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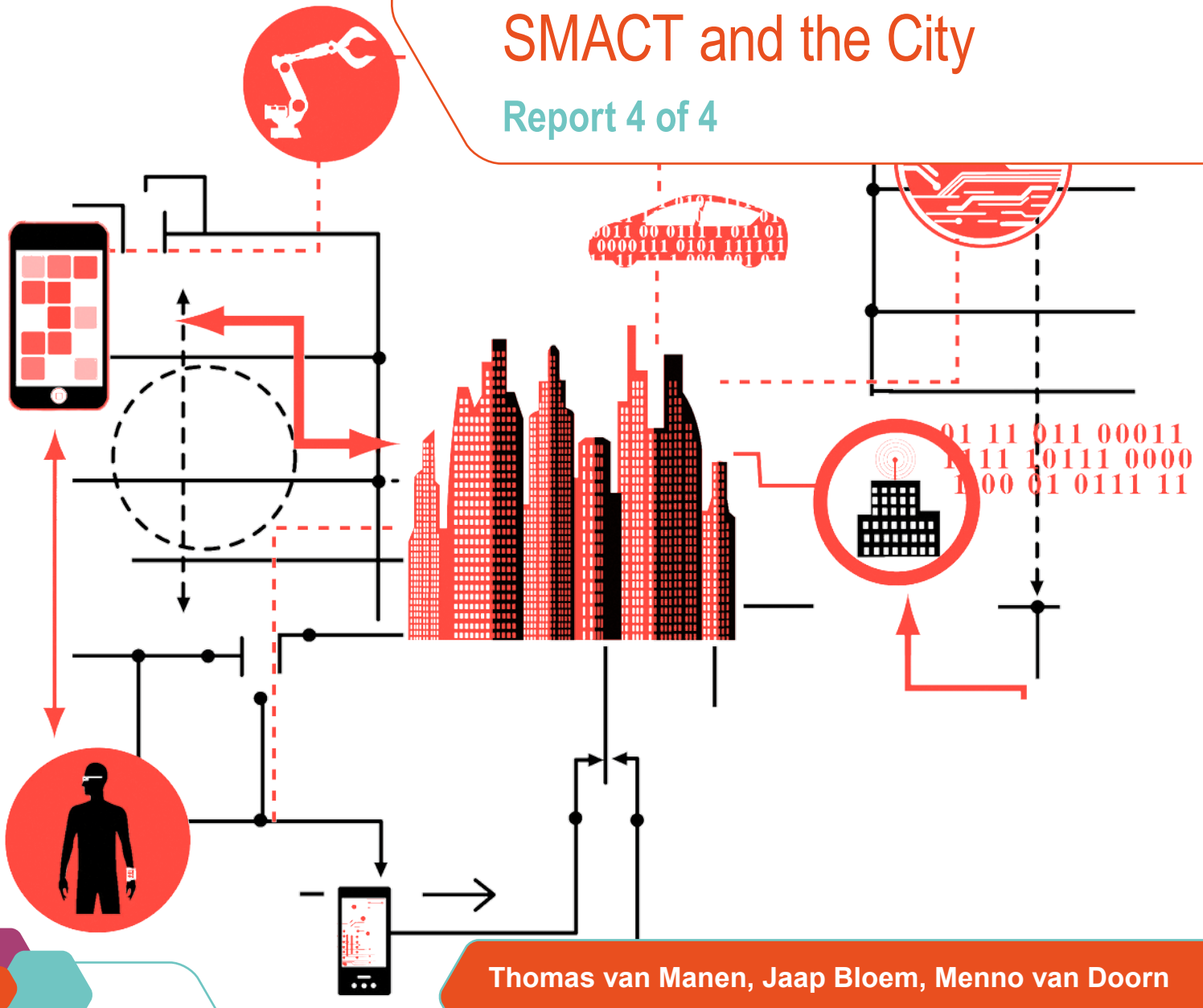
New Technologies in Urban Environments

SMACT and the City

Report 4 of 4



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VINT | Vision • Inspiration • Navigation • Trends | vint.sogeti.com vint@sogeti.nl

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Four new VINT reports on digital things

A rumor started at the end of the previous century, that "Things will be arriving on the Internet." Due to the long nose of innovation, as Bill Buxton of Microsoft Research describes it, it took fifteen years for that to happen, but now the clamor of Things is becoming deafening. In various sizes and shapes, all kinds of startups and renowned names are claiming to have made breakthroughs, ranging from off-the-shelf sensor hardware platforms such as Arduino and Libelium to business infrastructural giants such as IBM and McKinsey.

The relationship between humans, their artefacts and the world around them has always been a fascinating one. The difference nowadays is that we know how to program computers and can store everything in cyber-physical systems. That makes digital smartness concrete: stretching from smartphones and intelligent pill jars in healthcare chains, to the lifecycles of products and services with the customer as the focus of attention. From *science fiction* to *fact of life*.

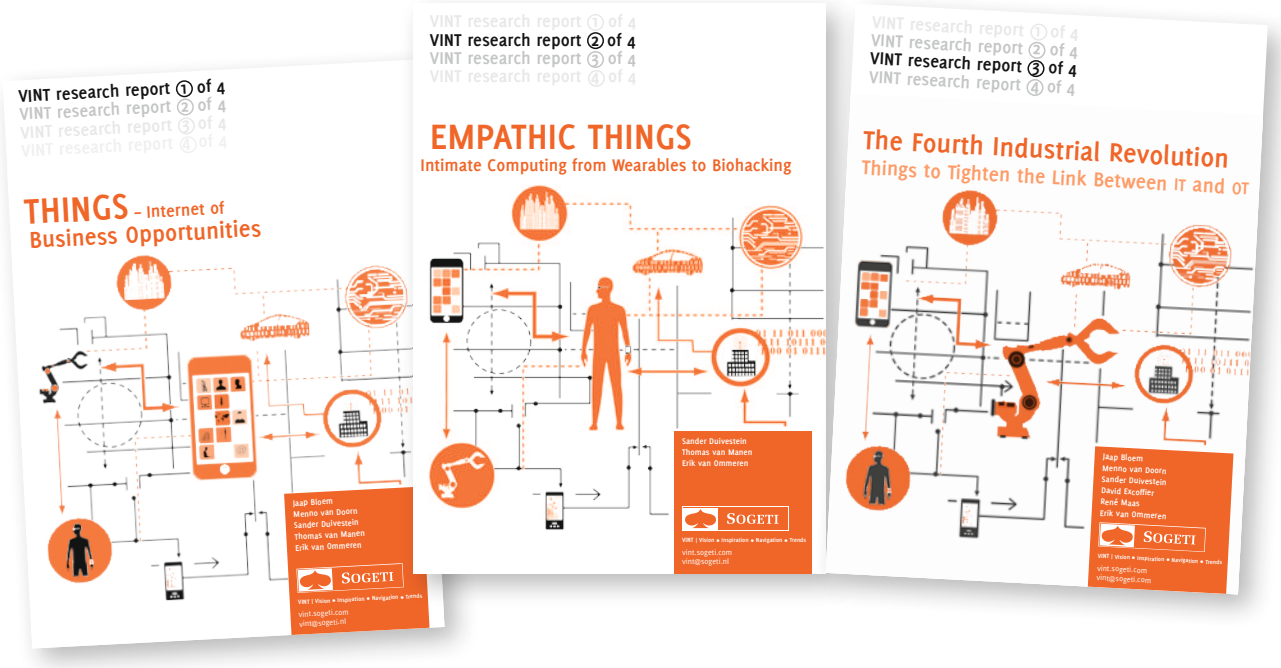
We now present the fourth and last VINT Report of our series, following the introductory report entitled *Things: Internet of Business Opportunities*, the second, consumer-oriented report *Empathic Things: Intimate Computing from Wearables to Biohacking*, and number three, *The Fourth Industrial Revolution: Things to Tighten the Link between IT and OT*.

The report now before you is the final panel of this quadriptych. After the reviews that focused on humans and industry, we now take the city as the center of Things: the city in which we eat, work, make love, are robbed, buy stuff, and where new technologies such as social media, smartphones and sensors have abruptly made their entrance. The rapid development of Social, Mobile, Analytics, Cloud and Things (SMACT) forms the vanguard of urban change, hence *SMACT and the City*, but most developments have not taken place yet. In the words of Vicente Guallart, the famous city architect of Barcelona: "Internet has changed our lives, but it hasn't changed our cities, yet."

1 Lessons we can already accept

Right from the outset of our research into the Internet of Things, it was clear that the city would be the topic of our final and concluding report. The city is the economic heart of society and the biotope in which people prefer to dwell. At home or on the street, on the way to the theatre, or waiting at school for the bus: the Internet of Things will soon be active at all such places. At least, that is the general expectation. Therefore, the city is a logical place to have a closer look at all these developments. Ultimately, the ingredients ought to converge at all these different urban locations: perfectly working technology, the ease with which people like to serve themselves, and all kinds of other extras that Connected Things promise to provide us with.

The reports that preceded this *SMACT and the City* already touched upon the essence of the smart city. To recapitulate, we present here the three most important messages from these reports.



Preventing waste

In the first report, we examined business opportunities. These are directed toward preventing waste in all forms and amounts: waste of time and energy when we have to wait unduly, or waste due to accidents, as things can always be done more safely, and all kinds of everyday frustrations that can be avoided by making things just a little smarter. We gave examples ranging from smart ways to tackle parking problems while simultaneously reducing CO_2 emission, to intelligent pill dispensers that warn the doctors in advance if the pills are not being taken correctly or require replenishing. A smart city is one where all kinds of wastage are tackled and resolved.

Focus on behavior

n the second report, we investigated the behavior of humans and the nature of new Things technology, which is particularly empathic – thus, a technology that has the ability to understand people better. In the report entitled *Empathic Things: Intimate Computing from Wearables to Biohacking*, we encountered the phenomenon of the so-called *systems of engagement*: systems that touch the hearts and minds of individuals. The secret is to examine the behavior that is stimulated by new technology, and the way slow technology fits into the (economic) lives of people. This is an interesting perspective from which to view the smart city.

Predictive talents

The third report focused on the marriage between operational technology (OT) and IT. We recognized opportunities to govern processes in real time and even to predict what the smartest next step might be, particularly in an industrial discipline that is growing strongly and rapidly: predictive maintenance. In urban environments, this is already varying from predictions about energy usage to identifying the places where the next crime will be committed (predictive policing), and other anticipatory possibilities. Processing sensor data in real time and taking direct action represent a major step forward in making cities much more intelligent.

Preventing waste, concentrating on human behavior and being able to undertake action in real time because we know what is going to happen – this kind of smart city is primarily a Personal City, as we describe in the final section here. It is a city in which the push and pull factors converge in such a way that the development is desired and useful because it harmonizes with individual experience.

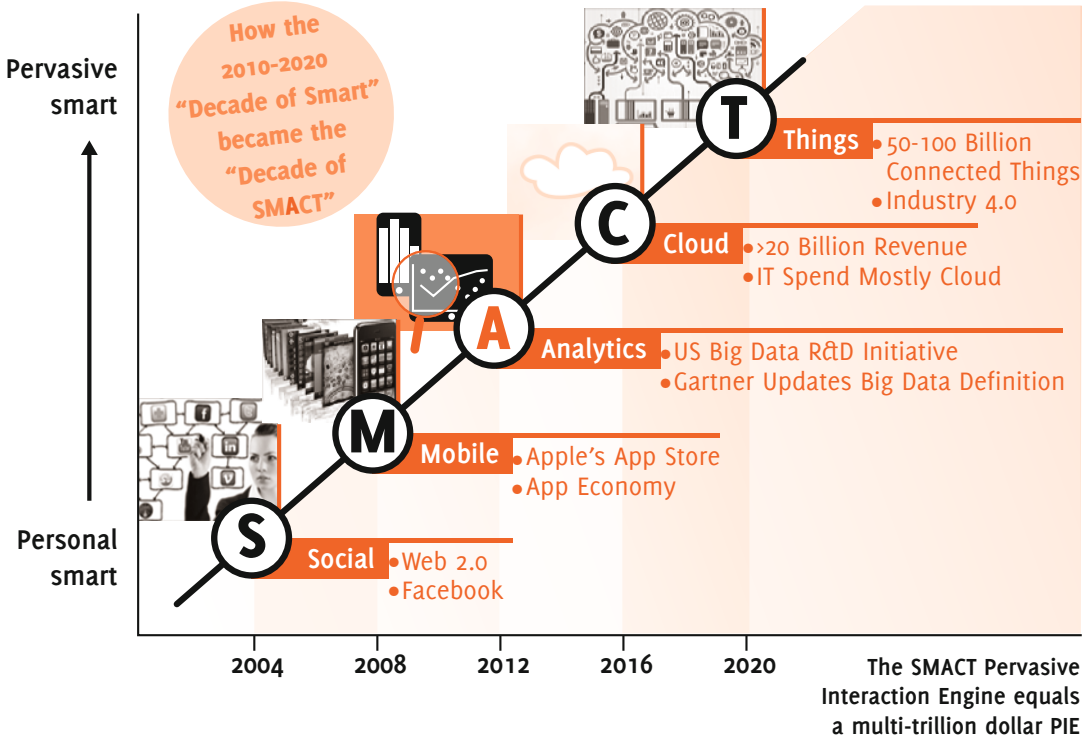
In *SMACT and the City*, we again concentrate primarily on technology in relation to human interaction: the City as a Platform, advancing pervasive applications, and sensitive technology. The three most important concepts from the rich literature on smart cities was the source of inspiration. Sections 5, 6 and 7 elaborate these concepts further, entering into the world of retail. In studies on smart cities, smart retail has been too much neglected. In traditional rankings (see Section 3), a city is appreciated on the basis of features of general usefulness such as transport and safety, rather than according to smart consumer behavior. Nevertheless, iconic retail instances, with their great economic spectrum, have much to offer: inspiration and insight for everyone who wishes to gain a better understanding of the way in which new technology is changing people's economic and social activities.

2 The Decade of SMACT, the new Smart

The city has been the throbbing heart of our society since time immemorial. The city is the place *par excellence* where people live, work, learn, enjoy recreation, grow up and spend their old age. The desire to improve that living environment has always been present, but the digital possibilities of the modern age have given this ambition an enormous impulse. It is therefore not surprising that former IBM CEO Sam Palmisano heralded the *Decade of Smart* on 1 January 2010, of which the Smarter Cities initiative of the oldest IT company in the world would be the showpiece. The comparative term 'smarter' indicates that the ambition to become a smart city is a long process and is in fact never finished.

Modern digital opportunities justify a similar claim. Besides smart, this is also the *Decade of SMACT*, with cities full of Social media, Mobile internet, (big) data Analytics, linked via the Cloud and physically and digitally intertwined thanks to connected Things aka the Internet of Things. As a result of the integration of these five basic technologies, urban development is slipping into top gear. SMACT has the potential to transform the city into a platform in which bricks and clicks blend seamlessly together.

The disruptive SMACT platform builds up linearly over time with exponential impact



The landmarks are consistently four years apart: from the founding of Facebook (2004) and Apple's App Store (2008) to the year of Big Data Analytics (2012), the Cloud (2016 – according to the economic impact predictions) and Things (2020). (See also "How the 2010-2020 Decade of Smart Became the Multi-trillion Dollar Decade of SMACT" and "SMACT 2004-2020: The Final Countdown."[1,2])

New technology and the urban environment

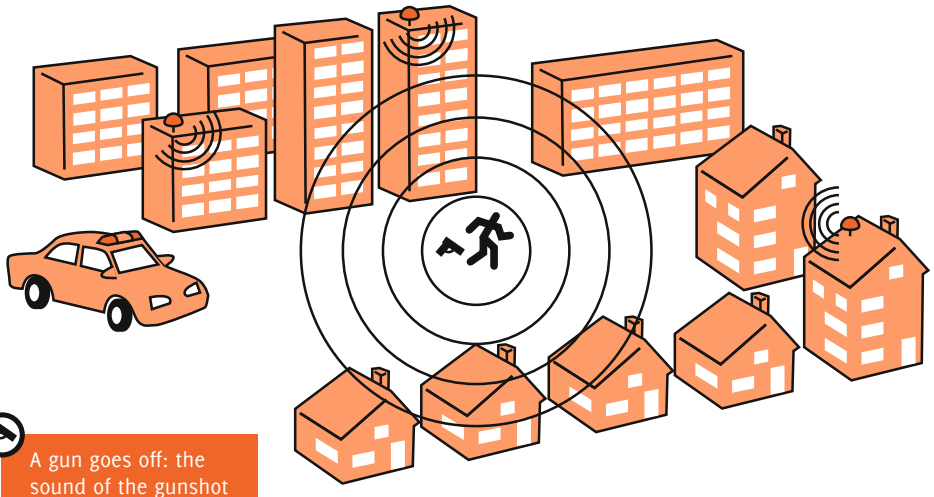
Cities are traditionally the places where new technologies are generated. Aqueducts and roads, skyscrapers, hospitals: urban environments are jam-packed with technological applications, all of them man-made. If we were to imagine for a moment just what the world would look like without technical expertise, this German advertising film gives a few pointers in that direction. Without technology, humanity does not amount to much.

A video still from "Das Leben ohne Handwerk" (Life without Craftsmanship), an image campaign to promote the technical professions in Germany, in which everything that has ever been made by humans falls apart and collapses: https://www.youtube.com/watch?v=oniqKg4VXdI

Technology historian Thomas Hughes has written splendid books on this subject, such as *Human-Built World: How to Think about Technology and Culture*. Just as in the German promotion film, the physical city is the focus of attention. The iPad and Twitter did not yet exist, so the former human-built world did not know any of these smart technological tricks such as the ShotSpotter that is used in Boston.

1 http://vint.sogeti.com/2010-2020-decade-smart-became-multi-trillion-dollar-decade-smact/

2 http://vint.sogeti.com/smact-2004-2020-final-countdown/



A gun goes off: the sound of the gunshot travels through the air.

Several ShotSpotter sensors in the area capture the signal.

The location of the shot is determined within a few seconds and a check is done on whether or not the data are correct.

The message is passed on to the police and they go directly to the location.

Within a few minutes the police arrive at the location, prepared for the situation.

It looks like magic. Acoustic sensors that have been installed throughout the city recognize gunshots and localize their place of origin. New technology is conquering the city and the entire physical environment is being given a digital dimension with new functions and applications: shops and streets, lampposts, water installations, cars. We have been building up our cities by means of craftsmanship and technology for centuries, but it is only recently that we have been able to use software and devices to monitor and govern the city in real time. And we are only in the infancy of discovering how digital and physical interlock with one another.

There have always been representations of new technology and cities of the future, as in the sci-fi film *Metropolis* by Fritz Lang, from 1926. According to this film, in 2026, airplanes would be flying among the buildings of the city, and robots would be able to operate independently of humans. We still have such visions, but now in a slightly different form. It is not airplanes but drones that dominate the airspace above the

city. And cities full of cars without steering wheels, because the cars are able to see and recognize the city and, thanks to smart data analytics, can transport people safely from A to B (for an update on the driverless car, see our research blog[3]).

The new Metropolis: supplying by drones, and the advent of autonomous transport?

The question remains as to how we should deal with the possibilities and consequences of new technology in urban environments. Drones and autonomous cars will have an effect on many sectors: tourism, postal deliveries, retail and pizza couriers, energy, car insurers and damage-repair firms, the manufacturing industry, tax levies and public transport.

SMACT and the City: four takes on the urban environment

"The Future is Cities" was the headline of the winter 2014 edition of *MIT Spectrum*. Half of the world's population now live in urban conglomerations and in 2050 that will be almost three-quarters of all people on earth. In China, 300 million people will move to the city within the coming 15 years. In 2028, China will re-rig the complete infrastructure as it is in America today. India will witness an increase of the urban population of 250 million, and in Africa the increase will be 380 million. Despite the fact that cities will have to accommodate 90 per cent of the population increase, 80 per cent of the worldwide CO_2 emission and 75 per cent of energy use, the city will remain the place where people will want to settle. The reason is simple: 80 per cent of our prosperity is created in and around cities.

In order to cope with these developments, cities, regions and governments are directing their attention to the concept of the Smart City: from Brazil to Dubai. Where does the profit lie? Research by Bosch, under the title of "Capitalizing on the Internet of Things," covers the main markets within which investment in new technologies will repay itself. This will amount to an estimated 596 billion dollars in total,[4] distributed as follows: intelligent buildings 213 billion, the automotive industry 175 billion, utilities 44 billion, cities 21 billion, the manufacturing industry 17 billion. Thus, the Smart City is responsible for 21 billion of the yield, intelligent buildings for ten times that amount

3 For an overview of self-driving cars from Volvo, Mercedes, Google and others, see: http://vint.sogeti.com/latest-self-driving-cars.

4 http://blog.bosch-si.com/infographic-capitalizing-on-the-internet-of-things/

– but these also belong to the Smart City, as do parts of the automotive industry and the energy supply. Between 2010 and 2020, investment in the infrastructure of smart cities will increase to around 108 billion dollars, according to Pike Research.[5]

We explore how and how quickly new technologies will develop in the urban environment, from the perspective of the most-discussed concepts in the world of smart cities: *Cities in a Box, Senseable Cities* and *Cities as a Platform*. We conclude with a concrete scenario, namely retail.

A *Cities in a Box*

Cities in a Box are completely new cities that are full of the latest gadgets, developed in conjunction with technology companies and available on request, to be realized through copy-paste technology. They are primarily oriented toward the efficient handling of energy, the environment, and safety and security. Because existing infrastructures do not need to be taken into account, the developers can make the fullest use of technology. Major investors are the driving force behind this kind of concept.

B *Senseable Cities*

Senseable Cities (especially existing cities) are cities full of sensors, where everything is related to data analytics. New insights from (Big) data must lead to policy adaptations. The focus of attention is the translation of every physical occurrence in the city into a virtual visualization. The concept comes from MIT Senseable Lab, of which Carlo Ratti is the spiritual father.

C *Cities as a Platform*

Cities as a Platform (both new and existing) function as a cyber-physical platform where the digital and the physical infrastructure are regarded as being one entity. Nevertheless, there is still much to be discovered about the way in which we wish to combine the virtual and the physical. Citizens and empowered behavior play an important role, as do technical (im)possibilities. The platform is an instrument to change the city and the process of change itself.

D *SMACT and the retail business*

We conclude with a concrete sectorial elaboration of *SMACT and the City*, namely the retail business as the showcase of economic activity. The retail business largely determines the dynamics in, and the attractiveness of, a city, regardless of whether or not you enjoy shopping there. Without smart retailing, every city – regardless of how smart it may be in other respects – is generally a dull experience. Section 8, "Urban scenarios: SMACT and retail activities," examines the hard reality of the retail business: we see how the advent of e-commerce has partly induced the closure of physical shops and how new technology is helping to reshape and revive the shopping experience.

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5 http://www.fierceenergy.com/press-releases/global-investment-smart-city-technology-infrastructure-total-108-billion-20

3 Who has the smartest city?

There are many smart city flavors. A consensus is beginning to form in the Netherlands about the forms of smartness that are desired in a city. In March 2013, *Stedenlink* ("City Link," an association of ten Dutch cities and three provinces that are at the forefront of the development of the social added value of IT and the knowledge economy for urban processes), the Minister of Economic Affairs, and the G4 and G32 (4 major and 32 medium-sized cities and municipalities in the Netherlands) signed the Smarter Cities Covenant, which focuses on the Digital Cities Agenda. The following eight areas are the focus of attention:

- *Caring City* – promotes self-sufficiency, good alignment of care assortment and requirement, and the deployment of smart (care) technology. It is alert with regard to price/performance.
- *Secure City* – works on event safety and security, intelligence, cyber security, and smart security of business grounds.
- *Regulation-light City* – works on the improvement of governmental services, the practicability of regulations, and fewer monitoring costs for companies.
- *Open Networks* – or the availability of Next Generation Networks (NGN) and the accessibility of these in the broadest sense of the term.
- *Our City* – is continually in discussion with the city, works on the reinforcement of self-organization and entrepreneurship with open data.
- *Learning City* – works on the enhancement of educational quality, the connection of education to the labor market, and the digital skills of the labor force.
- *Green City* – works on sustainable energy supplies, sustainable energy use and sustainable solutions to problems of mobility.
- *Industrious City* – works on reducing the pressure of regulations, the enhancement of e-skills in small and medium-sized businesses, the transformation toward smart working, future-resistant business parks, and Inner City 3.0.

We also see the same diversity of flavors abroad. Every year, the *Fast Company* magazine draws up a list of the ten smartest cities in Europe[6] and North America.[7] The indicators largely correspond to the 8-point list in the Smarter Cities Covenant. Helsinki, which occupies the 10th position in Europe, wishes to realize a smart government primarily via hackathons (marathons with creative hackers), Paris (at no. 5) aims at a good cycling and startup climate, Boston (at no. 2 in the US) scores with the above-mentioned smart sensor system that can identify gunshots, and Washington (at no. 4) is going for Big Data and equality of income.

According to this list, Seattle is the smartest city of North America, not only because of its sustainability but also because of the fact that the happiness of the inhabitants

6 http://www.fastcoexist.com/3024721/the-10-smartest-cities-in-europe

7 http://www.fastcoexist.com/3021592/the-10-smartest-cities-in-north-america

is measured on the basis of mobility patterns instead of questionnaires.[8] In this way, people wish to promote the comfort and satisfaction of the urbanites: inconspicuously and based on hard fact. Copenhagen is the smartest city in Europe due to its exemplary reduction of CO_2 emissions and its car-free ambition.

According to Rob van Gijzel, mayor of Eindhoven, the Netherlands, there are absolutely no smart cities, there are only smart people. His region won the Intelligent Community of the Year Award in New York.
In short, if there actually are smart cities, they come in all shapes and sizes. There are primarily smart urban environments or domains, such as education, energy and healthcare.

Despite the constantly changing smart-city lists, there are two cities that stand head and shoulders above the others: New Songdo (South Korea) and Masdar City (Abu Dhabi). They set the tone in the technology debate on smart cities. We shall first take a quick look at this kind of city before examining the other two variants.

8 http://www.fastcoexist.com/3018098/a-new-way-to-measure-happiness-finds-the-true-happiest-countries-in-the-world

4 City in a Box: smartness to order

We always want to realize our Smart City ambitions as quickly as possible. This can be done by building completely new cities, such as Masdar City and New Songdo. This is the City in a Box approach: you can buy and replicate the blueprints. China already has twenty new New Songdos on its planning schedule. Thanks to the City in a Box concept, all the smart thinkers can collaborate and all state-of-the-art SMACT technologies can be deployed, with the goal of implementing smartness as a standard. The other option takes the existing urban environment as its starting point and works, in that socio-economic context, through the formulated priorities step by step.

Masdar, Abu Dhabi

***Size**: 5 km², plans for 40,000 inhabitants, 1500 companies involved*
***Date of completion**: 2020/2025*
***Investors**: Consensus Business Group, Credit Suisse, Siemens, ADFEC*

Masdar City: transport via self-operating cars

One of the most renowned and prestigious Smart City projects, designed by the British architect Norman Foster and partly funded by Sultan Ahmed-Al-Jaber, is Masdar. It is a totally new city, constructed out of nothing, in the middle of the desert. The focus of this project lies on sustainable solar energy. Cars are prohibited and transport is effected by Personal Rapid Transit vehicles that run on solar energy. The CO_2-neutral city without waste is being realized here in conjunction with MIT. Until the present, the city has only been inhabited by a few hundred people, mainly students. Due to its limited size and high costs, questions have arisen about Masdar as a role model for future smart cities or urban development, and the project is mainly regarded as a testing ground for innovation.

14

Songdo, South Korea

***Size**: 6,1 km², plans for 250,000 inhabitants*
***Date of completion**: 2020*
***Investors**: Gale International, POPSCO E&A*

New Songdo Smart City Control Center
http://iotsys.blogspot.nl/2014/03/paper-presentation-at-ieee.html

Songdo International Business District has been constructed on a previously unused site, on a piece of reclaimed land along the waterfront of Incheon, a little more than 50 kilometers southwest of Seoul. The city is connected to Incheon International Airport by means of a huge bridge. The project is estimated to cost more than 40 billion dollars, which makes it one of the most expensive projects in the history of mankind. The Internet is ubiquitous in Songdo, as are the thousands of cameras that register every activity. This is not only with regard to security but also to enable the city to anticipate movements: such as the opening of doors and the summoning of elevators when people approach. This situation immediately reveals one of the major dilemmas we face in relation to smart cities: how can we align the efficiency of the smart city with the privacy of inhabitants and visitors?[9]

Not a good role model

The success of these megaprojects is certainly not guaranteed. This comes as no surprise at all to sociologist Richard Sennett, affiliated with MIT and the London School of Economics. His analysis in *The Guardian* ("No one likes a city that's too smart"[10]) refers back to architects Lewis Mumford and Siegfried Giedion who, in the 1930s, warned about "the scientific planning" of cities. According to Sennett, digital technology such as the Cloud has the same suffocating and soulless results. Advice on matters such as where we should buy our goods and when we should visit a doctor is dished up in a super-efficient manner. There is nothing more for us to discover, everything is user-friendly and we live via menu choices on the smart city interfaces.

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9 See also our report "Privacy, Technologie en de Wet" (Privacy, Technology and the Law) on vint.sogeti.com/downloads.

10 http://www.theguardian.com/commentisfree/2012/dec/04/smart-city-rio-songdo-masdar

A resident of Masdar City wrote on her blog that she lives in the middle of the desert in a spaceship with which nothing can compare:

> *"The buildings are beautiful here, and they look so different from anything I've ever seen, anywhere. I keep telling people that it feels like I'm living in a psychology experiment."*

To Sennett, the fact that a city such as Masdar presents itself as a creative bastion is simply a step too far. It is precisely the coincidental or erroneously planned occurrences and buildings that offer people a challenge. But, according to Jonathan Thorpe, CIO of Gale International, which is the company that funds New Songdo, both are possible,[11] you can take that into account in the plans: "You're trying to create a diversity and a vitality that organic development creates, in and of itself. So it's a challenge to replicate that in a masterplan." You can expect this kind of statement from the financer of this kind of city.

Perhaps Richard Sennett is passing over the merits of the City in a Box too easily. In Masdar City, for example, all cars operate without a driver. Recent research[12] has shown that if 90 per cent of all Americans were to travel in computer-driven cars, this would prevent 4.2 million car crashes, save 21,900 lives, and bring 450 billion dollars' worth of economic benefit. The same applies to energy usage and CO_2 reduction, in which both of these cities book outstanding results. It remains interesting whether or not a city can maybe be "too smart" in its prevention of accidents and saving of energy.

With all the possibilities for technology – physical and digital – we would do well to avoid seeing the "high-technopolis" as the only blueprint. After all, most people live elsewhere and it is certainly also beneficial to apply new technologies to existing urban environments.

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11 BBC News, "Tomorrow's cities: just how smart is New Songdo?" http://www.bbc.co.uk/news/technology-23757738

12 Eno Center for Transportation, "Preparing a nation for autonomous vehicles," October 2013.

5 Toward Senseable Cities

With our digital progress, we are moving increasingly further from instrumental applications, toward sensory and intelligent ones. This is in line with the Pervasive or Ubiquitous Computing vision that Mark Weiser envisioned as far back as 1988. Or, as Nicholas Negroponte remarked in 1995:

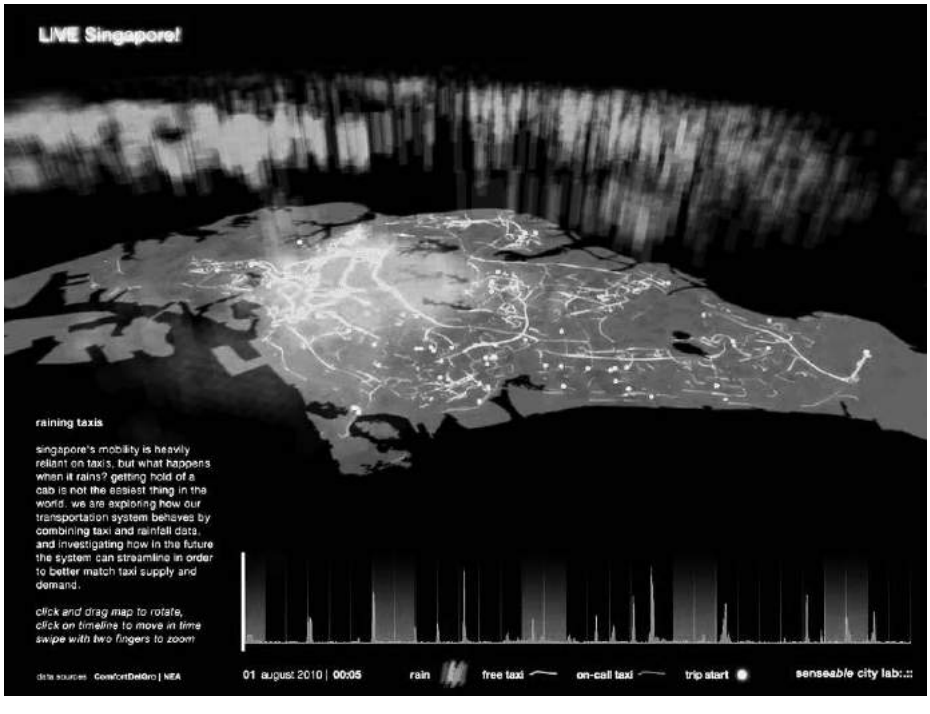
> *"Computing is not about computers anymore, it is about living."*

Carlo Ratti, architect, civil engineer and director of the MIT SENSEable City Lab, speaks of a city with antennae and senses, in which everything is experienced and given feedback in real time. The city is assigned a digital skin, is sensitive and "able to sense": it is senseable. This has direct consequences for the physical structures of the city.

> *"The increasing deployment of sensors and hand-held electronics in recent years is allowing a new approach to the study of the built environment. The way we describe and understand cities is being radically transformed – alongside the tools we use to design them and impact on their physical structure."*

Data Drives

The main activities are "collecting the data" and "responding to them." Good data visualization should ensure that citizens, authorities and policy makers can work with the data. Analytics are the essential part. The Data Drives project in Singapore is geared exactly to this situation. On an enormous "iPad," citizens can use the Big Data of the city, which come from public and private transport, telecom suppliers, figures on the consumption of electricity, and meteorological records. The analysis of such datasets is usually the domain of specialized companies, but everyone can visualize and manipulate the data on the screen to discover hidden patterns and dynamics, and respond to these.



Data Drives Singapore: data on rain combined with activities in the city, looking for hidden patterns

HubCab

HubCab is another example in which the basic elements of the Senseable City recur: they equip 13,500 taxis with technology that generates data, and make this information visible so that travelers and taxi companies can make smarter choices. In this case, we are referring to 170 million taxi trips executed by the New York Medallion taxis over a period of a year. The dataset contains the GPS coordinates and times at which the taxis pick people up and deliver them at their destinations, plus the zones where this happens more frequently than average. This provides insight into the mobility patterns of taxis and people. The figures show that, without reducing the comfort of the traveler, 40 per cent of the taxis could be shared.[13] With a CO_2 reduction of 423 grams per mile per saved trip, this amounts to quite a benefit to the environment.

HubCab:
data analysis and data visualizations of 170 million taxi trips produce new insights

Related trends include: sharing trips via Lyft, and the Uber taxis. New apps which make smarter use of existing infrastructures, can subsequently make transport much more efficient.

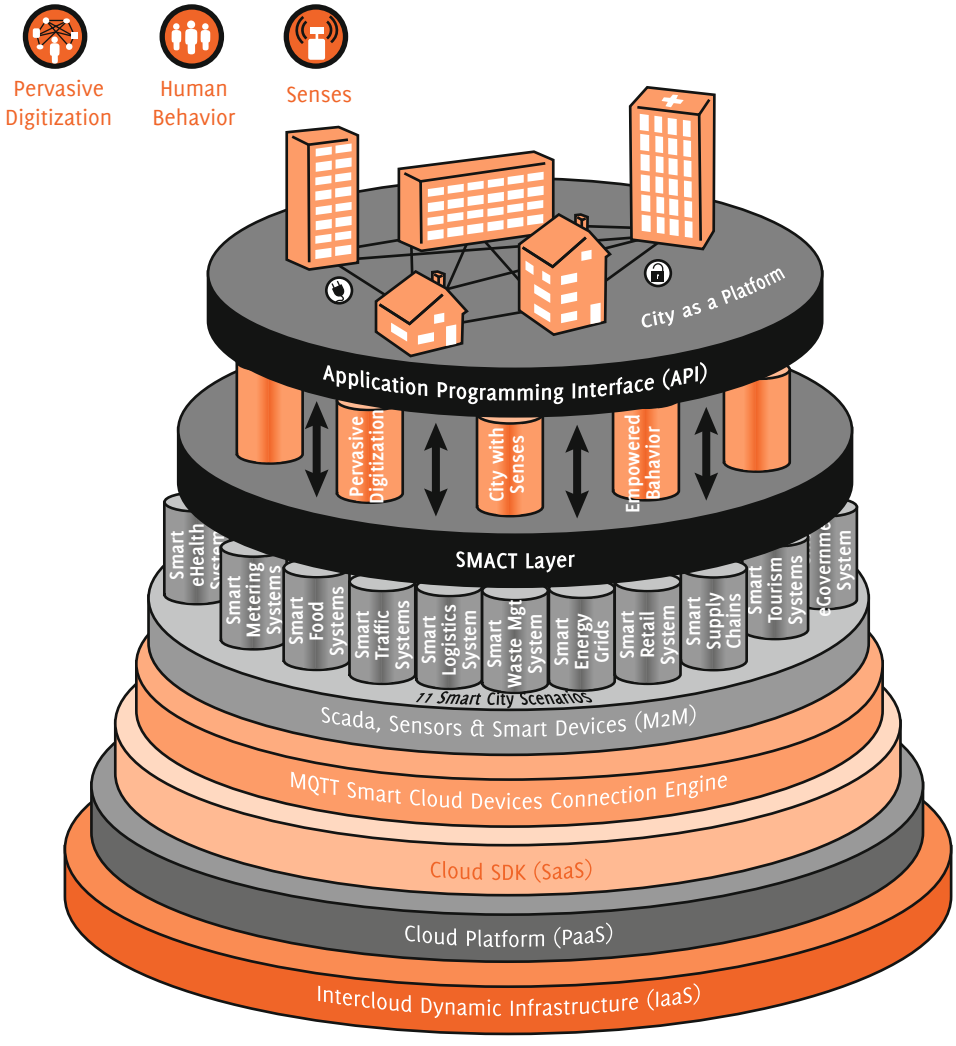
The calculations of Carlo Ratti's HubCab are convincing, but ultimately people will have to share taxis with one another. Whether or not that will actually happen will be partly determined by external motivation and regulations. It is certain that insights on the basis of Senseable Cities may help boost numerous new ideas and opportunities to make cities smarter.

13 P. Santi, G. Resta, M. Szell, S. Sobolevsky, S. Strogatz, C. Ratti. "Taxi pooling in New York City: a network-based approach to social sharing problems" (2013).
U.S. Environmental Protection Agency. "Greenhouse Gas Emissions from a Typical Passenger Vehicle."

6 Cities as a Platform

To an ever-greater extent, the digital architecture of the city is beginning to resemble a platform with various components that support and reinforce one another and accelerate developments. Cities have always been infrastructures, and now the physical and the digital infrastructure are mutually interwoven, as Amrit Tiwana of the University of Georgia describes in his book *Platform Ecosystems: Aligning Architecture, Governance, and Strategy*:

> *"A platform provides the infrastructure on which apps operate, much like buildings in a city connect to shared city infrastructure like water, sewers and electric grids. Much like a city's infrastructure, a platform serves as a backbone for apps, providing consistency and order."*



All in all, we can distinguish eleven areas or scenarios where the platform enables a city to become smarter: healthcare, measuring (smart meters), food, traffic, logistics, management, grids, retailing, supply chains, tourism and e-government.

At the top, there is the physical city with the activities of its citizens, consumers, students and commuters. Immediately below this top layer lies the technology stack. Via the Application Programming Interfaces it becomes possible to observe the city through Google Glass, for instance, or via all kinds of apps and dashboards. Thus, for example, security cameras can provide real-time information in dangerous situations if they are linked up with a face-recognition service. At the basis we see, as usual, the Internet layer of Infrastructure as a Service, the related Platform as a Service, and Software as a Service. What follows is an additional layer to improve mutual communication and collaboration among the connected areas. The exchange of information takes place via a service bus (smart engine).

A great many parties are working on making cities 'instrumentally smart' at these levels. For instance, the French company SigFox that is rolling out a mobile M2M/Internet of Things network in Silicon Valley, via patented UNB (Ultra Narrow Band) technology, which will be accessible for any wireless device at a yearly charge of only a few dollars because the frequency used is license-free worldwide.[14] Other examples are the European digital agenda for the Internet of Things, which aims at improving the digital infrastructure of cities, the British loT network, which is going to be rolled out as 5G in collaboration with Germany in 2015, and the Sensing China program, which had its official kick-off in June 2010. In the USA, organizations such as City Protocol and Global Communities are working hard on the development of an Internet of Cities. Such networks are needed for the performance of communication and analytics in the functional SMACT layer.

Platform thinking is becoming popular

According to Kristian Kloekl, who is responsible for SENSEable Labs' real-time city initiative at MIT,[15] the city platform not only serves as a basic condition for the Senseable City, but also as a bearer of insight. And for Cities in a Box, the city platform is a major addition to their instrumental command-and-control approach. The essence of the City as a Platform is twofold: it is the infrastructural capacity plus the human dimension, the empowerment of behavior via data and applications. These two aspects are reflected in all the examples of City as a Platform projects that have been realized so far. Cities have high ambitions, also because they have large amounts of data at their disposal. Rachel Sterne, Chief Digital Officer of New York, made a plea[16] in her keynote "Architecting a City as a Platform" speech, in which she emphasized that the city as a (communication) platform is in no way inferior to, for example, Face-

14 http://www.technologyreview.com/news/527376/siliconvalley-to-get-a-cellular-network-just-for-things/

15 http://ebusiness.mit.edu/platform/agenda/slides/9%20Kristian-Kloeckl_City-as-a-Platform.pdf

16 Rachel Sterne at the GovFresh Conference: http://gov20.govfresh.com/architecting-a-City-as-a-Platform-video/

book or Twitter. New York is a city where QR codes and mobile apps are becoming integral parts of the (smart) city, which is largely due to the availability of generous quantities of data:

> *"When we think of platforms and APIs, we think of things like Facebook and Twitter that create an entire ecosystem. Well, in New York City we're sitting on top of one of the largest stores of data and information, probably in the world."*

Considering the success of companies such as Uber and Airbnb – the well-known taxi platform and the bed and breakfast platform – the concept of platforms has apparently become very popular. And because the two services are so deeply rooted in the functions of the physical city, its buildings and its motor vehicles, this is having an inspiring effect on other possibilities for smart city projects.

Renault, the French car manufacturer, is running an Urban Mobility Platform: a booking system for rental vehicles to autonomously drive to the hirer's location (see video[17]), and the city of Nice in France is running a City as a Platform project[18] under the title "Boulevard Connecté." The platform provides urban services in various areas, including those of transport and waste disposal management. It is also open to suggestions from citizens with regard to innovations.

17 https://www.youtube.com/watch?v=jOy_OMPVnyg

18 Connected Boulevard video explanation https://www.youtube.com/watch?v=neVyOTXB4eI

The European Union sees the platform as an alternative to the costly and large-scale technological infrastructure of the ready-to-assemble Smart City. It led to the concept of a Smart City as a Service, an idea that has meanwhile been implemented in Manchester, Issy-les-Moulineaux, Brussels and Tirgu Mores in Romania.[19] If EPIC, as the concept is called, lives up to the promise of its name, we may expect an impact of epic dimensions.

19 http://ec.europa.eu/digital-agenda/en/blog/epic-enabling-every-city-europe-access-and-deploy-innovative-smart-city-applications

7 When will the Internet change our cities?

The Spanish urban architect Vicente Guallart is clear about this: the Internet has changed our lives, but not our cities. Not yet. Entire cities full of the latest gadgets are available and can be delivered on demand (City in a Box), everything that happens in a city can be analyzed and improved right down to the smallest detail (Senseable City), and cities can realize that situation more quickly than anticipated thanks to a software platform with functions in the physical city.

As stated previously: we have been building cities for many centuries, but the digital city is brand new. Facebook was established only 10 years ago and it will take another 6 years before the Internet of Things will reach a substantial tipping point. All these technologies – Social, Mobile, Analytics, Cloud and Things – lead to high expectations, particularly because of the mutually amplifying effect or, as Gartner calls it, the nexus of forces.

The automobile has had a major influence and has left a distinct mark on urbanization and the layout of cities. Likewise, the autonomous automobile may cause cities to be completely refurbished. For example, parking space will no longer be needed in city centers, as vehicles will park themselves on the outskirts. The number of vehicles that need to enter the city can be greatly reduced, because people get around by getting into (and out of) any autonomous vehicle that happens to pass by.

In the summer of 2014, Caros Ghosn, CEO of Renault-Nissan, adjusted his expectations with regard to the autonomous vehicle, which will hit the streets in 2018 instead of in 2020 or 2025, as was the prediction earlier. Apparently, technology is no longer the bottleneck. Thanks to analytics and sensors, cars can autonomously cruise the streets without any problem, but it is legislation that is lagging behind. However, a small step forward was taken here recently: in June 2014, a new rule was added to Article 8 of the United Nations Convention of Road Traffic, saying that it is permitted to drive a car without holding the steering wheel.

The influence of the automobile on urban development

Strong, even explosive expansion is also expected in the domain of decentralized generation of power. On many fronts, smart energy meters, thermostats, and charging points/outlets for electrical automobiles at people's homes will make their mark in urban living environments.

Urban systems will change considerably. Sensors, Big Data Analytics and mobile apps will be fine-tuned to a city's physical elements. As a solution, the platform, the sensory city, or the box will play a major role here. In the next section, we elaborate on this, taking retailing as a scenario. First, however, here are the three elements that establish the smartness of the SMACT forces on the basis of three smart concepts:

A ***Pervasive digitization***

The deep penetration of connectivity in urban surroundings. The Internet of Things leads to an increase in omnipresent connectivity: ranging from people's homes to cars and from trashcans to the LED lights in offices. The smartphones in people's pockets serve as data collectors as well as mobile gateways that enable providers to make all kinds of data services available.

B ***The city as a sensory platform***

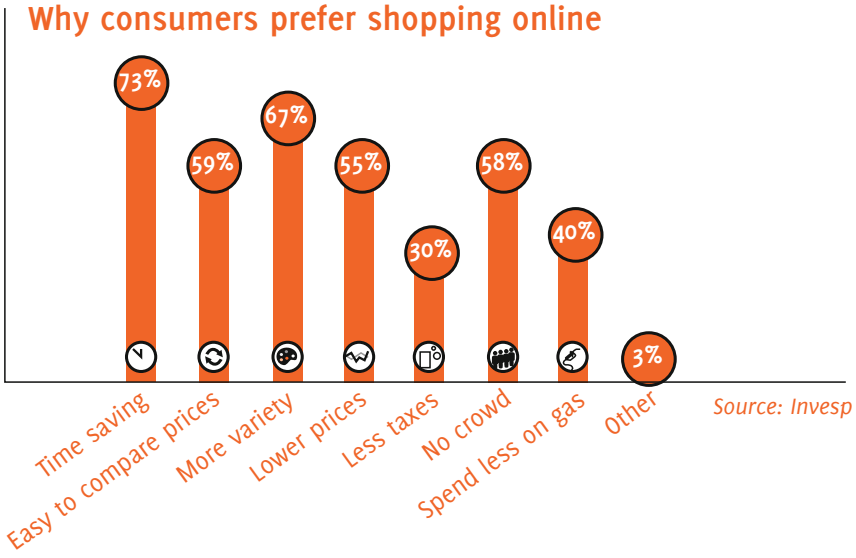
A smart city functions on the basis of a number of platforms on which it gathers data that, having been analyzed, are made accessible to the city's governors, shop owners, consumers, municipal administrative departments, citizens, companies and other parties, by means of apps, dashboards and APIs. Investments in this platform come from companies, municipalities and inhabitants who buy IoT products.

C ***Eye for (digital) human behavior***

By making use of new technology, the smart city will develop a new, higher level of smartness. The way leading to this higher level runs via people's (digital) behavior in the areas of purchasing, driving, environment, power consumption and health(care). SMACT will help us gain better insight into how the city and its people function and behave, which will affect the digitally controlled behavior of the city itself.

8 Urban scenarios: SMACT and the retail

Retailing is all about omni-channel activities, i.e., all ways in which clients want to be served, whether that be at home or downtown. It is important that clients are recognized as such everywhere, via integrated touch points and commerce platforms. Sensory capacities are used wherever there are people. Vicente Guallart says that "currently, the Internet still has to change our cities" but, as a matter of fact, that process has been going on for some time now. The first strike was the online store and the consequent wave of delivery vans that flooded the cities – before long there might even be a wave of delivery drones. Currently, we are in the technological fast lane. The physical urban environment may also benefit from the new possibilities that pervasive digitization brings with it. We hope that this will occur by means of sense & response systems, for, in the retail world, it has been and will always be all about stimulating, predicting and satisfying the potential customer's impulsive buying behavior.



Increasingly and preferably online?

A smart consumer buys his commodities online and in doing so, saves money and time. In 2013, 69 per cent of Americans purchased their consumer products online, 67 per cent bought their books online, and 63 per cent bought their clothing and similar products online. Other products, like those bought in supermarkets, daily shopping products, and cat grit were bought online by 20 per cent. In the Netherlands, online purchases are good for 22 per cent of all consumer expenditure.[20] This percentage surprised even Thuiswinkel.org, the organization that represents the online sector in the Netherlands. The Netherlands has 10.5 million online shoppers, which is three

20 http://www.thuiswinkel.org/persberichten/online-bestedingen-eerste-kwartaal-2014-363-miljard-euro

quarters of the buying public. With online buyers amounting to only 1 per cent of the buying public, the food sector is lagging behind here, but in the UK, for example, this is 4.5 per cent.

In the USA, consumer spending generates one quarter of the jobs there, and it constitutes 70 per cent of the Gross Domestic Product.[21] The growth rates of digital buying behavior are impressive, particularly those of Amazon, which has shown growth percentages of between 20 and 40 for years, with an expected total turnover of well over 80 billion dollars in 2014. In the second quarter of 2014, Walmart, the world's largest retailer, realized an even bigger increase in online sales than Amazon, while traditional offline sales remained steady or decreased. "Online" has firmly embedded itself in the modern consumer's DNA, and this is proving to be a global trend that can also be observed in India and China, for instance. A telling example here is the record sales figure of the Chinese company Alibaba, which managed to turn over 5.75 billion dollars' worth of goods in one day, via its virtual outlets Taboa and Tmall, on November 11, 2013. Early in 2014, Jeff Jordan, a partner in the Andreessen Horowitz venture capital fund, expressed his surprise about the speed at which the process is taking place:

> *"We're in the midst of a profound structural shift form physical to digital retail [...] it's happening faster than I could have imagined."*

By now, Amazon knows so much about its customers that the company could introduce anticipatory shipping, which means that in many cases the company can – and dares to – anticipate which product the buyers of product X will order next, so that the smiling delivery service man is virtually standing on the buyer's doorstep the very minute the latter clicks on the 'BUY' button in the digital order form.

21 https://nrf.com/media/press-releases/retail-sales-unchanged-april-consumers-tempered-spending

This type of Big Data Analytics forms the heart of SMACT: via social sensing and impulses (e.g., recommendations), mobile technology and apps (which facilitate impulse-buying even further), suppliers get to know their buyers inside out. Buyers can collect their purchases at a gas station or a lumberyard or, in time, have them delivered at their home address by drones. In the meantime, Amazon has been given the green light to experiment with drones for the delivery of their goods.

Amazon Prime Air drone home delivery

In an (editorial) article on the Internet of Things entitled "Retail technologies in the sensor economy,"[22] *MIT Technology Review* put the spotlight on these developments, which fuelled the thought that, before long, the digital dinosaur will evolve into a swift, smart bird:

> *"With all the technological tools at our disposal, the retail industry should be able to take an approach that Darwin might appreciate by morphing from a dinosaur to a bird – profitably."*

Shops closing down and returning in a different form

Although companies such as Barnes & Noble, Staples and Gap have been closing hundreds of their outlets since 2011, retail can assume other forms of expression. By now we know that physical Things are equipped with sensory capacities. Thus, millions

22 http://www.technologyreview.com/view/528956/evolving-beyond-coupons-and-mobile-apps-retail-technologies-in-the-sensor-economy/

of square feet of selling space, whole buildings, entire streets, but also buses will be included in the SMACT offensive. Michael Chui, partner in the McKinsey Global Institute, is very positive about this development:

> *"A lot of things we can do online, now, with the Internet of Things, we can also do offline. Bricks-and-mortar-stores have seen nothing like it."*

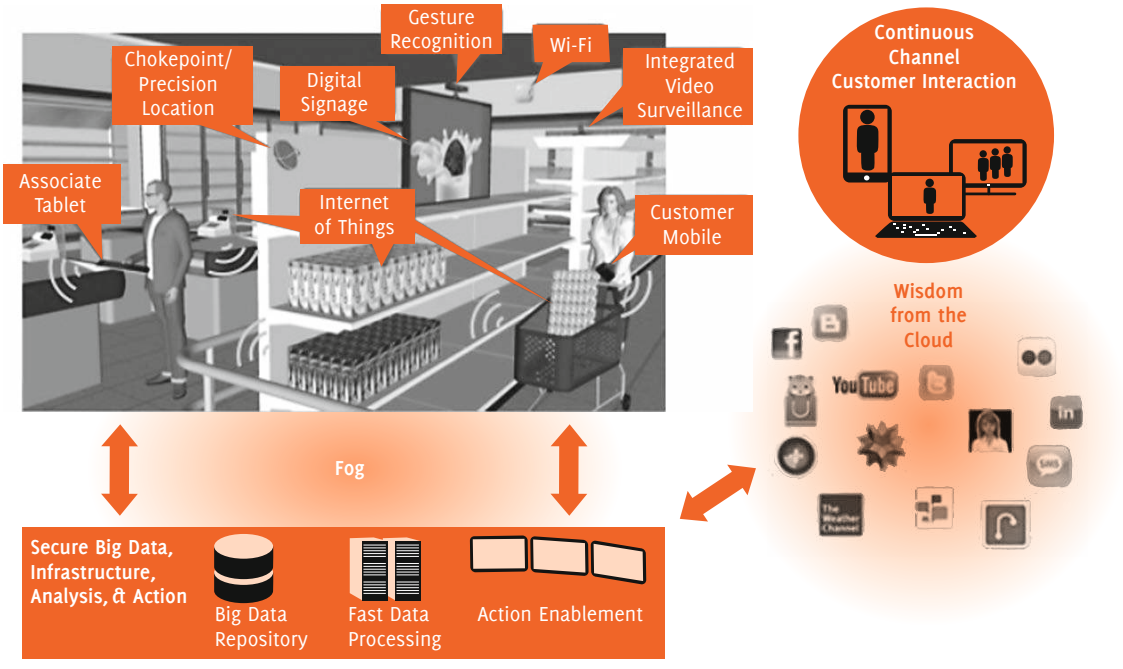
One of the surprising developments Chui predicts is that in the future we will simply walk out of a store with our purchases and the bill will be automatically charged to our bank account. This kind of convenience is likely to make the physical experience of buying things a lot more attractive, it also enables physical stores to fill in their function as distribution points much better, and it might even lead to it that, in a riot situation, looting no longer pays, even in case of a power failure, as the sensors are equipped with cheap but long-lasting (backup) batteries.

The technology stack of the retail platform is being rapidly developed further and put in position. Similar to what the French SigFox company is doing in California, Arqiva is rolling out a special Internet of Things network[23] in the UK, to relieve the pressure on the telephone network there. About one hundred stores are already equipped with the technology to send special offers to shoppers' cell phones when they are in the vicinity of the store. Since it was announced that all the stores there would be equipped with Apple's smart Bluetooth technology, the renowned Baker Street in London has been nicknamed iBeacon Street. Other players and applications are Qualcomm's Gimbal, Android-based Datzing, Motorola's MPact, the Swarm beacon and Philips' LED-light-based beacon.

Beacon	Near Field Communication (NFC)
Beacons are small wireless sensors that send data to smartphones via the Bluetooth Low Energy (BLE) protocol	NFC enables two wireless devices to exchange data via shortwave radio signals over (very) short distances (hence "near field")
Virtually every cell phone is equipped with Bluetooth	Not all cell phones support NFC
Beacons have a range of (up to) 50 meters (150 feet)	NFC has a maximum range of 4 centimeters (1.5 inches)
Beacons work on electricity	NFC can work without electricity
Beacons can send personal messages (push) which are customized according to the client's location and/or buying history	NFC is opt-in; i.e., it has as a precondition that the consumer must agree to enter into the dialogue (pull)

Beacon vs NFC

23 http://motherboard.vice.com/read/the-internet-connected-things-are-getting-their-own-network



SMACT and the store: sensing plus action, as applied in the modern web store
Source: http://omnichannel.me/role-reversal-brick-and-mortar-stores-as-websites/

Similar to Apple's beacons, Philips' new intelligent light system can establish a client's location and communicate with him/her. The information is carried across by the LED light, which flickers at frequencies invisible to the human eye. The information may be "beamed" to a client's cell phone to draw attention to a store's special offer that is displayed on the shelves in the potential buyer's immediate vicinity.[24]

Senseable Stores

The Senseable City for retailing is now under construction. Aimed at interacting with the client, a continuous stream of data is fed by determining the buyer's position in the store, the Internet of Things products on the shelves, an analysis of the client's movements, the wisdom of the Cloud (via social apps), and the wireless devices the client carries.

iBeacon is well on its way to becoming a success. The chemist's chain Walgreens has announced that it will start up iBeacons in its Duane Reade stores in New York. Macy's, Tesco and American Eagle have showed an interest and want to participate. The Berg Insight agency expects that, as a result, the global market for real-time location-based advertising will increase from 1.2 billion euros in 2013 to 10.7 billion in 2018. iBeacon is much more than just a means to send messages to shoppers' smartphones. It can also serve as a virtual shop assistant in supermarkets, showing buyers

24 http://www.zdnet.com/apple-ibeacon-challengers-multiply-a-look-at-five-rivals-7000030830/

the way to the shelves that carry the products on their shopping lists and, at the same time, register the buyer's purchases in the store's stock control system.[25]

The omni-channel challenge for the staff

The retail business is developing in stages from single channel, multi-channel and cross-channel toward omni-channel, where there is no longer any distinction between channel and brand: everything merges together.

Omni-channel: video-buying wall on a subway carriage in South Korea

25 http://blog.bosch-si.com/categories/manufacturing/2014/08/internet-of-things-iot-and-big-data-brought-together-in-commercial-use-cases/?utm_content=bufferf70cc&utm_medium=social&utm_source=linkedin.com&utm_campaign=buffer

The French company Klépierre has developed an inspiration corridor, in which clients can receive suggestions on their mobile device concerning which clothes they might consider buying, based on a body scan via a Kinect camera and iBeacons. Via their smartphones, clients are informed that the corridor can help them find matching items, such as clothes that match the shoes they have just bought.

Omni-channel: inspiration corridor for clothing

The omni-channel approach to the client "as a whole" poses quite a challenge. The seller's organization, staff, information systems, supply-and-delivery channels and communication systems must all be optimal and must be made accessible to the client in the most convenient and relevant way. All computer systems, from supply chain to stock control to POS data, social media and personnel deployment, must be integrated and analyzed to facilitate swift and adequate anticipation of changes in buying patterns, the ultimate goal being an increase of turnover and profits.

In clothing shops and department stores, it is becoming common practice for the staff to carry tablet computers to provide clients with personal buying advice, not only based on that client's previous purchases, style preference, size, and loyalty status, but also on his or her online behavior on social media, for example. The instant availability of this information enables companies to interact with their clients in an optimal way, be it in a store or on the Internet.

Source: https://www.screenfood.com/html/pages/en_references_success-stories_karsadten.html

Department stores such as Karstadt in Germany now serve their customers via in-store interactive kiosks, where product experts can provide any additional information the customer may require. Videos and other information the customer can watch, read or look at in the store, combined with the (expert) information the staff can provide, form the physical counterpart of websites with virtual assistants. The store only needs to have a limited number of demonstration models of a product in its showroom. The customer chooses the color, type and accessories he wants, after which the order will be delivered to the customer's address. Karstadt's experience (and that of other companies that operate in this way) is positive: more sales on one tenth of the traditional shop floor area, and much smaller stocks.

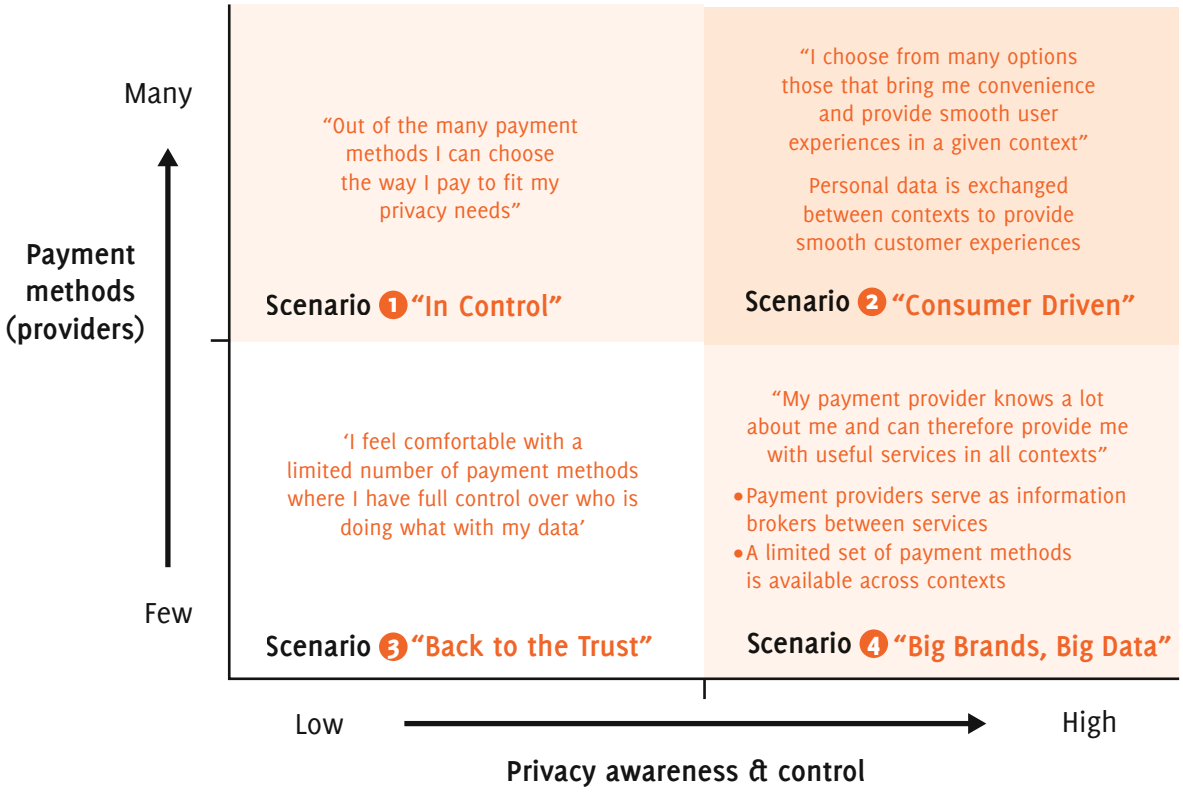
Personal online (data) banking in cities

The digital wallet will play a major role in retailing. Just like on a website, every single customer is individually recognized and treated as a special client. Starbucks, for example, has launched a smartphone app that enables customers to pay their bills, which generates an annual turnover of 1 billion dollars. That is 14 per cent of the company's total turnover in the US. Users can charge the app with money from their bank accounts, pay (Starbucks) bills instantly with the special easy-to-use shake function, get credit points with every purchase they make, receive special personal offers, a "free pick of the week," and so on. Starbucks has cleverly transferred the e-commerce lessons of the PC world into the m-commerce of the modern shopping mall. In this way, it will not be long before Michael Chui's dream in which buyers leave a store like thieves (i.e., seemingly without paying) will come true. A recent report by Forrester states that there is a fair chance that Google, too, will become involved even further in the relation between banking and retailing[26] or, seen from the consumer's point of view, improve the ease with which purchases can be paid for.

26 http://blogs.forrester.com/category/digital_disruption

The bank will become a personal data bank, where the exchange of money and personal information go hand in hand. In exchange for allowing parties to gain an insight into their buying behavior, buyers are rewarded with special personal offers. This was already common practice for supermarket chains, but the integration with the payment function is new. Obviously, this is every retail executive's dream: the city that knows and recognizes you (as a person) and rewards you in exchange for allowing it to have a peek in your wallet. On the other hand, one person's dream might be another person's nightmare.

In June 2013, the international research bureau GFK included this theme in an investigation named Shopping2020, in which the focus was on the future consumer. Amongst other things, the report states that shopping will predominantly become a matter of scanning and that home delivery will become the new norm.[27] With regard to the way in which purchases will be paid for, the report describes four scenarios:



27 https://www.shopping2020.nl/images/2/23/GfK_Consumentenonderzoek.pdf
https://www.shopping2020.nl/images/6/6f/Transaction_Rapport.pdf

The scenarios on the left are rather different from those on the right. Typical features of those on the right: being recognized and rewarded in the public space, personal service, direct contact with one's favorite store and salesperson. Typical features of the scenarios on the left: I am in control and therefore the only one who decides how others may use my personal data. If I cannot control this myself, the banks and payment apps can count me out! It remains to be seen how anonymous or how transparent the Smart City will eventually become. For now, the scenarios on the right hand side of the quadrant seem to be on the winning hand. A far-reaching personalization of what is on offer in the stores and people's shopping experience in the city requires further integration of all SMACT components.

9 Five retail lessons for the Smart City

We now elaborate a few insights and lessons for retailing, as they could be of value to other Smart City domains. Smart retailing starts at home, on the couch, when we order goods on the Amazon or Alibaba platforms, for example. In doing so, we all contribute to changing the urban environment, as it leads to an increase in the number of home deliveries and fewer sales in physical stores. Conversely, the development of Smart and Senseable Cities and Cities as a Platform starts in the streets, with the insight into how traffic circulation in an urban environment can be optimized.

A Omni-channel

Physical and digital experiences will become one integral, smoothly flowing perception. People will be digitally recognized in the streets and their personal experience of buying goods on the web will be extended and amplified in the stores. This poses new challenges to the stores' staff. The balance between the brick-and-mortar stores and the clicks and swipes in the digital city will have to be constantly monitored and adjusted. This not only applies to the retail business, but also to education, healthcare and other areas.

B Fading sector boundaries

Due to the convergence of digital and physical on platforms that integrate all functions, the boundaries between the different sectors will gradually disappear. Only a brand name and a touch point will remain, the rest is irrelevant. Platforms like Facebook and Google are eager to add a payment function of their own to their service assortment. Starbucks is already harvesting billions of dollars with its own payment function, and Amazon is rapidly annexing new markets.

C The consumer decides how fast smart is

The empowered consumer serves as the Smart City's catalyst – first in the retail business, but also soon for the driverless vehicles in our streets, the solar energy collectors on our rooftops, and the computer-aided curricula in our "iPad schools." The changes will be initiated by the consumer, who has adopted and become hooked on online buying. Once a concept catches on, further developments will follow at an incredibly fast pace.

D Sensing technology is still in its infancy

The shopping mall with its sensory antennae is the small-scale version of the Senseable City, similar to the sensors in a production chain. A major aim of smart retailing is to identify, recognize and record people and their behavior on the streets. Communication between a city's citizens, stores and service providers stands to profit from proximity sensing systems such as the new beacon technology. However, little experience with this technology has been obtained so far and, at this point, it remains

to be seen if the push technology will really catch on. Other Smart City applications stand to benefit from the new sensing technology, too.

E Big Brother limits not yet established

The technological possibilities to get to know the consumers and the inhabitants of a city are virtually boundless. In retailing, the phrase "Big Brother Is Watching You" implies that it is possible to make personal offers to individuals. But think of, for example, the smart thermostat: on the one hand, it helps consumers gain an insight into how to economize on their energy consumption. On the other, it enables the energy supplier to monitor what happens behind the front door, in the privacy of people's homes. At this point in time, most consumers do not seem to mind or feel that this is all going too far – which is excellent news for a city with smart ambitions.

The city with a digital shell offers opportunities and possibilities in every conceivable area. The City as a Platform forms the inspiration as well as the (pre)condition to realize these opportunities. Digital platforms have had this digital shell for some time now. Those consumers who shop online receive special personalized offers based on their clicking-and-buying history and their personal profiles. The good old laptop computer is senseable and actionable at the same time. It is the Internet of Things, the pervasive digitization of the city, including the analytics that go with it, the social media and the iBeacon smartphones that make these possibilities available to the city too.

10 Life in the Personal City

We are living in "the Decade of Smart," as IBM's former CEO Sam Palmisano said in 2010. Smart houses, smart traffic, smart stores, smart energy: in this decade, everything seems to be becoming smart, thanks to technology. However, the phrase might equally well be: "this is the decade of SMACT: Social, Mobile, Analytics, Cloud and connected Things." These five elements represent the new digital technologies that are the bricks needed to build the new smart living environment: *SMACT and the City*. Both Smart and SMACT deserve to bear the honorary title of "the Decade of": Smart from the viewpoint of ambition and goals, SMACT from the viewpoint of technological possibilities and implementation. It is precisely the relation between the two that is so interesting and formed the inspiration to write this report.

All in all, we distinguish eleven areas or scenarios where cities can become smarter thanks to (the presence of) a technological platform of which SMACT technology is a part: healthcare, measuring (smart meters), food, traffic, logistics, management, grids, retailing, supply chains, tourism and e-government. Occasionally, the push and pull factors which enable a city to become a smart city appear to clash: on the one hand, we see the desire and ambition of local authorities, retailers, city planners and the conglomerates behind cities like Masdar and New Songdo while, on the other, we see the consumer, the citizen and the patient, all of whom regard the city as *their* city and all of whom would like to see their wishes fulfilled.

How plannable are cities?

There is a tendency toward increasing autonomy on the part of the client, the citizen and the patient. The concept that a city can also be a Personal City, with a different meaning for every individual, is self-evident when we look at the possibilities new technology provides. The smartphone, for example, is an extension of ourselves, and forms a powerful interface with all physical things around us. Empowered citizens, consumers and patients mainly use these tools to keep control of their environment. Just as there are smart cities, there are also smart inhabitants.

We may have doubts about the extent to which a technopolis like Masdar can be planned. Can creativity and unpredictable human behavior be ordered in a ready-to-assemble package? The makers say it is possible, but others claim that it is exactly such developments that cause delay in the growth of this type of cities. Senseable Cities, too, want to make people's behavior more plannable. For example, Carlo Ratti's calculations point out that people could easily share taxis, without too much trouble. But whether these calculations will persuade people to actually do that, remains to be seen. The unpredictability and irrationality of human behavior are factors that are all too easily overlooked.

Just how independent of technology are we?

We would never consider giving up the convenience we derive from our automobiles or smartphones. Yet, this attitude is now being challenged by better alternatives –

driverless cars and improved Internet of Things products. It is an illusion that we could ever be able to do without them. Indeed, once we are empowered, we simply adjust our expectations and drop our wishes and demands at the counter of the store where we do our shopping or at the hospital where we go for treatment. Thanks to smart technology, everything is available anywhere, at ever increasing speed, and the factor of instant availability is becoming a criterion. Technically speaking, the context, in terms of factors such as location or identification, no longer forms a hindrance and, consequently, our expectations of the services that go with it rise.

The Personal City

The Personal City, i.e. the city that regards its citizens as individual people and understands the latter's desire to be – or at least have the illusion of being – in control of their own environment, is the smartest city. Commitment and customer satisfaction are not things that can be imposed – they depend on the participants' perception and experience. The Personal City can also be the city where the citizen is tempted to participate on the basis of these principles, with new services that capitalize on the desire for immediacy, have a personal context, and use technology as persuasive technology – as described elaborately in our investigation of the App Effect. Applied in this way, a Smart City's push and pull factors will converge and make sure that the city becomes a much more comfortable, cleaner, more energy-efficient, more entertaining and safer place to be.

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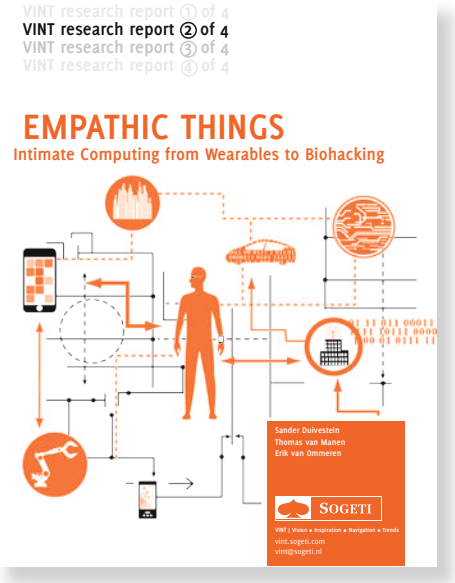

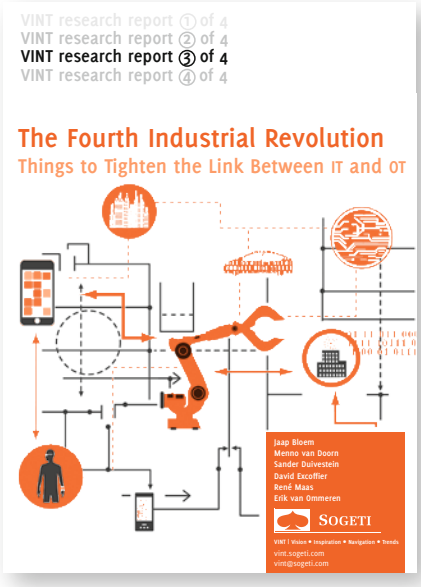

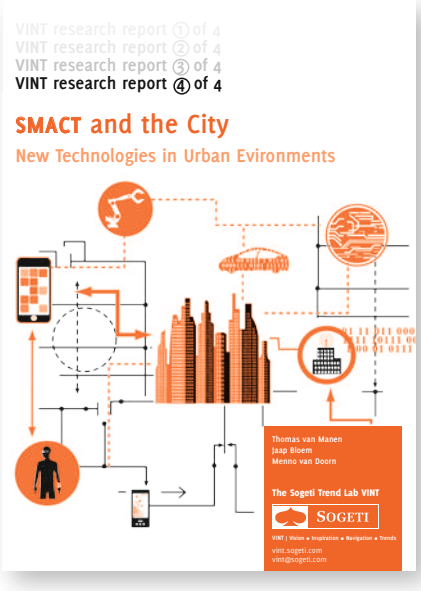

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