by two requirements, both of which necessitate innovation. Climate change and the threat of raw material shortages mean greater **resource efficiency** is required, whilst the continuing rise in cybercrime, the potential threat of terrorism, as well as a greater aversion to risk in our daily lives, all demand more **security**.

Not all these trends are new. Some of them having been talked about for decades. MIT has been conducting research into the Internet of Things and 'things that think' since the early 90s. Scenarios modelling 'ambient intelligence', that is to say, a highly-networked intelligent everyday world, were already the subject of a major EU project at the end of the last millennium. What is new, however, is the sudden increase in development speed, resulting from a change in the social context and the level of maturity of key technology markets.

IT – having taken over our desks, our trouser pockets and, increasingly, even our living rooms over the last few decades – now has the rest of the world in its sights.

A new operating system

"If I want to know what the weather is going to be like today, I'll open the weather app on my smartphone. I used just to look out of the window."

The more digital networking takes hold of all aspects of our lives and all types of commercial transactions, the more it becomes a fundamental part of our daily reality – a changed reality, in which future generations will not be able to understand how it was possible to live with 'stupid things' that weren't permanently linked to the Cloud, nor how we managed to survive without goggles and information-forecasting services. These words do not depict a distant future, rather they describe a trend that began long ago and which will change, over the next few decades, not only our daily lives and value-creation processes, but also our concept of reality itself.

Holding connected reality out as an example of the transformational power of the super-convergence of information technology is just as bold as it is vague. All too often, developments are heralded as the next big thing set 'once again to change everything'. On the other hand, innovations in information technology – from the telephone via the Internet to the smartphone – always have a profound effect on the social and economic 'operating system'.

The emergent super-convergence of information technology has the potential not only to update but also to introduce a completely new operating system, which will redefine our expectations of, and our dealings with, the things, devices and spaces that surround us.

If, in a few years, we have become used to the constant availability of information about people, situations and things in our immediate surroundings thanks to technology about our person – so-called wearables, and if it has become the norm for intelligent products, houses and vehicles to 'recognise' us and to use networked services to cooperate and anticipate our requirements, then a world in which these magic properties are lacking will soon seem very strange to us. Welcome to **connected reality**.

What connected reality means for businesses

The interplay of innovation drivers is already apparent. For example, augmented lifestyles, new interfaces and the real-time economy are creating hybrid shopping opportunities that remove the boundary between traditional and online shopping; and, ubiquitous intelligence, Big Data and security requirements are forcing international companies to adopt cloud-based working practices for their projects. There are numerous **trend indicators** that show that superconvergence is imminent.

Connected reality will set new parameters for businesses. Thus, value is increasingly being created in networks through the use of hyperconnectivity.

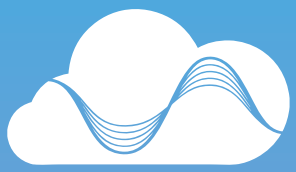
The importance of individual companies is disappearing: connected reality means the key players will actually be '**business economic systems**'. Manufacturers and service providers will offer complex solutions to customers' requirements, e.g. the use of wearable sensors in the field of smart health, providing cloud-based data analysis, medical diagnosis and nutritional advice that will make it possible for health to be monitored intensively in real time. However, within business economic systems, even former competitors will come to collaborate; for example, car manufacturers and transport operators, such as train companies, will use data integrators to link their products instead of trying to entice customers away from one another. Thus, traditional market boundaries will begin to disappear, giving rise to new **cross-sector markets**. To enable these new markets to develop, **system innovations** will be required – not to improve individual product parameters, but rather to build application contexts from the bottom up. The economy must, therefore, adopt a new culture of openness, going as far as open innovation and open collaboration. These will become an essential and self-evident part of business life in connected reality. Markets will no longer be characterised as battlefields, where as much ground as possible must be won. Instead, they will become

spheres of cooperation where it is possible to come up with appropriate solutions amongst the constant flow of data and information and in conjunction with customers and other operators.

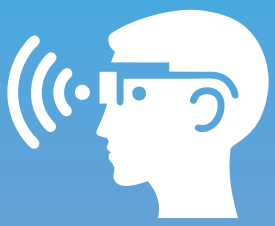
This creates a multitude of new challenges for businesses. Products that can be networked will generate a continuous stream of data, and new ways of creating value based on that data will have to be developed in order to generate added value from the data. Customer relations will come to be characterised more and more by **real-time interaction**. Increasingly, products and services will need to be developed and marketed as **hybrid bundles**. It will be necessary to open up the potential for **smart automatisation** along the entire value-creation chain.

We can already see all these developments in use today; each one is the subject of numerous strategic discussions and management consultancy studies. Yet, as the pace of change becomes greater, the more important it becomes to evaluate the various trends and future developments in the round in order to gain sight of the big picture. This overview can then be used to guide strategic focus. This study represents a first step along this path.

TECHNOLOGICAL TRENDS

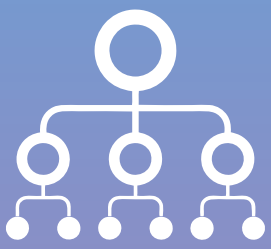


UBIQUITOUS INTELLIGENCE



NEW INTERFACES

DIGITAL PRODUCTION



INTERNET OF THINGS

TRENDS

CONNECTED REALITY 2025

DRIVERS

AUTONOMOUS SYSTEMS

DIGITAL LIFESTYLE

SECURITY

THE NEW SPIRIT OF AUTARCHY

REAL-TIME ECONOMY

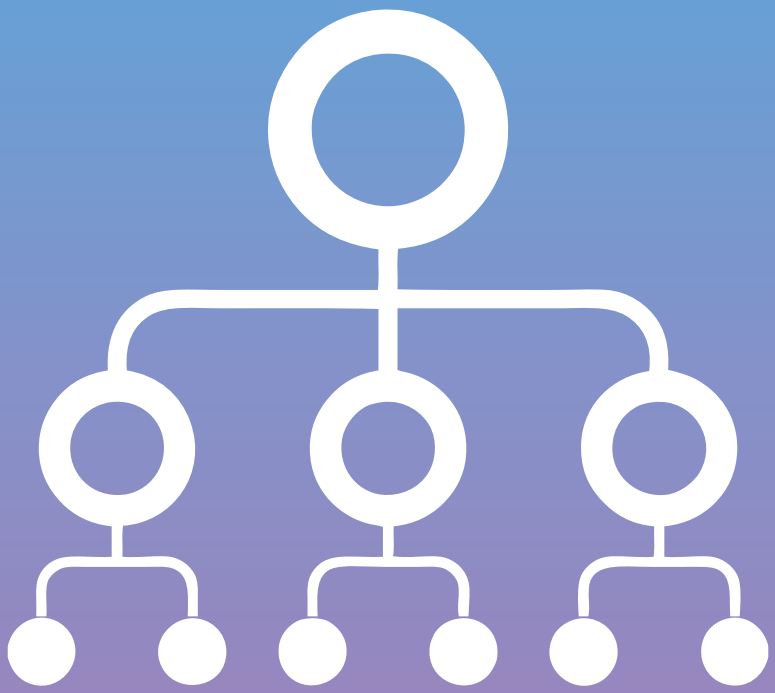
RESOURCE EFFICIENCY

SOCIAL DRIVERS

CONNECTED REALITY 2025: TRENDS AND DRIVERS

#2

Connected reality is driven by five central technological trends, which are colliding with five social developments at an unprecedented speed. People know about these trends, and are already discussing them. However, the ideal breeding ground for sudden and unexpected breakthroughs is the intensive interaction taking place between technological levels of maturity and social drivers. In the following chapter, we discuss the ten trends in detail, and highlight five innovation environments that are giving rise to the networked world of tomorrow.



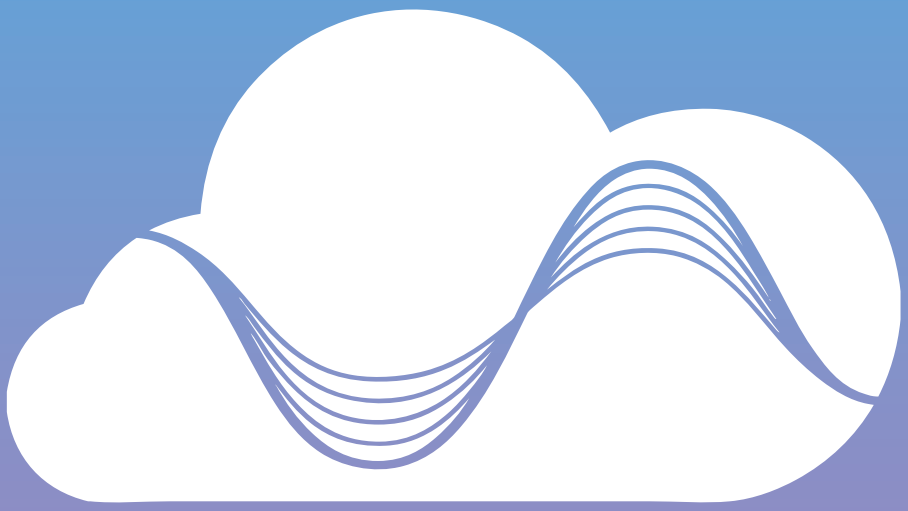
2.1 TECHNOLOGICAL TRENDS INTERNET OF THINGS

In the beginning, there was the computer. First one, then two, then three – the US Arpanet was born. That was in 1969. And the Arpanet begat the Internet, a worldwide network of hundreds of millions of computers, which did more to change our daily lives and working practices, trade and business than anything that had gone before.

After computers, it is now things that are gradually becoming networked – not only cash registers and manufacturing machinery, which have long been connected to the Net, but also everyday objects such as heating systems, household appliances, cars, traffic lights, and even flower-beds; they will soon be sending and receiving wireless data. This vision was first described in 1991 by Mark Weiser, and, eight years later, Kevin Ashton came up with the expression 'Internet of Things'. As spectacular as the idea sounded in the late 90s, it was still far from reality. At that time, sensors, RFID tags and efficient embedded processors were too expensive and required too much electricity. Wireless data transmission was only just beginning.

It is different today: the mobile Internet is omnipresent, and various transmission processes, such as Bluetooth, Zigbee and T-Wave, can now cover the last few metres between network and thing. Depending on capacity, the requisite sensor chips cost between 50 cents and a few dollars – even the price of Bluetooth chips has fallen to a dollar since 2000. Meanwhile, it has even become possible to house slimmed-down web servers on such chips, the electricity consumption of which has fallen considerably. As a result, toasters and washing machines, factories and underground carriages can now act as web servers. All with their own website and their own web addresses. Thanks to the new Internet Protocol version 6 (IPv6), in future, there will be enough IP-addresses to allow every blade of grass on Earth to be a part of the Internet. By way of comparison, whereas IPv4 offered barely 4.3 billion addresses, IPv6 offers 340 sextillion.

Whilst the network provider Cisco estimates that by 2020 some 37 billion devices will be part of the Internet of Things, IDC market researchers reckon it will be 212 billion – with a concomitant market value of 8.9 billion dollars. It is already becoming clear that communication between machines is altering how data is transmitted: in 2012 inter-machine communication was responsible for 20 per cent of all data transmitted on the Net, excluding videos.



UBIQUITOUS INTELLIGENCE

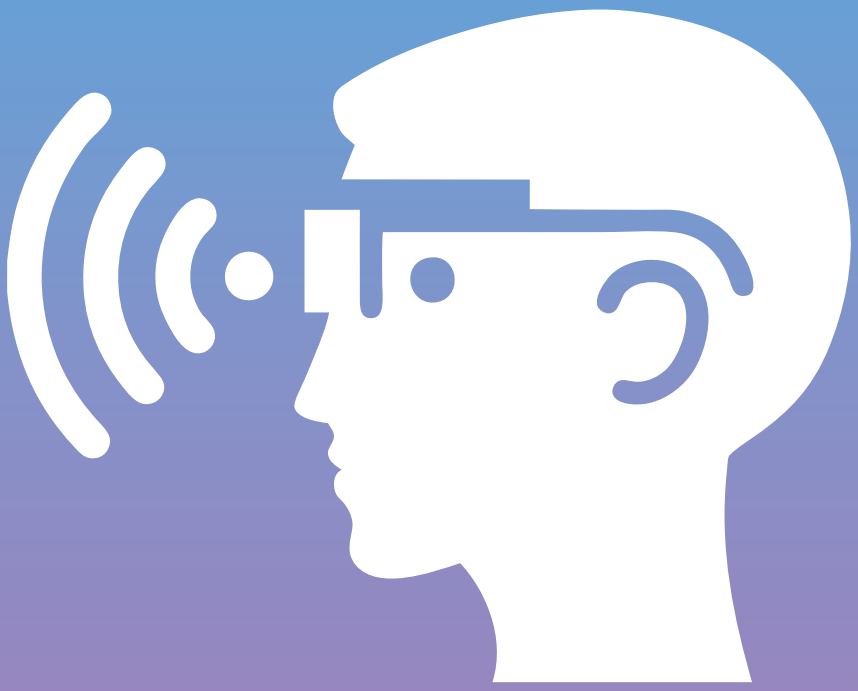
Hardware is nothing without software. Yet, our view that a computer performs tasks using locally installed programs is now long outdated. In the past few years, computing power has migrated to the Cloud: into whole swarms of computers, which, together, process enormous quantities of data at breathtaking speed. Following on from distributed computing – examples include IBM's 'Computing on Demand' and projects such as SETI@home around the turn of the century – cloud computing has become big business. The big IT giants, such as Amazon, offer cloud computing as a service, or, as Apple does with Siri, utilise the Cloud for their voice processing before pushing the results onto the end devices. So behind every smartphone, there is now a virtual super computer.

Parallel to this increase in computing power in the Cloud, algorithms have also made enormous progress. It's Big Data. Today, data relating to transactions, measurements and pictures are scanned for patterns that even the best computers of the 90s would have given up on. This means that researchers can analyse protein networks, businesses consumer behaviour, and security firms photos taken by public security cameras.

Their success is due to new efficient algorithms, for example from the field of computer-assisted learning. The Californian start-up Kaggle is driving developments with Big Data competitions that bring research and crowdsourcing together. Even the military are grabbing a piece of the action: Israel has a world-leading Big Data scene.

On the other hand, 'brain computing' is an attempt to develop algorithms based on the brain, which may be slower but is a high-ranking parallel biological computer. Research projects, such as the European Human Brain Project, the Blue Brain Project from IBM and ETH Lausanne, as well as the US BRAIN Initiative, are trying to make a decisive contribution towards achieving the age-old dream of Artificial Intelligence.

Consequently, cloud computing and Big Data are linked to a network intelligence that will soon be replayed over the Internet of Things into our environment – and will be omnipresent, ubiquitous and available.



NEW INTERFACES

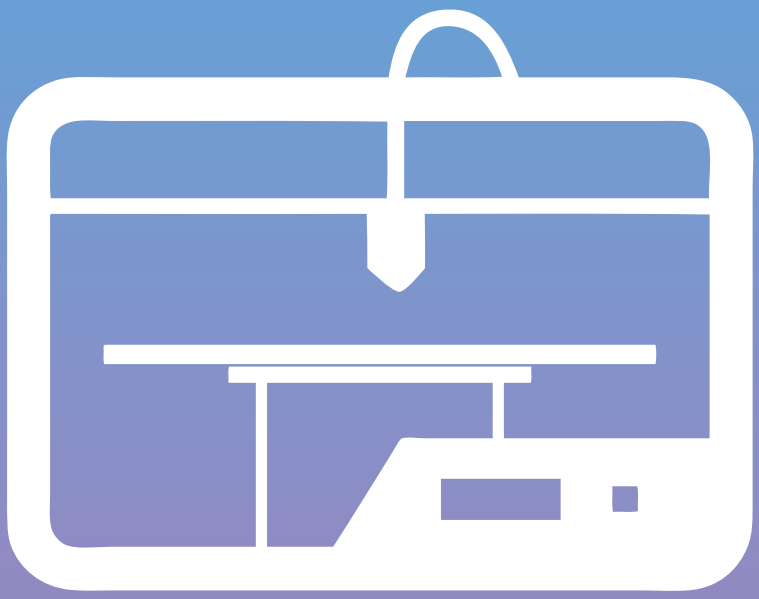
When the legendary Apple Macintosh celebrated its 20th birthday in 2004, it had long been obvious to experts that its ground-breaking user interface of desktop screen, mouse and keyboard had no future. Too faffy, not intuitive enough, was the judgement of interface designers. And, in particular, not suitable for mobile data use. But, this time, the masses didn't have to wait long for the breakthrough: at the end of 2006, Nintendo brought gesture control to the mainstream with its Wii games console; a few months, later Apple unveiled the ultimate touch screen for its iPhone, which, along with its apps, made PCs look like the black-and-white television sets of the early fifties.

But that is by no means everything that is to come. The 'Internet of Everything', with its ubiquitous intelligence, is difficult to fit into a smartphone display. Even more intuitive and, at the same time, more comprehensive access is desired – and already foreseeable. Voice-activated interfaces, such as Apple's Siri, developed during a research project for the US Research Agency DARPA, have made the old idea of talking to a computer system an everyday possibility.

Google now combines them with a goggle-type display, which – on a spoken command – can even take pictures: in 2013 "OK glass, take a picture" went down in history as one of the catch-phrases of the year.

Goggles such as Google Glass, Meta Glass and Vuzix Smart Glass M100 are the first devices to prepare the mass market for extended-reality interfaces. Heads no longer have to turn and face the screen of a mobile end device in order to obtain information; the information now reaches the eyes of users as a discreet layer of information embedded in their field of vision.

And that's not all: small wearable computer units, carried in a jacket pocket or even woven into the jacket itself, obtain context information from the Net to connect with the Internet of Things on the nearest street corner. A new reality is coming into being, in which cyberspace and surroundings are connected. And, via the network of interfaces that they are wearing, users themselves become a permanent part of the Net.



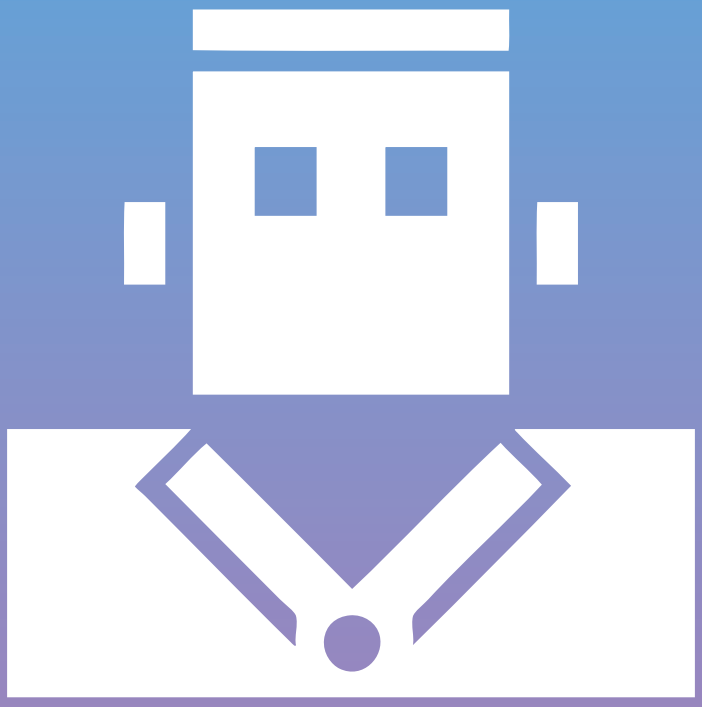
DIGITAL PRODUCTION

The Internet and freely available software have democratised information technology. Moreover, the production of bits is sexy. A whole generation is fascinated by apps, web applications and digital content, and it dreams of following in the footsteps of Steve Jobs, Sergey Brin and Larry Page, Mark Zuckerberg and other entrepreneurs of the Internet Age. In contrast, since the 90s, the traditional production of things has been seen as stemming from yesteryear. Yet, nothing could be further from the truth. It has long been obvious that 'bits and atoms' are not objects. What began with computer-controlled machines has now become digital production: additive manufacturing turns data sets into new products, and information chains optimise the interplay of manufacturing plant and intelligent machinery.

The idea that bits could give rise to atoms began in the 80s as rapid prototyping. Instead of producing expensive prototypes with traditional tools, they were built up in layers from plastic or metal powder in a new type of machine using a data model. The result is what, today, is causing a storm under the name of 3D-printing. The fact that nerds and DIY enthusiasts were also interested was originally thought ridiculous.

The first consumer devices, such as Makerbot Industries' Replicator, and 3D-printing service providers, such as Shapeways, make traditional industry sit up and take notice. The USA is already putting 60 million dollars into a programme to promote additive manufacturing technologies, and they are even worth 50 million dollars to China, the land that has, up to now, been globalisation's workbench.

Even in traditional industries, there is a move towards digitalisation. The financial crisis has also toppled the idea that mature economies can rely on their service sectors alone. In order to keep ahead of the competition in Asia, manufacturing processes must use sensors, networked machines and new control algorithms to become 'smart factories'. Products become 'cyberphysical systems', which communicate with assembly lines and surroundings and, thus, make it possible to record their life cycle. With 'Industrie 4.0' (Germany) or the 'Industrial Internet' (USA), industrial value-creation has the opportunity to make a huge leap forward: GE and the World Bank are forecasting a growth potential by 2030 of 6.1 billion dollars for global GDP – a growth of just under nine per cent.



AUTONOMOUS SYSTEMS

One of the great new inventions of the 20th century was the robot: an artificial worker who never gets tired, never complains and can do jobs that people cannot do or can only do with difficulty. In fact, people initially feared that this artificial worker would make humans superfluous. Yet, that didn't stop them. Today, manufacturing robots are omnipresent – but even they are only one step along the path to autonomous systems on which business, society and not least the military are becoming ever more reliant.

The early manufacturing robots on the conveyor belts of the 70s pale into insignificance when compared with those of today, which already have incredible contextual knowledge and the ability to make decisions. This is all made possible thanks to progress in sensors, motoricity, computer-assisted learning and knowledge representation. Lawnmowers and vacuum cleaners are only the simplest examples of robots. Freight robots, such as those developed by Boston Dynamics for the US armed forces, carry several hundredweight of equipment safely over the most impassable terrain. A new generation of industrial robots no longer operates in restricted areas, which were needed to prevent injury to human beings. Tactile sensors enable them to 'feel' non-living and living obstacles and to stop moving for a moment. Robots learn alongside their human counterparts, and are becoming more and more like colleagues. In view of demographic change and the concomitant ageing population, forecasts predict a huge market for care robots. Starting in Japan, which was drawing up a roadmap for this type of robot as early as the 1980s, the first models are already in use in retirement homes and hospitals.

There, they carry patients who would be too heavy for staff, or even assume the role of a nimble-fingered surgeon. The DARPA Grand Challenge has, once again, provided a huge impetus for the development of autonomous vehicles, and the Google Car Project could one day revolutionise private cars.

However, not all autonomous systems use hardware. The Net is overrun with software agents as pure data sets. There, they are already taking over customer services (as voice-activated interfaces) or placing orders to buy and sell as part of electronic trading systems. Combined with Big Data and the Cloud, they can utilise data sets that are too large for any human to comprehend and can use algorithms to make decisions at a rate far beyond the ability of any human.

CULTURE OF INNOVATION // SHARECONOMY/SHARERS

With digital natives, a new generation of consumers has grown up that increasingly follows the maxim using instead of owning. Whether it's cars, accommodation or tools, sharers exchange them on networked platforms. It's never been so easy to research possibilities in seconds. Sharers often both offer and want things, thereby promoting innovation. Those who react to requirements can quickly expand their business, as shown by the example of Airbnb.com, the website that allows users to book private accommodation in 192 countries.

2.2 SOCIAL DRIVERS DIGITAL LIFESTYLE

A lot has happened since Tim Berners-Lee invented the World Wide Web in 1989. If the computer was then a not particularly exciting tool for office and research work, today, as a smartphone, it is both a status symbol and an interface for accessing the mobile network. It links people with a permanent data stream. In the evening, the light from their display screens is reflected on people's faces as they exchange news or gossip, check out the latest hit on SoundCloud or look for a video that simply must be shared with friends. This digital lifestyle has already turned whole industries upside down, above all the music and media sector, which has been forced to depart from its old business models.

Tourism and transport are also facing an increasingly steep uphill battle because the digital lifestyle is widening out to encompass the sharing economy. Who books a hotel room these days when it's cheaper to spend the night in a swanky New York apartment advertised on a sharing platform? Who needs a taxi or a hire car if car-sharing services such as Autonetzer and websites such as Uber.com get you where you want to go for less? And remember, in principle, anything that can be bought or sold over the Internet can also easily be found using a suitable app, which may even build a community of like-minded people around the sharing service. However, the digital lifestyle is no longer limited to relationships and services. In the quantified-self movement, it applies to the body. With apps and wearable sensors, users carefully measure their own health and sensitivity. Providers of health services and insurers are extremely interested in this information. Those who voluntarily provide figures for their blood pressure and fitness levels may soon benefit from lower tariffs and insurance premiums. Health economists expect that, in the next few years, medical care will be provided not by GPs but by smartphones, leading to a huge drop in administrative expenses.

In contrast, users have not yet fully accepted the idea of the smart home. Intelligent electricity meters and networked household appliances reduce energy consumption and increase the level of comfort within a person's own four walls. Although there are still gaps in demand, in general, the market has really taken off. A multitude of apps and devices to control the smart home are already on the market. And the major utility companies and Internet providers are already champing at the bit, impatient to promote the market. The takeover of the thermostat manufacturer Nest by the Internet giant Google is a clear indication of this trend.

CULTURE OF INNOVATION // HACKERS AND MAKERS

It's been a long time since the DIY ethos was to the domain of nerds and amateur craftsmen. The Maker Movement also includes designers, IT experts, electricians and architects. As well as distributing software on platforms such as Github and Sourceforge, they also offer designs for objects and devices on Thingiverse and Fabster. The principle of open innovation applies. DIYers put their ‚manufactured items' under open licence, which allows rapid adaptation and is, therefore, followed by further innovations. Each type of big business is looked at critically by its customers.

THE NEW SPIRIT OF AUTARCHY

The thought of being independent of the daily constraints of society at large is as old as industrialisation itself. Henry David Thoreau popularised it in his biography, Walden, back in the middle of the 19th century. One hundred years later, it was the conflict with the post-war consumer society that encouraged a new independent spirit, which extended beyond the realm of traditional DIY. It was expressed in alternative cultures, in particular the hippy and, later, the punk movements. In the 80s, it got a foothold in software development; the idea of freely accessible and usable computer programs gave rise to the open-source software movement. Today, a considerable proportion of the digital world is based on its products; hundreds of millions of people use one of the variants of the GNU/Linux operating system, Apache servers, Firefox browsers, WordPress blogs and Wikipedia.

Meanwhile, machinery is also entering the fray as open hardware. Initial designs, such as DIY 3D printers, which have their origins in the RepRap project, and the Arduino Controller, are about to enter the mainstream. A number of other concepts, such as the DIY phone, are also being developed. The common idea of their creators is empowerment, which doesn't mean autarchy in the sense of a drop-out culture, but rather making deciding independently which technologies to use – without any of the often all-too-familiar restrictions that characterise large companies' high-tech products. It may even make good business sense, but this is not so much a traditional producer–consumer relationship as a business economic system in which the boundaries between producers and consumers become blurred and operators become 'prosumers'.

The new spirit of autarchy also creates its own digital currencies for use in these economic systems. If they want, the new prosumers can pay in Bitcoins, OpenCoins or other virtual currencies. These new forms of payment are also a reaction to the recent financial crisis, which has eroded trust in the banking system. Instead of being held in reserves by a virtual central bank, the new digital money is created using cryptographic algorithms.

The urge to take things into one's own hands is certainly more pronounced in the world of IT and machinery, but is by no means limited to it. In the urban-gardening movement, it has given rise to the collective production of plant foods; unproductive urban spaces are occupied, and inner-city sites are transformed. In the energy sector, the spirit of autarchy got its foot in the door long before the transition to renewable energy. Municipal windfarms and lucrative feed-in subsidies for solar panels on private houses have made a considerable contribution to the rapid rise in renewables in Germany during the past 15 years – a development that has also been noticed in the USA and elsewhere, and is becoming more widespread there too.

CULTURE OF INNOVATION // CULTURE OF INNOVATION IN CALIFORNIA

One of the major innovations of the last few decades has been the culture of innovation in Silicon Valley. The proximity of universities, venture capital and urban life offers the ideal breeding ground for new ideas, not all of which will succeed. This risk-taking culture cannot be transplanted just anywhere top-down: it grows from the bottom-up, if the mixture is right. Since then, it has also succeeded in such varied places as Berlin, which experts see as the next start-up-centre in Europe, and Nairobi, where an innovatory scene has grown up around the iHub and from where it is radiating out across the whole of Africa.

REAL-TIME ECONOMY

In global competition, there are two things you cannot afford: long delivery times and high stock levels. The former drives customers to competitors, the latter costs money.

Starting in Japan, lean production became established in the 70s as a solution to this apparent contradiction. But even that isn't the last word, because today's customers are used to the Net and have forgotten how to wait – and they also want products that are even more customised. What should you do then if, in an extreme case, you only receive one order for a special product? The real-time economy now combines lean production, networked logistics and mass customisation to offer an unprecedented level of flexibility and instantaneous range of goods.

Amazon is leading the way in the retail sector. Thanks to clever warehousing technology and inventory management techniques that comply with all the rules of Big Data, overnight delivery is now standard, and same-day delivery is on its way. That drives the competition. eBay already has 90-minute delivery times in its sights for several large cities; however, it is not relying on its own infrastructure to achieve this, but rather on the software of the British company Shutl, which makes use of local courier services.

At the same time, the real-time economy offers the opportunity to give manufacturers feedback as and when customers use their products. If the goal is simply the transaction itself, plus traditional after-sales support, if required, this simply doesn't happen. Instead, manufacturers are increasingly turning into providers of services, helping customers to fulfil their requirements. For example, fitness apps and sensors based on the ideas of the quantified-self philosophy will only be successful in a highly competitive and dynamic market if they provide more than just measurements. Manufacturers must hold their customers' hands, so to speak, and make it easy for them to interpret the data – showing them how to improve their health or watch their purse-strings. The US motor-insurance company Allstate Insurance is already doing just that. It offers to monitor customers' driving habits. It attracts customers with the promise: Safe drivers save more with Drivewise. This is how the new real-time economy is redefining customer relations.

CULTURE OF INNOVATION // CRITICAL CONSUMERS

Useful, cool and advantageous is no longer enough: consumers are taking a greater interest than ever in factory conditions, the consumption of resources and the environmental sustainability of products. ‚Markets are conversations', said the Cluetrain Manifesto of 1999. What still sounded like a bold thesis then, is, today, becoming reality, with critical consumers using the Net to exchange views on the advantages and disadvantages of products in next to no time. The innovation that they generate in this way extends far beyond technical novelty. It affects corporate culture and the way companies communicate. They can no longer rely on selling their products in a marketplace where you can't hear yourself speak – the market of today demands transparency.

RESOURCE EFFICIENCY

When the US astronaut Harrison Schmitt photographed the Earth on 7 December 1972 from Apollo 17, he could not have known that his picture would have a political impact. The 'blue marble' came to symbolise the burgeoning environmental movement for the spaceship named Earth, which flies through space with limited resources. The oil crises of the 70s and the growing certainty about climate change finally put resource efficiency on the agenda. And not only in the case of fossil fuels: in autumn 2010, China's temporary ban on the export of rare earth metals – which are used in displays and permanent magnets in wind turbines – made it crystal clear that computer technology and renewable energies have a raw-material problem.

Digitalisation has the potential to dematerialise numerous processes and, thus, reduce greenhouse-gas emissions and save on raw materials. E-mail is used instead of snail-mail. Instead of jetting around the world to meetings, participants use videoconferencing without leaving their offices. By using its own videoconferencing system, Cisco has already reduced CO_2 emissions from internal business flights by 45 per cent, and more and more international companies are following its example.

Industrial production is slowly but steadily reducing its ecological footprint. The car industry is one example. Between 2010 and 2012, Volkswagen reduced the average amount of energy it used for manufacturing cars by 14 per cent and the concomitant amount of water used by ten per cent. Yet, it is not only industry that is improving the resource efficiency of its processes; agriculture is also turning to 'precision farming'. Satellite pictures and sensors provide valuable data for optimising the use of irrigation and fertilizers. This helps to prevent wasting water and applying too much fertilizer. However, the speed at which digitalisation increases resource efficiency also depends on the lifecycles of products. The shorter they are, the sooner they eat up gains in efficiency, since too many new products are coming onto the market too swiftly. The effect of the reduction in the size of the ecological footprints of individual products is cancelled out by the growing ecological footprint of total production.

To what extent digital networking can contribute to the development of sustainable consumption and lifestyles is currently the subject of intensive discussion. If, instead of a one-size-fits-all use-by date on packaging, integrated sensors were to ascertain the actual condition of food, it would be an important stage in the fight against food waste in industrialised counties. Another approach could be the intelligent networking of transport companies to optimise individual travel, making it more environmentally friendly at the same time.

CULTURE OF INNOVATION // TRADITIONAL ENGINEERING CULTURE

The reputation of traditional engineers isn't very flattering. They are seen as too circumspect and risk-averse. That is simply not fair. Whether wind turbines, telematics systems, microprocessors or household devices, numerous innovations that alter our daily lives come out of the engineering laboratories of industry and research year after year. Calmly, expertly and resolutely, traditional engineering culture is working on the future. Unlike makers and founders it continues to rely on patents to protect its innovations, yet even it has accepted open innovation.

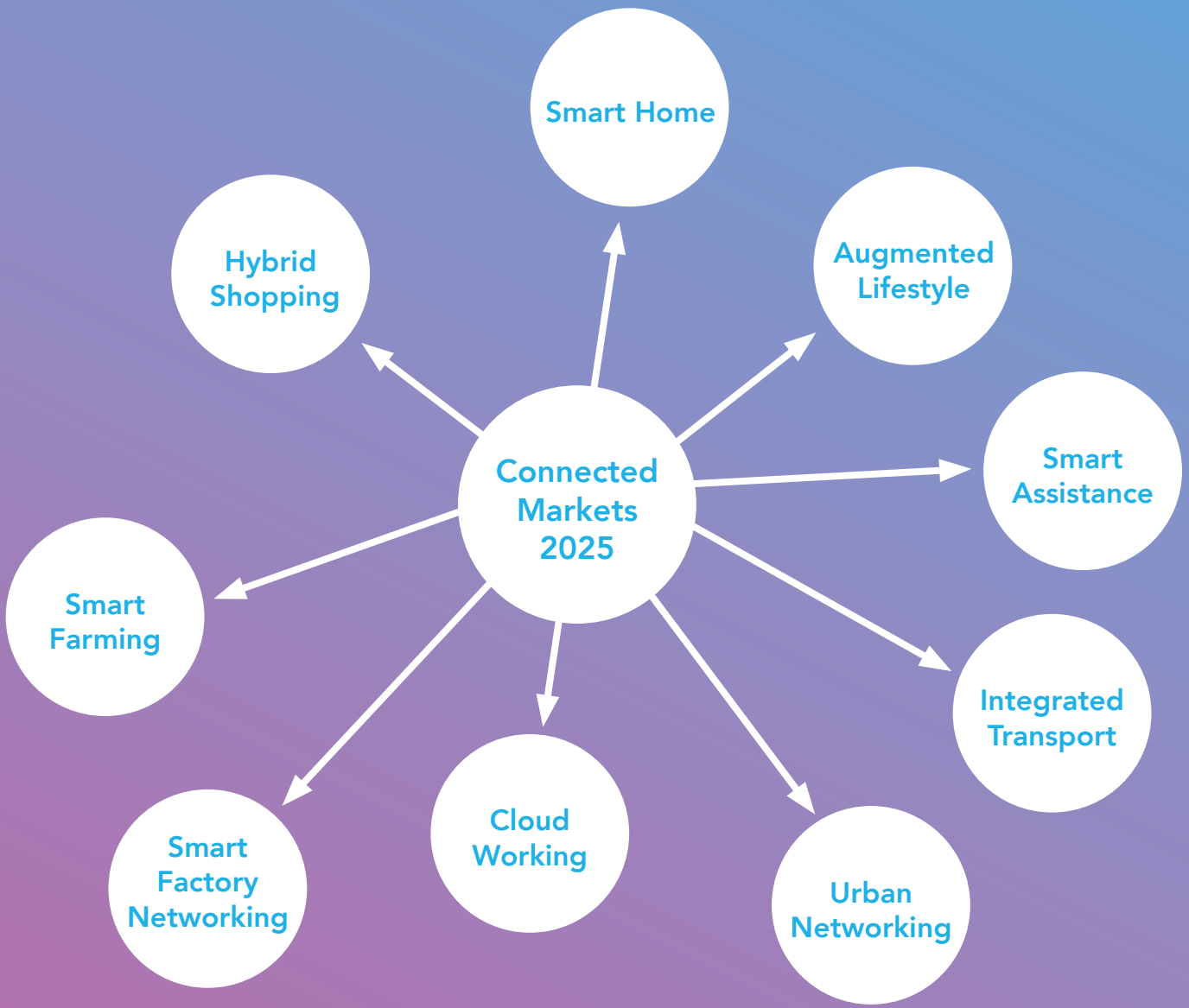
SECURITY

There are few historical events that remain in the minds of every person who lived through them. September 11, 2001, was one such an event, though. The attacks on the World Trade Center in New York radically altered the way we thought about security in the new millennium. The security industry helped to turn the subsequent 'war on terror' into a boom: the scale of the monitoring of communications and also of public spaces is unprecedented. The West is using Big Data, face-recognition and semantic analysis in an attempt to understand the level of the threat from outside. Authoritarian regimes, such as China and Iran, are also using these methods to ascertain the internal threat to their powerbases.

As states employ increasingly high-tech methods against their perceived enemies, they are actually creating a paradox: the use of ever more elaborate IT systems increases the scope for cyberattacks by criminals or secret services. The same applies to infrastructure and companies; in order to become more efficient and faster, they must increase the level of networking – in doing so, though, they provide the first lines of attack, which previously did not exist. The Stuxnet worm, which made headlines in 2010, was designed for equipment that was physically separated from the network. However, on the 'Industrial Internet', every conveyor belt and every water pump is online. The search engine Shodan is already helping to find devices of all kinds that are hidden from one another but which can be accessed via an Internet connection.

The need for security and the feeling of being under threat are increasing in society at large too. Parents use tracking systems to ensure that their little ones really are in the playground. Monitoring systems reassure the elderly that, if they have a heart attack, the emergency doctor will automatically be notified. Networked cars prevent drivers whose attention is diverted from making mistakes, thereby preventing accidents. And it is, again, true that the more the use of networking increases, the greater the danger of misuse whenever data are manipulated. If it doesn't happen, new security systems will be needed.

As part of ongoing feedback processes, growing levels of technicalisation conjure up fears that were once vividly depicted in many science-fiction novels: life in a Big Brother state, the powerlessness of man against the machine. Technology threatens to become independent because, on the one hand, it provides security, but, at the same time, it generates new feelings of uncertainty. Keeping these contradictions in check is one of the major challenges facing the hyperlinked world of tomorrow.


Smart Home
Hybrid Shopping
Augmented Lifestyle
Connected Markets 2025
Smart Assistance
Smart Farming
Integrated Transport
Smart Factory Networking
Cloud Working
Urban Networking

CONNECTED MARKETS 2025: SIGNALS

#3

The impact of technical and social innovation drivers on connected reality can already be seen today. Data services are entering spheres that, up to now, have not been (or have hardly been) touched by digitalisation – particularly in the areas of the *smart home*, *smart assistance*, *urban networking* and *smart farming*. Data services also combine online and offline worlds to provide new experiences such as *hybrid shopping* and *cloud working*. They also make greater use of existing information technology as part of an *augmented lifestyle*, *integrated transport* or within the *smart factory*. These process are demonstrated by various trends in the nine application fields, as shown by the Reality Check.

Tesco – Online pickup at local retailer // **images:** www.tescoplc.com

HYBRID SHOPPING

Ever since e-commerce took over our daily lives in the 90s, people have been seeing the writing on the wall for the traditional retailer. Wrong! Online and offline shopping are increasingly blending into a seamless experience, because data-supported networked processes are standard in both worlds. In this way, the retailer becomes the delivery point, where not even a credit card is needed any longer.

CASE 1

Tesco – Online pickup at local retailer

Consumers 2.0 have not made themselves popular with retailers. They go to shops for advice but then buy things more cheaply online. However, there has been a reverse in this trend in British retailing thanks to 'RoBo' – Research online, Buy offline. Customers search for vegetables, milk, meat or ready meals on the website of the Tesco chain of supermarkets – keeping a careful lookout for special offers, and then send their orders to the company, telling it what time they will call at their nearest branch. They collect their basket of purchases on their way back from work during the designated 'collection slot'. No crowds round the shelves, no queues at the checkout in rush hour. Tesco is already offering this service in 200 branches, thereby making money locally by fulfilling customers' requirements for information, bargains and convenience.

CASE 2

Paypal Beacon – An easy way to pay

Whilst retailers are going in for online shopping, traditional online service providers are discovering the world of real shops. The PayPal payment system has done some point-of-sale analysis and developed a system to make paying at a checkout even more efficient. Cashless payments may be convenient, but using PINs or signing slips of paper holds things up. The solution is PayPal Beacon, a small pay point, which uses a USB-interface to link into the retailer's bookkeeping system and carries out the transaction using Bluetooth Low Energy and its associated app on the customer's smartphone. The chief attraction is that the customer doesn't have to open the app: when the customer enters the shop, it connects to the Beacon and gives off a sound signal or a vibration. The rest works exactly the same as when buying online using PayPal. With 230 million users in 92 countries, this payment service is likely to be introduced in major cities.

Drivers: New Interfaces, Real-Time Economy

Drivers: Internet of Things, Digital Lifestyle, Security

Fitbit Flex™ – The motivation coach on the handlebars // **image:** www.fitbit.com

AUGMENTED LIFESTYLE

The mobile Internet on the smartphone has taken over our daily lives, yet new types of device are now spinning a digital cocoon around the user. They broaden the digital lifestyle using apps, monitor health, and open up completely new ways of interacting with online content. The universal interface with the cyborg factor is fast approaching.

CASE 1

Fitbit Flex™ – The motivation coach on your handlebars

Health and fitness are in, but people are inclined to tell themselves fibs when assessing their own physical condition. However the data wrist band Fitbit Flex always tells the truth. It counts the steps that the wearer takes in a day and, using a body profile, calculates the number of calories burned. The gadget also records how many minutes the wearer has moved during the day, phases of sleep and the short periods of wakefulness during the night. All the information is later transferred onto a computer, which enables the 'quantified self' to visualise how near it really is to the wearer's personal fitness goals. The Fitbit itself also provides feedback: a row of LEDs indicates whether the user has been sufficiently active during the day or has been taking things too easy.

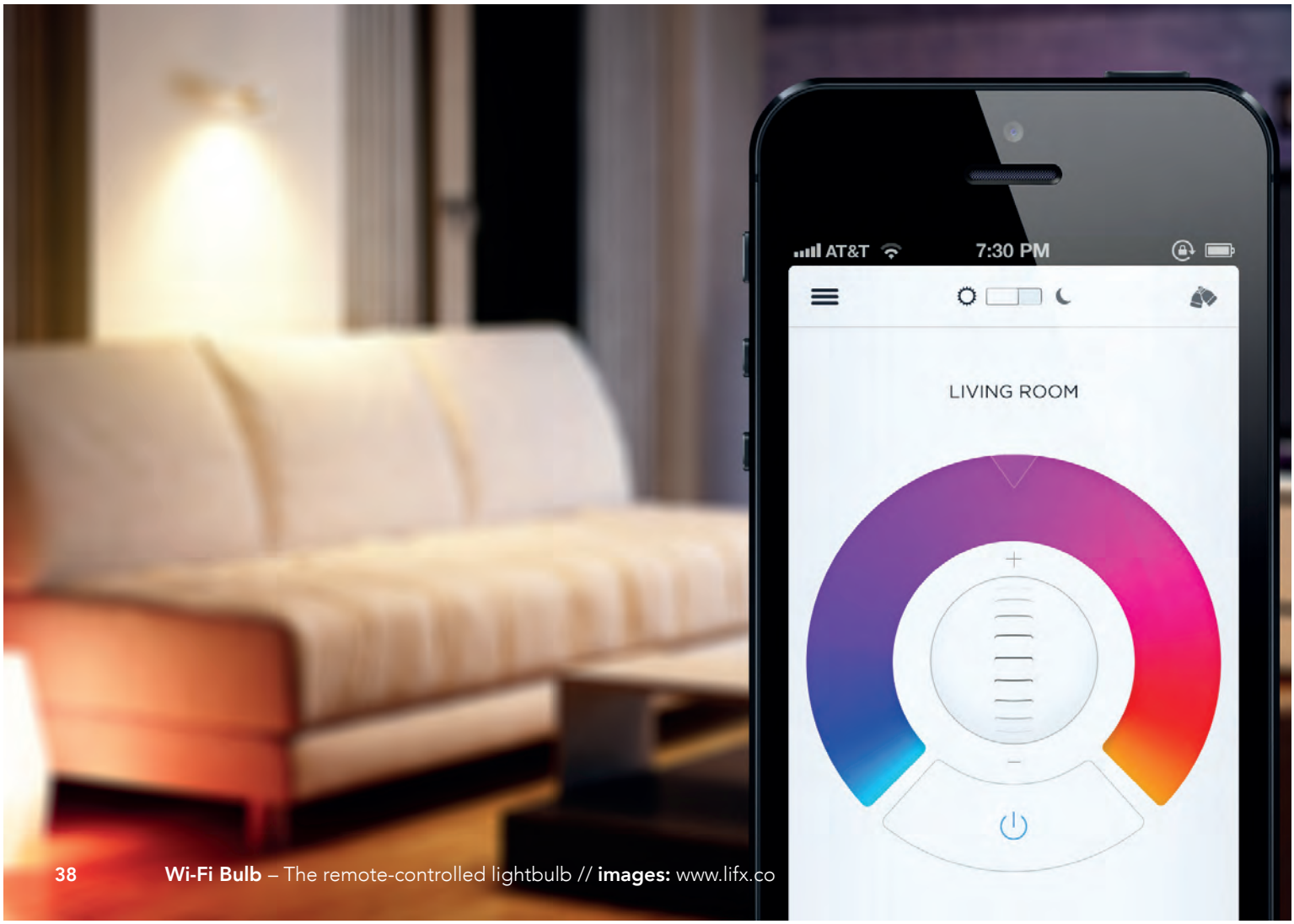
CASE 2

Meta Glass – More than just 'goggles'

Not since the iPhone has a device created such a storm as Google Glass. The company's goggles are just a taste of things to come. With news blended into the field of vision and voice-controlled photography, they have only just cracked the potential for this new type of device. By contrast, the start-up Meta is about to redefine how we view our daily lives. Its goggles, modestly named Meta Glass 0.1, will make it possible for end users to experience augmented reality. Gesture recognition enables them to work on objects hovering in space with their own hands. In this way, reality and virtual reality blend into a seamless sensory experience. Technology aficionados are ecstatic. Meta obtained twice as much start-up capital from crowdfunding on Kickstarter than it expected. The first samples will be supplied to the Crowd in November. If the start-up carries on at this rate, Meta Glass 1.0 will cause even more excitement.

Drivers: New Interfaces, Digital Lifestyle, Security

Drivers: New Interfaces, Digital Lifestyle



Wi-Fi Bulb – The remote-controlled lightbulb // **images:** www.lifx.co

SMART HOME

Up to now, it has been impossible to sell the idea of the fully networked home. The vision of manufacturers for the communicating refrigerator propagated at the end the 90s has not yet reached the mass market owing to a lack of interfaces and standards. Since then, mobile Internet and digital entertainment, as well as rising energy prices, have all made the idea attractive, and thanks to control apps and omnipresent sensors it is also easy to market to consumers.

CASE 1

Nest – The intelligent thermostat

Even today, buildings still lose an enormous amount of heat, not only because many are poorly insulated but also because some people leave their heating on all the time in the winter. Thermostats with time switches were, initially, the solution to the problem. The US company Nest, which now belongs to the Google Group, is now bringing the thermostat into the Internet of Things, giving it built-in intelligence. Once installed, the device begins to determine an appropriate warm–cold cycle based on the user's manual settings. If the occupants are away, Nest ensures the temperature remains at an energy-saving level. The Nest app also enables the user to operate the intelligent thermostat remotely. A green leaf on the screen also shows whether Nest is saving more energy than the manual settings would. This helps the user to learn, too.

Drivers: Internet of Things, Digital Lifestyle, Resource Efficiency

CASE 2

Wi-Fi Bulb – The remote-controlled lightbulb

The change from traditional lightbulbs to energy-saving bulbs has ignited feelings in Europe. The intention was honourable: even if a lot of people leave their lights on, not so much electricity is wasted with energy-savings bulbs. The Australian firm LIFX, born as a result of an idea dreamt up in the pub, is now introducing this idea to the Internet of Things. A control unit is located in the bulb holder, which can be controlled using the traditional WLAN-standard 802.11 and can communicate with other bulbs using standard 802.15.4. In this way, the lighting in homes or offices can be controlled from a single location using a smartphone app. Other companies, including Philips, have developed this solution But the LIFX Bulb is the first that can communicate directly with mobile end devices.

Drivers: Internet of Things, Resource Efficiency

Zookal – Flying textbooks // **images:** www.zookal.com

SMART ASSISTANCE

Networked devices can also provide vital assistance, whether by supporting a healthier lifestyle that transcends the trendy quantified-self movement or helping in situations where it is just not possible to provide other forms of assistance. And, what is more, It is not just the older generation that will benefit.

CASE 1

HAPIfork

Who doesn't remember being told as a child not to bolt down their food? In the age of fastfood and readymeals – eaten whilst watching TV or standing in a sandwich bar during a short break from work – this advice falls on deaf ears. A Frenchman (no surprise there!) now wants to get us to take time over eating: Jacques Lepine of the US company Hapilabs has developed a fork with sensors that ensure at least ten seconds elapse between mouthfuls. If you still try to gobble down your food, the fork vibrates. The HAPIfork brings the Internet of Things to the table. An ARM microcontroller, a USB interface and a battery also make the eating implement a diagnostic tool, which collects information about eating habits. The information can be evaluated if required or also transmitted to medical equipment.

Drivers: Internet of Things, Digital Lifestyle, Ubiquitous Intelligence

CASE 2

Zookal – Flying textbooks

The general public considers drones, that is to say autonomous flying devices, to be a particularly objectionable type of new military technology. However, they can also have civilian uses as a form of transport in the logistics sector. Whilst the pizza-copter in London and the cake drones in the Chinese city of Dongguan are still just a publicity stunt, the Australian company Zookal has an intelligent application. From Sydney, their flying devices deliver textbooks to borrowers within the shortest possible time. Until now, overland deliveries have taken days. Amazon also wants to get into using drones for deliveries in 2015. That will be the beginning of Amazon's Prime Air service. The US company Matternet is going in another direction, though. It hopes small transport drones can deliver medicines to regions that are difficult to reach. A test flight has already been undertaken in Haiti.

Drivers: Internet of Things, Real-Time Economy

Double – Omnipresence for all // **images:** www.doublerobotics.com/

CLOUD WORKING

The boom in mobile working continues. By 2015, 1.3 billion people – a good 37 per cent of the global workforce – are expected to be helping to create value whilst working remotely, often in virtual teams. It is becoming more and more important for companies to select and coordinate cloud-workers carefully. At the same time, co-working spaces are increasingly extending into the Cloud.

CASE 1

Saba People Cloud – Managing talents and making them visible

Collaborative work platforms are now part of our everyday working lives. But they mean more than just working on the same documents. Projects require joint planning, exchanging experiences, developing ideas and team management. People Cloud from Saba is a system that combines such a platform with active knowledge management and social network functions. With 200, 300 or more mobile and often freelance colleagues, it is no longer possible for one person to have an overview of the whole input into the workflow. Intelligent algorithms ensure that all participants in the system, whether on an island, in a city or in a hotel, receive updates from People Cloud tailored to their profiles. As on social networks, colleagues can comment on and like posts. The system calculates a People Quotient (pQ) for each participant, which provides a ranking according to ability, expertise and creativity.

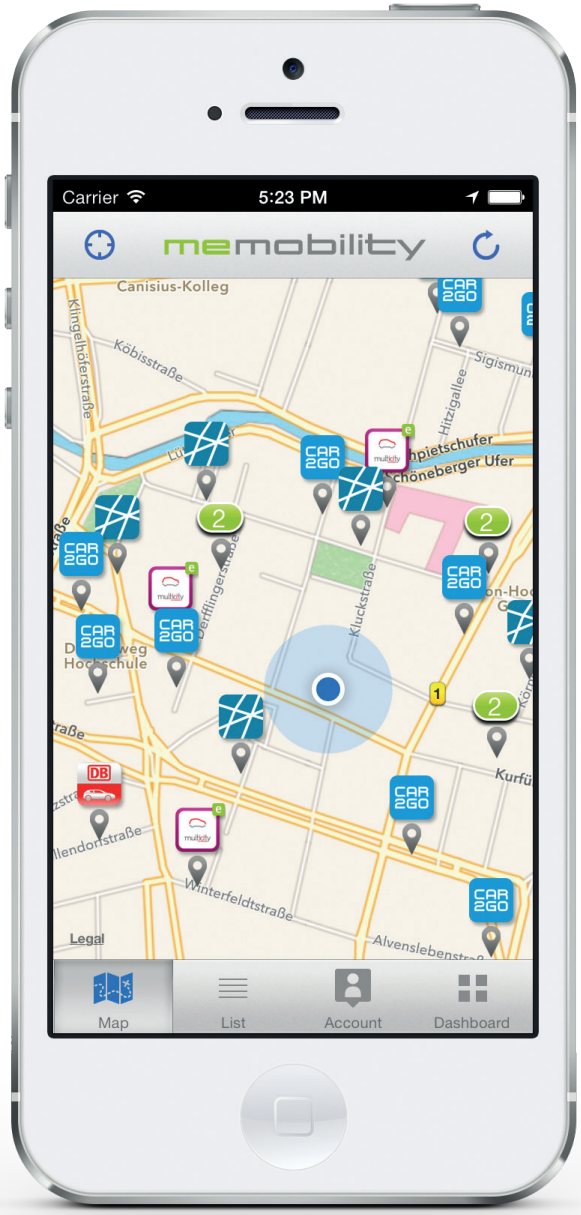
CASE 2

Double – Omnipresence for all

Videoconferencing is becoming more and more important as the size of the mobile workforce increase, but it is also a means of avoiding unnecessary journeys. Double Robotics has developed a different solution to traditional videoconferencing systems: a cross between the Segway two-wheeled personal transporter and an iPad – the 'Double'. It functions as a sort of avatar in the office. Mobile employees use an app to log into a Double at the location where face-to-face communication is required. Colleagues can then see them on the iPad screen, and they take part in the discussion via the iPad camera. As the Double can be controlled remotely, it can follow colleagues around the office, even during breaks. The device has been on the market since May 2013. The office avatar costs 2,499 US dollars, but luckily several employees can share it.

Drivers: Ubiquitous Intelligence, Security

Drivers: New Interfaces, Ubiquitous intelligence, Resource Efficiency



MeMobility – En route to a seamless transport service // **image:** www.memobility.de

INTEGRATED MOBILITY

The age of personal transport propelled by fossil fuels is coming to an end, albeit slowly, since the post-war, car-friendly town cannot be dismantled overnight. If cleverly networked, eco-friendly transport will attract more and more customers.

CASE 1

MeMobility – En route to a seamless transport service

For several years car-sharing has been growing in popularity. Your own car in the city? Stressful and expensive. But that's just the first step. Transport can be really sustainable if various different types are combined, ideally networked through the use of apps. The Berlin start-up MeMobility is providing just that. Four different people offering to share their cars are located, and the nearest car is immediately booked. MeMobility bundles data streams together for the customer in a single interface, and is an efficient intermediary between market participants and customers. Hired bicycles and local transport are also shortly to be integrated into the system. And autonomous driving systems are also planned for the long term, too. MeMobility then deals with payment for the method of transport used.

CASE 2

Transport robots Ropits (Hitachi)

They were already around in the science-fiction films of the 70s: driverless taxis that took passengers to their destination all by themselves. The Japanese electronics group Hitachi is working on making this futuristic vision pay. The prototype is called 'Ropits' (short for 'Robot for Personal Intelligent Transport System'), and is already being tested in the research town of Tsukuba. As with the autonomous vehicles being developed by Google and BMW, the Ropits is also equipped with a GPS, gyroscope, laser distance sensors and cameras, enabling the driving robot to model the surroundings live in 3D. The system operates in a similar way to city bikes: when passengers get into the vehicles, which look a bit like squashed Smart cars, they can select a 'specified arbitrary point' on the display. The Ropits then navigate their way there independently, driving around unknown obstacles.

Drivers: New Interfaces, Ubiquitous Intelligence, Digital Lifestyle, Resource Efficiency

Drivers: Ubiquitous Intelligence, Autonomous Systems, Security

Big Belly Solar – The solar-powered compacting rubbish bin // **images:** www.echelon.com // www.bigbellysolar.com

URBAN NETWORKING

It is not only by networking transport that towns can save resources, but also by networking other types of infrastructure. Sensors in towns provide the required data. Urban networking not only benefits the environment, but also improves security and the quality of life for inhabitants.

CASE 1

Echelon – Intelligent streetlighting in 500 towns

Street-lighting has been part of modern city life since the early 20th century. However, up to now, these lights weren't very sustainable. The US company Echelon, which also runs a development centre in Bielefeld, is setting about changing that. Networking street-lighting using power-supply lines by means of a power-line datalink allows municipal authorities to switch street lights on and off, or to dim them as required, either individually or in groups. It is obvious how useful this is; Oslo has reduced energy consumption for street-lighting by 62 per cent using this technology. The Echelon system is already in use in 500 towns worldwide. China wants to install half a million intelligent street lights by 2014, and expects to make an energy saving of 55 per cent.

Drivers: Internet of Things, Ubiquitous Intelligence, Resource Efficiency

CASE 2

Big Belly Solar – The solar-powered compacting rubbish bin

Councils all over the world are trying to cope with the amount of refuse. A strike by refuse-collectors in a city such a Naples can swiftly turn into a medium-size disaster. So, why not make refuse collection easier by getting rubbish bins to help out? Big Belly Solar, the US company founded in 2003, has developed solar-powered bins for collecting separate types of waste, which measure how full they are and transmit the information to control software. The improvement in efficiency is considerable, as the case of the University of Washington in Seattle shows. The old campus rubbish bins used to be emptied once or twice a day, irrespective of how full they were. Collections took up to 90 minutes. That changed considerably with the new Big Belly Solar containers, which on average only have to be emptied twice a week, taking just 30 minutes. The containers can also be used as compost bins.

Drivers: Internet of Things, Resource Efficiency

Baxter – The intelligent manufacturing robot // **images:** www.rethinkrobotics.com

SMART FACTORY

Today's manufacturing processes are already highly networked, but still require a lot of controlling. Advanced digitalisation enables them to be carried out more and more decentrally and autonomously, hence making them more efficient. This allows companies to save both time and resources.

CASE 1

Trumpf Lensline – The machine that supervises itself

An initial example of 'Industry 4.0' is LensLine, a technology developed by the mechanical engineering company Trumpf. As the lenses of industrial laser cutting machines become dirty over time, they must be repeatedly cleaned, otherwise they may be irreparably damaged. A new 'RFID lens' stores measurements taken by a camera monitoring the state of the lens onto an RFID chip. At regular intervals, the chip transmits the results to the monitoring system, which tells the operator when the lens needs to be cleaned or replaced. This can lead to a 40 per cent reduction in cleaning times, during which the machine is unproductive. DetectLine technology also monitors the condition of the jet, refocuses the laser beam if required and automatically replaces defective jets.

Drivers: Digital Production, Ubiquitous Intelligence, Real-Time Economy, Security

CASE 2

Baxter – The intelligent manufacturing robot

For decades, manufacturing robots have been the backbone of manufacturing. The start-up Rethink Robotics, founded in 2012 by the MIT expert Rodney Brooks, has brought out a model called 'Baxter' that embodies a new generation of manufacturing robots. The chief attraction is that Baxter's movements no longer have to be programmed in advance. Instead, the robot 'learns' during a training run by having its arm moved in the way it will subsequently work. As the arm is not driven direct by a motor, but is rather operated by a spring mechanism between motor and arm, Baxter can stop moving if it comes across an unexpected obstacle. With a unit price of 22,000 dollars, the mechanical factory worker is cheap compared to other manufacturing robots commonly in use.

Drivers: Digital Production, Ubiquitous Intelligence, Autonomous Systems, Security

Bitponics – The gardener in the Cloud // **image:** www.bitponics.com

SMART FARMING

Networked cows, combine harvesters equipped with GPS, 'precision farming' and computer-controlled hydroponics – yes, 'smartisation' has also reached agriculture and horticulture. Decisions that were previously left to the intuition of the experienced farmer or gardener are now increasingly underpinned by data.

CASE 1

Agrobot – The harvester with the delicate touch

When you think about harvesting machinery, you think about massive combine harvesters rolling across huge fields. The Spanish company Agrobot now also wants to use robotics to pick delicate strawberries. The SW 6010 harvester uses robot picking arms and image recognition to detect and pick ripe fruit, before immediately sorting it according to appearance. The prototype was developed in the Agresva agricultural research centre in Huelva, Spain, and was trialled in California in 2012, where 40 per cent of the American strawberry harvest is gathered. Agrobot estimates that the cost of harvesting strawberries can be halved; and for fruit grown on an industrial scale, it can even be reduced by as much as 90 per cent.

Drivers: Digital Production, Autonomous Systems, Resource Efficiency

CASE 2

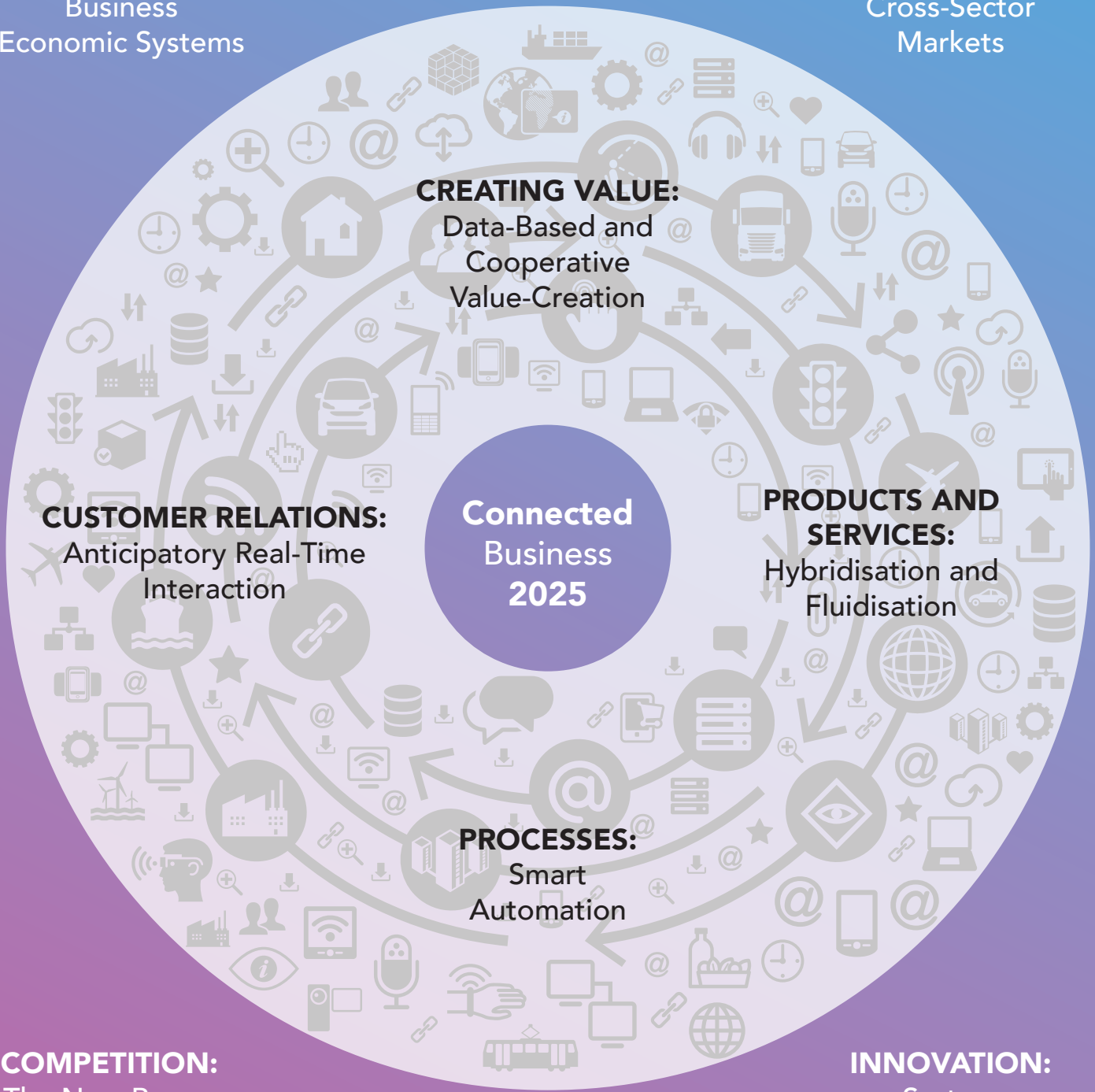
Bitponics – The gardener in the Cloud

Horticulture in cities is a growing trend. Urban gardening is already popular as a hobby and as a community activity, whilst the concept of urban farming envisages fresh food being produced in style. The US start-up Bitponics is now equipping inner-city plots with sensors that provide a continuous flow of information about the condition of plants. The information is processed by the Bitponics base station, and can then be downloaded via the network from any location. And that's not all – at the same time, the Bitponics system also acts as a social network of urban gardeners, who can use it to swap gardening chit-chat. As a result, a green-fingered neighbourhood becomes yet another online community.

Drivers: Internet of Things, Digital Lifestyle, The New Spirit of Autarchy, Resource Efficiency

OPERATORS:
Business
Economic Systems

MARKETS:
Cross-Sector
Markets



COMPETITION:
The New Power
of Integrators

INNOVATION:
System
Innovations

CONNECTED BUSINESS 2025: TRANSFORMATIONS

#4

Hyperlinking as a technological basis for connected reality is not only drastically changing our daily lives, but is also creating new parameters for economic value-creation processes. Its potential to disrupt companies, sectors of the economy and even the economy as a whole is very high. In this section, we outline briefly what 'connected businesses' of the future will look like, showing which sectors will be particularly challenged by the developments already discussed.

4.1 TRANSFORMATIONS IN THE ECONOMY

The central message of the hyperlinked economy is 'Redrawing boundaries – Accepting complexity'. Boundaries will no longer be set by technology if super-convergence causes previously separate domains to overlap. The challenge comes instead from organisational, legal and social boundaries. What does that mean then for operators, competition, markets and innovation?

Operators: Business Economic Systems

Traditional economic models assume that individual businesses are at the centre of the economic process. However, the greater the role hyperlinking of the digital and physical world plays in creating value, the less influence the individual business has. Therefore, in future, we must think more in terms of networking value-creation processes, instead, i.e. in terms of business economic systems. It will not be individual businesses that will be in competition with one another in the connected reality, rather it will be competing business economic systems. Customers will not be attracted by the technical features of a vehicle, but will look for the whole package of services that come with the vehicle, which will mainly be provided by other companies.

Competition: The New Power of Integrators

In hyperlinked markets, the balance of power is moving in the direction of integrators, a development that is well known from the Internet economy. In the economy of the connected reality, it is not size that determines competitive advantage, but the ability to link value-creation processes and operators intelligently in order to provide the customer with the highest possible added-value by offering bundles of personalised and flexible products and services. Today, it still remains unclear who these integrators will be. It seems likely that integrators in the Internet economy will expand their range of services beyond purely digital markets. Indeed, after its takeover of Nest, Google was able to move into the smart-home sector, and its research into autonomous vehicles took it into the field of networked mobility. Yet, it is also conceivable that, over the next few years, new integrators will appear on the market that will be in competition with the established players and will manage to create an attractive economic system around themselves.

Markets: Cross-Sector Markets

If the customer takes centre-stage, solution will not be confined to the traditional sector/segment boundaries. These will lose ground to converging or cross-sector markets in connected reality. The classic example is food, which already overlaps in a multitude of ways with the fields of health, medicine and cosmetics. However, it won't stop at overlapping. The fact that Nestlé, in future, will be stronger in the field of health clearly shows the extent to which markets are converging.

The new technological parameters of connected reality and the networked business models they enable will mean companies quickly reach the limits of their own sector-based understanding, which will need to be very much more open in the future. In connected reality, opportunities for growth will arise where traditional markets overlap, and will be found by integrating the expertise of different sectors to provide an all-encompassing service – such as the boundaries between media, lifestyle and trade, for example, or transport, energy and financial services

Innovation: System Innovation

As connected reality gathers pace, it will no longer be enough simply to improve products to generate business opportunities. New business contexts arise through system innovations, by attempts to create completely new solutions for social requirements based on hyperlinking.

Rather than new cars that merely provide improved comfort and efficiency compared with today's models, we're talking about networked transport services. Instead of a new heating system, better designed and with faster heat radiation, customers will go for a networked home power plant as part of a virtual electricity-generating structure. In place of delivering parcels within a town using an ever-growing fleet of lorries, taxis integrated into an intelligent distribution system will be used to 'go the extra mile'. But system innovations cannot be developed and marketed by individual operators. They require cooperation, alliances of developers and a mindset that ranks value-creation higher than technological innovation for its own sake.

4.2 TRANSFORMATIONS IN BUSINESS

Transforming the new economic parameters of connected reality will inevitably lead businesses to change direction. From today's perspective, four areas will be ripe for transformation in the next few years: the establishment of data-based and cooperative value-creation, a radical change in customer relations to anticipatory real-time interaction, the hybridisation and fluidisation of products and services, and the transformation of manufacturing and business processes through a new wave of smart automation.

Creating Value: Data-Based and Cooperative Value-Creation

Data are the global economic currency in connected reality. Obtaining and analysing high-quality external and internal data, drawing the right conclusions and transforming these discoveries into real-time value-creation processes are core skills in all sectors of the economy. This applies just as much to a global company as to a medium-sized mechanical engineering firm or a small workshop. At the same time, they must all develop the ability to cooperate with other companies within a business economic system. That inevitably means that businesses must be more open. Cooperative value-creation requires a fresh attitude, generally accepted rules and quality standards, and intelligent platforms for integrating processes.

Customer Relations: Anticipatory Real-Time interaction

Attempts to develop Big Data analytics and ubiquitous intelligence at the customer interface have one basic aim: to forecast the condition of machines and the behaviour of people in order to resolve problems or satisfy requirements before the problems actually arise or the requirements are explicitly expressed. There are distinct economic advantages for the manufacturer of a machine in being able to forecast the risk of breakdowns. By sending out technicians promptly, he can prevent a plant grinding to a halt. This, in turn, means fewer losses to the customer. However, this only works if manufacturer and customer are in contact with each other at all times and are able to exchange information in real time. Such arrangements are also entering the B2C arena. In future, mail-order companies will send out products 'in anticipation', i.e. on the reasoned assumption that the customer needs the product today. If customers feel that a supplier is doing their thinking for them and is pro-

actively offering individual solutions to problems and context-specific services that they will like or that genuinely remove the hassle for them, they will also be willing to grant the supplier access to the information required to do so.

Products and Services: Hybridisation and Fluidisation

Hybridising products to create bundles of products and services has been common practice in many sectors for years. The Internet of Things takes the integration of tangible products and intangible services to a deeper level, causing services to actually be technologically 'embedded' in the products. Thus, the service is not an add-on, but a basic element of the product itself. A typical example of a connected business product would be a mattress with built-in sensors and actuators that continuously analyse the user's sleep pattern but also refer to information in the Cloud about the manufacturer's other customers in order to provide an optimum sleep environment. This service is an integral part of the guarantee provided with the hybrid product. Taking connected business to its logical conclusion, in future, nobody would buy new mattresses anymore, but rather would pay the supplier for services leading to 'a good night's sleep'.

In addition to hybridisation, many markets are expected to 'fluidise' products by using a greater number of pure utility and sharing models to break down the link to the individual product. Thus, in the case of users of car-sharing services, the make of the car will frequently no longer be in the foreground. At the same time, the product will be used by a lot of different customers. Customers will 'surf' considerably more frequently than today between different makes of product. This poses a great challenge for branding and retaining customers in the future.

Processes: Smart Automation

The vision of the smart factory in Industrie 4.0, where products control their own manufacturing processes, is already indicating that the next wave of industrial automation will soon be upon us. The more autonomously software systems and machines can act, the more likely that they will be used outside the smart factory, since connected reality technologies generate new options for automation along the whole value-creation chain – not just in manufacturing. These options range from digital agents at the customer interface, via robots and drones used in logistics, to the automation of management functions and decision-making processes using Big Data analysis. Yes. automation will mean a loss of jobs, which will inevitably lead to social conflicts. Quite clearly, lorry and taxi drivers the world over will not give way to a convenient and reliable transport service using autonomous vehicles without a fight, even if the operator is called Google.

4.3 CONNECTED-BUSINESS SECTOR COMPASS

How much of a disruption can technological trends pose for the value-creation chain in various sectors?

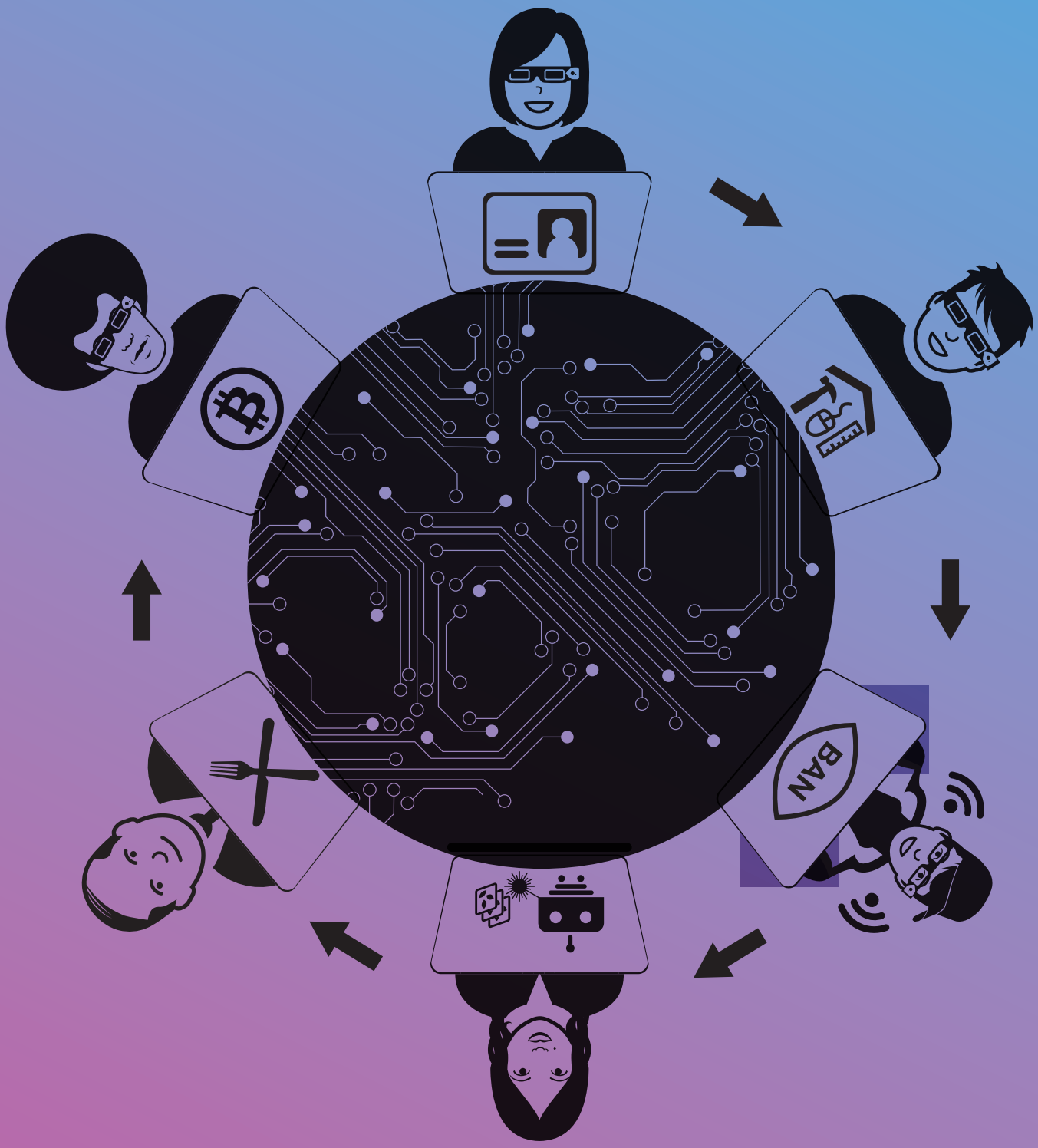
In the next ten years, there will hardly be any sectors able to withstand the pressure to innovate stemming from the technological trends we have described in this report. There are two aspects to this: risks of disruption for established players on the one hand, and opportunities for innovating systems and a huge boost to growth on the other.

Connected reality will give rise to new sectors, segments and professions of which we have only a very hazy idea today. Data architecture, context development and cyber-physical engineering will become academic subjects. Lots of new companies are expected to be founded in the next 10 to 15 years that will use connected reality. Although it will be a long time before the future of connected business becomes clear, it is already easy to predict the potential for innovation and disruption it will have on existing sectors. The table shows how much of an impact the technological trends mentioned in this report will have on various sectors over the medium and long term.

Against this backdrop, every business must ensure that getting to grips at an early stage with the opportunities and threats posed by connected reality is high up on its strategic agenda.

Innovation and Disruption Potential	Internet of Things	Ubiquitous Intelligence	New Interfaces	Digital Production	Autonomous Systems
Agriculture and Forestry					
Foodstuffs					
Textiles and Fashion					
Chemistry					
Pharmaceuticals					
Telecommunications and Media					
Electronics					
Mechanical Engineering					
Motor Vehicles					
Transport and Logistics					
Household Appliances					
Furniture					
Banks and Insurers					
Energy					
Construction					
Commerce					
Hotels and Catering					
Property					
Consultancy					
Health/Medicine					
Training					
Security and Defence					

low medium high


BAN

CONNECTED LIVING 2025: ONE SCENARIO

#5

From abstract analysis to the real world. The following scenario, taken from a German city in the year 2025, is an attempt to make connected reality come alive. As with all scenarios, it is designed to clarify the expected change.

A pair of eyes are starting back at **Lisa B.** (32) through the data columns that seem to flow through the room a metre in front of her. Her client has sent her a new Big Data algorithm, which she is now testing on shipments for a logistics services provider; however, no interesting pattern has emerged, yet. Lisa B. moves the data column to one side with a swipe of her hand, and looks disconcertedly through the transparent display screen. The eyes belong to one of her workspace neighbours, a data artist like her – not an uninteresting guy, but she can't yet make head or tail of him, although she has already run a scan of his identity through all the networks.

"Do you fancy coming to the pictures with me tonight?", he asks. "To the cinema??" – "Yes, *Wall Street* is on at the Cineplexx, the original. Not in 3D." *Wall Street*. Wasn't that the film from the last century, with Michael Douglas walking along the beach with that ridiculously big mobile phone?

Lisa B. can't help smiling, when suddenly a message appears in front of her: "U GOTTA SEE THIS." The algorithm has found a pattern in the data. "Wow!", exclaims Lisa B. She must send that immediately to **John M.** (41). He's several thousand miles away at an ImCo, an immersion conference, for his company.

The conference has been arranged to determine the strategy for the next four weeks to coordinate drones, transporters and freight ships better for delivering the new Sendai care robots. John M. brings up the results of the data analysis for participants with a hand gesture.

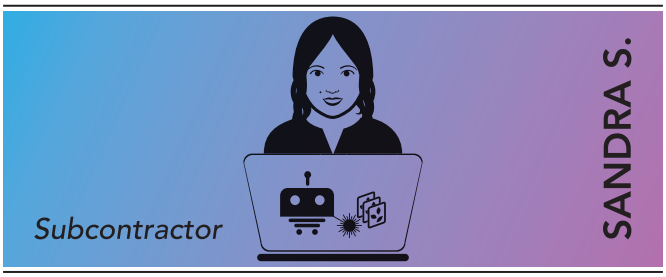
"This has just come in, and could explain why last month we built up overcapacity in London. You see, defective sensors in the envelope meant that the feedback from Dubai was a bit late reaching the system, so the warehouse in London kept on placing orders."

"I'll get someone to check the sensor network immediately," says the Dubai Logistics City Inc. avatar, and turns to the person on his right. "What stock levels would London have if there hadn't been a delay?" The representative of the simulation supplier looks up.

"Give me ten minutes to run the corrected data through the model." The Amazon manager's avatar gets up and says, "Okay, let's have a ten-minute break." Etiquette at ImCos is exactly the same as in the old world of business diplomacy. The Amazon woman disappears. John M. also logs out of the ImCo, takes a deep breath, and switches to work mode.
"Good work, Lisa! Seems you got us out of trouble," reads the message on Lisa B's screen. And then the next popup appears: the data set for her new tracker wristband has been printed out. She logs out of the system and goes to the ground floor, where there is a small Fedex fabrication hub under the workspace. The man at the desk gives her a bag – made of biodegradable plastic, of course – containing the finished titanium wristband for her tracker module. It is actually a complicated object made of coils twisted around one another. The small tracker module with the fitness sensors is not at all noticeable in it. Suddenly, Lisa B. notices an anonymous question mark in a five-pointed star stamped on one of the coils. Then, a thought flashes through her mind. This Little Maker is also an anarchist.

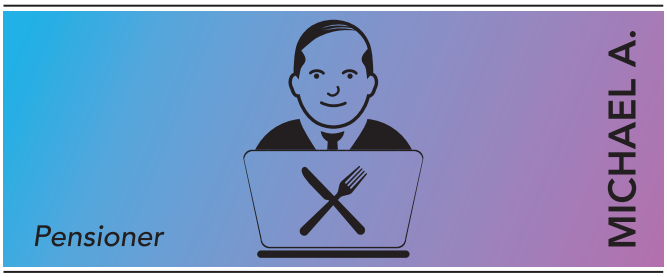
The Little Maker is **Leon M.** (18). He would never call himself a maker, preferring the word sculptor. Sculptors are specialists who make 3D models for any kind of additive manufacturing machine, usually working freelance. Leon M. recently quit school in order to concentrate on sculpting. In his opinion, people such as Lisa B. are lemmings who bow to the dictates of health insurers and bravely transmit their physiological data 24/7 in order to keep their health-insurance premiums down. He would never wear a tracker like the one Lisa B. has just had produced. Leon M. built his body area network (BAN) – his jacket, cap and goggles – himself. He'd never dream of wearing one of those mainstream products from HTC, Samsung or Google, which are constantly clogged with spam visualizations.
Only last week, a man in Berlin drove into the Brandenburg Gate because he had not dimmed his BAN whilst driving, and suddenly a porn ad appeared on his windscreen. It was lucky nobody was walking in front of him. Whilst Lisa B. takes her tracker wristband out of the hub, Leon M. is sitting with his mates in the virtual 'machine

room' of their home project, mesmerised. Spellbound, they are following the drone ballet being performed in the square in front of the town hall in their goggles. Ten minutes ago, they hacked into the police and fire-brigade fleet of drones and directed the flying devices to the mayor's office to display their disapproval of his hard-line politics. Now, they are making a rotating five-pointed star in the sky. Youthful defiance never dies.



Sandra S. (47) thinks this act of defiance is anything but a laughing matter. Just a short while ago, another data protest held up the production of her business for 18 minutes, That was 18 minutes in which no Hunters could be assembled – and that cost a lot of money. Hunters are an enormous step forward for agriculture. The microrobots roam through fields of corn and remove pests with a laser beam. No pesticides, no more green genetic modification – what do these rascals really want, Sandra S. wondered. The factory she manages is actually not a factory in the traditional sense, but rather it is a network of former office blocks in various inner-city business districts. Many of the office buildings that stood empty in the middle of the 2010s have now gradually been filled with 'intelligent' space-saving assembly lines. Sandra S., originally an IT expert, is now a subcontractor coordinating ten such buildings for an international manufacturer. Of course, she works from home, but out of habit she still always works with a traditional computer.

"Lunch?", the word suddenly appears on her screen. Sandra S. clicks on OK, activates her BAN and leaves the flat. On the stairs – she never uses the lift – she reads through the menu at 'Addis' two streets away. A few years ago, there were still a number of small drone delivery services, but the inner-city airspace was finally blocked off in 2022 after too many collisions. Now, only the big logistics companies are able to obtain a permit.



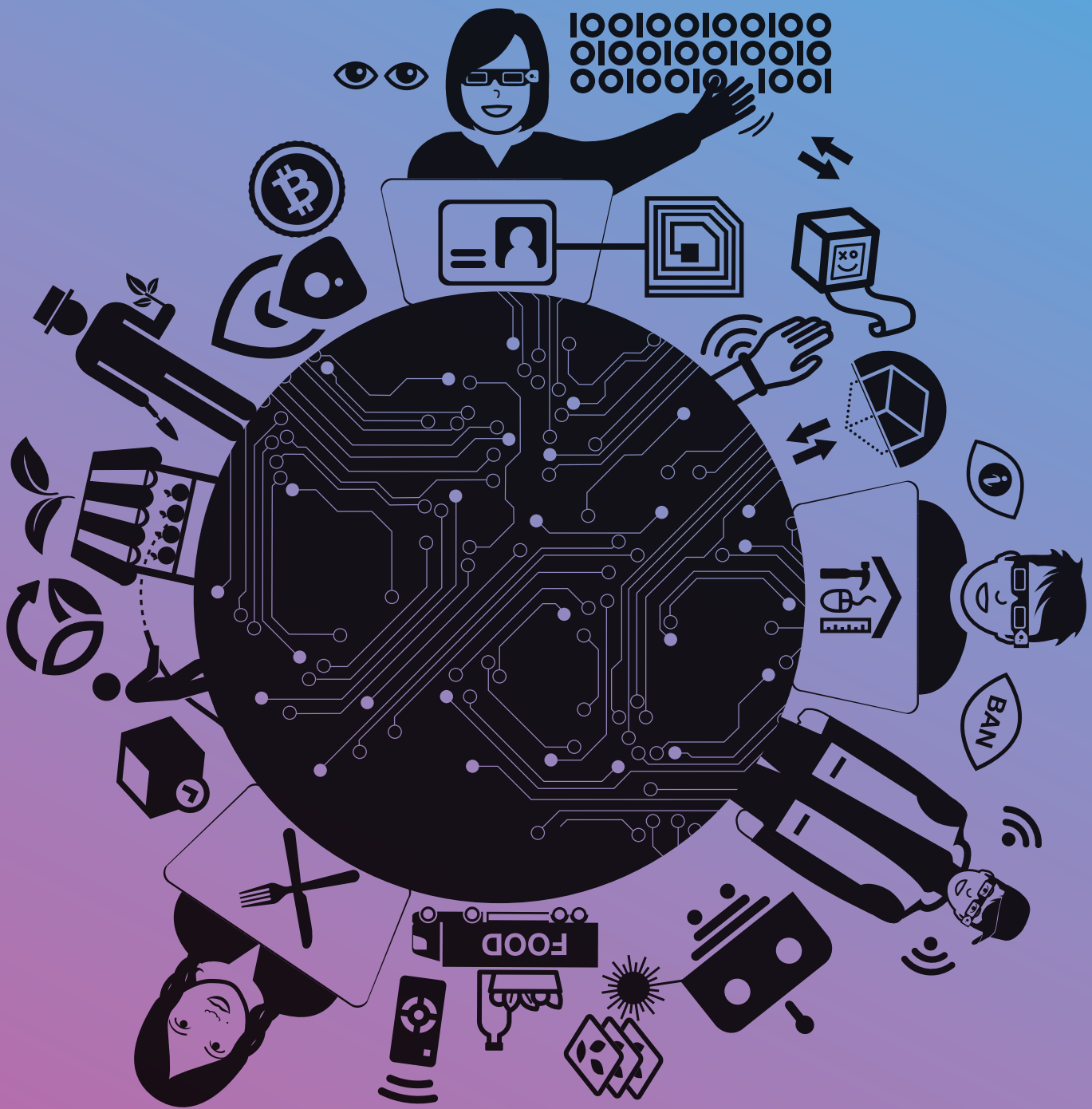
As she arrives at Addis, her usual order – Injera and chicken curry – is already waiting for her on the table. Ethiopian cuisine is the big thing of the 20s. Addis was opened by **Michael A.** (70) three years ago, shortly after his 67th birthday.

It had long been obvious to the landscape architect that he wouldn't be able to live on his pension. He and his comrades-in-arms obtained the start-up capital in 24 hours through crowdfunding, and thanks to the help of his nephew Leon M., who knew how to sell the project.

Amused, Michael A. takes Sandra S. her curry. "Do you see that chap back there in the corner?" he asks, indicating a young man in a collarless suit with a blond Afro. "He's been sitting there for a full two hours in a meeting with Hyderabad and Rio and gobbling his food down. Pity." Video meetings have become the cheap alternative to ImCos, and a nuisance in inner cities, similar to mobile phone calls on trains in the past. For some strange reason, a lot of people now go to restaurants for meetings, perhaps clinging to the old belief that business is better done whilst eating. In contrast, Michael A. has made his peace with the world. Apart from Addis, he runs another delivery service for restaurants, mainly local ones. His nephew has programmed an app for him so he can check wholesale prices and the origins of key ingredients. He then places an order for courgettes, tomatoes and various other foods, which are delivered by a driverless van. Unlike private cars, autonomous vehicles have very swiftly become part of mainstream inner-city logistics over the past few years. In contrast, autonomous private cars, apart from the projects that Google and car manufacturers thought up fifteen or so years ago, have not caught on. Not many people have been willing to give up the pleasure of driving.

The blond Afro belongs to **Jan P.** (28), who now leaves the restaurant. Just as his goggles display is confirming the transfer of 0.57 Bitcoins, a message comes in.

"Hey Jan, I've reached you at last. Have you explained the ProjectionSpace in the Europa Centre?" Damn, the Europa Centre, remembers Jan P. Jan P. is a placer for an international advertising network. He specialises in personalised advertising concepts in public spaces. "Give me an hour," he replies, and sets off. He looks carefully at the information that blends into his field of vision whilst he's walking. "Burgers for 0.17 Bitcoins" – an ad for a nearby snack bar jumps out at him. "What amateurs!", he thinks. He views his work, which he studied at the animation design college, as interaction art. Apart from his advertising job, he is developing an urban space game, which he hopes will give him his big breakthrough. Another message appears. "Check out Lisa B.," it says, "9 out of 10." It's been three weeks since his dating service has turned up something so promising. Her profile is just his thing. Only, why on earth is she going to the cinema tonight? And with that data artist? Well, we'll see about that, thinks Jan P. to himself, and gets down to work.


FOOD
BAN

SMART WORLD OR NETWORKED NIGHTMARE?

#6

The next wave of digital transformation will hit us in the next 10 years; it can already be felt in many applications and sectors. But it's not a sure-fire success.

A central challenge for the further development of connected reality is setting uniform standards for data protocols and interfaces in order to integrate the umpteen million computers, mobile devices and sensors into the Internet of Things. Of course, competing business economic systems will be tempted to use their own standards first, especially as the big IT and online businesses will put themselves forward as integrators and try to link up to as many partners as possible. However, that sort of competition would reduce the new potentials for creating value. Success is most likely if standards are global and open, in the same way as traditional web business blossomed thanks to http, HTML and XML. The forthcoming standardisation is all the more demanding in that it is no longer simply a matter of server content, but also of data from environment sensors, everyday devices, manufacturing machinery and other networked types of device.

Standardisation of interfaces is also a requirement for security. Gaps in security in Internet software, such as browsers, or in operating systems can still be closed by users installing manufacturers' updates. But, for millions of other objects in the Internet of Things, it is no longer so clear who has access to them to install a security patch. Proprietary interfaces could give rise to islands of uncertainty in the Internet of Things, from which malfunctions could spread through hypercomplex networking. At the same time, a security feedback system must be built into the real-time interaction of data producers and data users to indicate if digital systems have critical problems that could harm people, infrastructure and companies. In view of the increasing globalisation of customer relations and value-creation chains, it will become more and more important to standardise legal positions where there are regional variations. A hyperlinked real-time economy can no longer manage to clarify copyright, data protection or warranty obligations in vengeful and lengthy disputes. The national community must see some legal areas as basic components of the overriding 'operating system' of connected reality without which it will fall at the first fence.

And the customer is still there, amid the frantic rush towards hyperlinking. Two decades of the Internet as a mass medium have turned transparency, reliability and willingness to commu-

nicate into values that, today, many customers already automatically expect from businesses. However, with a product such as Google Glass any lack of clarity about what happens to the data that users of the goggles generate may develop into a backlash against a whole category of device, adding to the general feeling of insecurity triggered by the extent of the monitoring by the NSA and other secret service agencies.

The concept of an omnipresent network arouses mixed feelings. The opportunity for the intelligent use of resources, a higher quality of life, more efficient processes and, last but not least, enormous new business potential make connected reality an option for the future that is worth striving for. Misgivings about security, lack of independence and over-complexity in the hyperlinked world of tomorrow are enough to bring you out in a cold sweat. Connected reality will not develop without conflict.

Will the new wave of ubiquitous intelligence and automation give rise to fears and Luddite-type resistance? If so, in future, it won't be blue-collar workers but professionals such as doctors and managers who will bear the brunt of technological evolution when their ability to make decisions is replaced by intelligent data networking and highly developed algorithms. Social conflict over the introduction of the next phase of digital transformation is inevitable.

However, in the end, it will as always be customers and citizens who will, by accepting or rejecting them, decide which system innovations will survive in the long-term and which business economic systems will dominate the complex markets of connected reality. One thing is certain: the struggle over creative power en route to connected reality began long ago, and market participants have already staked out their claims.

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