

Cities and digitalization

how digitalization changes cities - innovation for the urban economy of tomorrow

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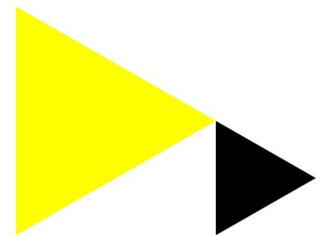
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CITIES AND DIGITALIZATION

DISCUSSION PAPER PREPARED FOR A CONFERENCE ON:

HOW DIGITALIZATION CHANGES CITIES – INNOVATION FOR THE URBAN ECONOMY OF TOMORROW

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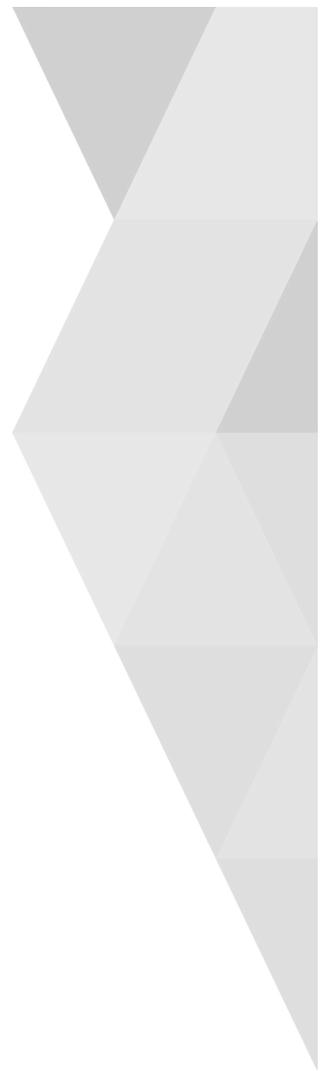
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1. INTRODUCTION

Digitalization – an unfolding convergence of the real and the virtual world – comes in many forms and pervades our societies and economies. The Urban Agenda for the EU, adopted by the Pact of Amsterdam in May 2016, sets digital transition as one of the key priorities to be championed by EU urban authorities, requiring integrated action at the EU level by multi-level cooperation to enforce (European Commission, 2017). The attention to digitalization ranks high in national and international policy agendas as well. In 2016, the OECD held a Ministerial meeting dedicated to the Digital Economy, and the World Economic Forum has developed several initiatives to discuss and act upon the on-going digital transformation (World Economic Forum, 2017).

There are many ways to understand what digitalization is. A narrow one is to think about the development of digital technology and associated industries only: software development, telecommunications, computing equipment and digital media. Yet, that same digital technology increasingly permeates (and enables) each and every other industry and economic sector, driving innovation and changing production and business models – e.g. in transportation, manufacturing, health, retail, energy, etc. (e.g. Kagermann, 2015). Ultimately, digitalization can be seen as a broader and long-term societal transition, affecting the way we work, how we communicate with friends, move in cities, shop, listen to music, do our banking, etc. From this perspective, digitalization is a game-changer with profound impacts in society (in general) and in cities (in particular).

In this short paper, we give an overview on how this major trend is unfolding and, specifically, how it affects cities. We take the following starting points:

- Digitalization is a strong force that “happens” everywhere in the (urban) society. It has positive and negative effects – explored later in this paper –, which might be promoted or redressed by collective action or government intervention. Rejecting or denying it may come at high costs;
- Digital technologies offer new tools and answers to address urban issues;
- Digital technologies and their adoption bring a lot of new and unpredictable challenges;
- Digital technologies raise several new ethical questions and dilemma’s regarding privacy, safety and security;
- As in any other major societal transition, legal and institutional systems are not prepared for the digital age. Reality is always ahead of new regulation, resulting in constantly moving “grey areas” where it is unclear which rules (should) apply – think of how to deal with services like AirBnB or Uber.

What is Digitalization?

The IGI Global dictionary (2017) provides 2 definitions of digitalization:

A societal view: The integration of digital technologies into everyday life. Digitalization also means the process of making digital everything that can be digitized and the process of converting information into digital format.

A technical view: Refers to the technology of digitalizing information. Digitalized information is usually made up of binary digits and can be processed by computers. The computer decodes the digits and generates information that is human-readable.

2. GENERAL TRENDS: WHAT IS NEW WITH DIGITALIZATION?

Information and telecommunication technologies (ICT) and the digital economy have been unfolding in society for some decades now (Carlsson, 2004), and impacting cities and urban policies accordingly (van der Meer and van Winden, 2003; Carvalho and van Tuijl, 2017). Hence, why is there a growing fuss about digitalization now? Four major interrelated shifts¹ can be discerned: the spread of wireless broadband access; the diffusion of smartphones and mobile devices; the declining cost of moving, processing and storing data; and the diffusion of social media and platform business models.

One major change concerns the speed of diffusion of *mobile broadband* access, which is becoming increasingly universal in most OECD countries. While in 2009 only one in four OECD inhabitants had such a connection, this number rose to three out of four in 2013 (OECD, 2014) to become ubiquitous in 2016 (on average – see Figure 1), with many inhabitants having actually more than one mobile broadband subscription.

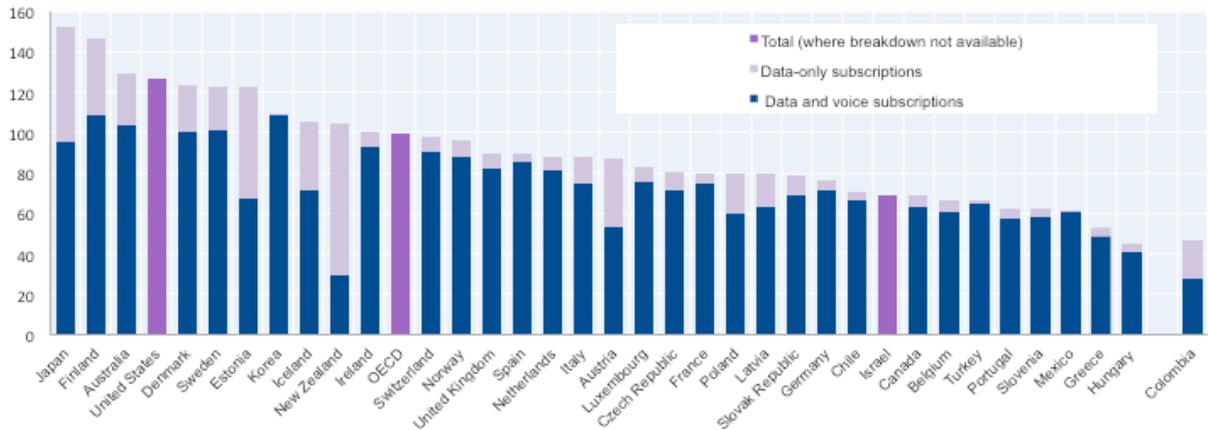


Figure 1. OECD Mobile broadband subscriptions per 100 inhabitants, by technology, December 2016 — Source: OECD Broadband portal.

A closely related trend is the *proliferation of (increasingly powerful) smartphones* in society. In 2013, the number of smartphones being traded exceeded regular mobile phones for the first time (Figure 2). This means that, over the last years, most people started carrying out a microcomputer in their pockets, endowed with multiple sensors and advanced computing possibilities. Together with mobile broadband diffusion, this has been having several deep impacts on individuals and society – e.g. on the ways individuals communicate with each other, how they move in a city, how they shop and access information, etc.

¹ We are not claiming to be comprehensive – please see the recent OECD Digital Economy Outlook for a detailed account of major trends (OECD, 2015)

Smartphones facilitated the ever-increasing generation of data by individuals on a scale never seen before. The *decreasing costs of sensors and of moving, processing and storing data* went in the same direction. For example, over the last ten years, the average cost of sensors was cut in half and the cost of data processing and storage is estimated to have decreased sixty times (Goldman Sachs, 2014). This has enabled the emergence of the so-called “Internet-of-Things” (IoT), with an exponentially growing number of devices being connected to one another through the Internet – e.g. consumer objects, homes, vehicles, wearables, urban infrastructure, energy meters, machines, among many others. These developments have been enabling massive information gathering and new ways to manage these devices, with implications not only for individuals, but also for entire industrial sectors and the ways government services are provided and managed.

The Internet of Things – two examples involving companies and the urban environment

Venian is a technology company founded in 2012, with an eye to develop technology solutions for what they call “the internet of moving things”. Their mobile wi-fi and data solutions allow connecting vehicles in a city to one another through mesh networks to gather massive amounts of urban data and insights on how mobility is developing in a city. The company already holds more than 80 patents and provides technology for many vehicle fleets in the world. They are actively working to deploy their technology to self-driving vehicle fleets (<https://veniam.com>).

Propeller Health is a health software company that developed specific plug-in sensors for asthma inhalers, allowing patients to connect their inhaler to the Internet through a geo-locating solution. This is connected to an app that allows the patient to know where in a city she uses the inhaler more often. This massive amount of geo-located data provides new knowledge on which environmental features are causing the symptoms, delivering valuable information for patients, physicians and urban environmental managers alike (<https://www.propellerhealth.com>).

Another fundamental trend related with digitalization is the rise and diffusion of *social media* and *networking platforms*. Online social networking has grown very fast, both mobile and through computers. In 2013, more than 40% of smartphone users in OECD accessed information through social networks several times a day (Figure 3). As argued by the OECD (2015), many elements of social networking (e.g. having an online identity, sharing content) have been paving the ground for new business models to emerge, notably the ones associated with the so-called “sharing economy” and collaborative consumption. For example, platform-type business models (like Amazon, Booking.com or Uber) use digital technology to intermediate between supply and demand. These firms typically do not own physical assets, but play a central role in transactions, which gives them prime contact with consumers, and access to a wealth of data that they use to optimize their platforms further.

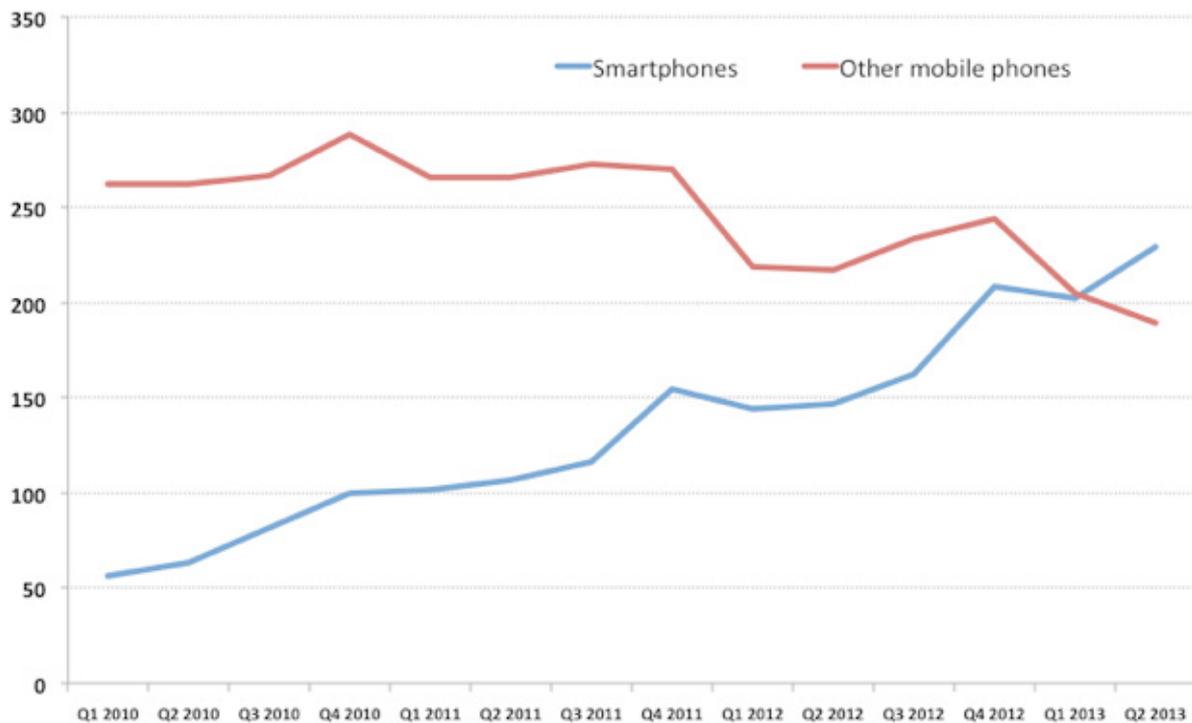


Figure 2. The progress of smartphones 2010-2013 (millions) — Source: Own elaboration, based on data from OECD (2014), using information from the 14 largest mobile producers global sales data (ABI Research).

Recently, two more digital technology developments are starting to make inroads: Blockchain and artificial intelligence.

A blockchain is a distributed database that is used to maintain a continuously growing list of records, called blocks. Each block contains a timestamp and a link to a previous block². Blockchain has the potential to revolutionize contracts of any kind. Using a distributed ledger, participants can share transaction and contract records. This implies that trust no longer needs to be enforced (or verified) using (potentially) vulnerable or expensive mechanisms like auditors, third party intermediaries, etc. Blockchain technology is very effective in industries with many transactions and many parties involved (e.g. involving large supply chains and logistics), but also when reliability is very important (e.g. ensuring safety of the food supply chain)³.

Artificial intelligence (AI) is intelligence exhibited by machines⁴. Recent advancements in AI, and specifically in machine learning, have contributed to the growth of autonomous things such as drones and self-driving cars, becoming the main driver of innovation in the automotive industry. There are many urban applications as well. The availability of data about the city and public spaces is increasing exponentially, thanks to the many connected sensors (“internet of things”). AI can be used to interpret the data and support decision making, for instance on urban traffic

² <https://en.wikipedia.org/wiki/Blockchain>

³ Read some use cases here: <https://www.ibm.com/blogs/internet-of-things/iot-blockchain-use-cases/>

⁴ https://en.wikipedia.org/wiki/Artificial_intelligence

control management. More controversial applications are preventive policing, or identifying suspect behaviour of individuals analysing data from CCTV cameras.

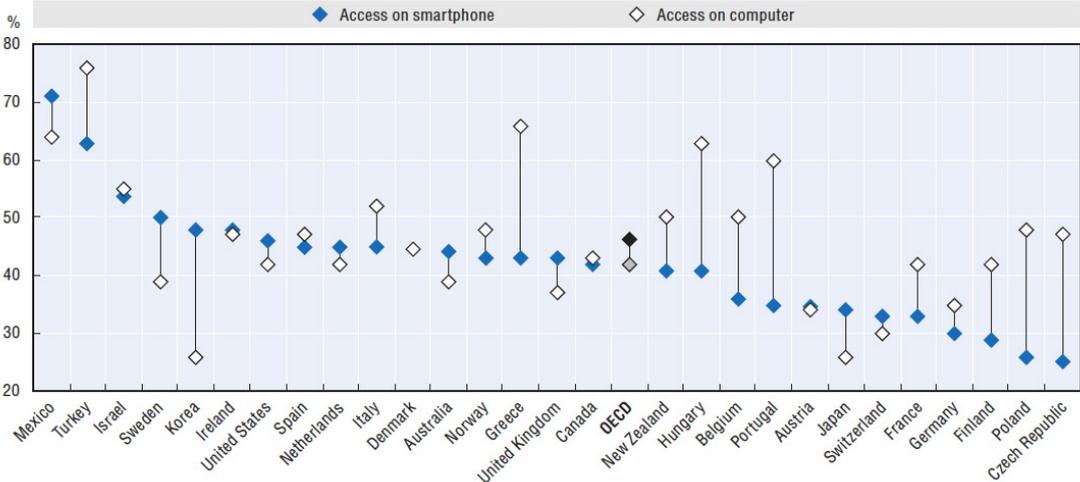


Figure 3. Access to information on social networks as a percentage of smartphone users who use the Internet, 2013 — Source: OECD (2015).

All in all, these trends are driving profound changes in the economy and society. They are linked to industrial change, the emergence and decline of business models, but also to the ways people interact with each other, how they work and consume. Moreover, this comes with a massive data deluge (The Economist, 2010), whose possibilities and threats are only now starting to be explored. Many of these developments and impacts are best observed and felt in cities, which have been developing a new “digital skin” (Storper and Rabari, 2015) over the last years. These developments have many consequences – positive and negative – to which we turn to in the next section.

3. IMPACTS AND CONSEQUENCES FOR CITIES

Digitalization has many potential benefits for cities, which are often advocated by governments and industrial players. Yet, there are also other less positive sides that must be accounted for (see Table 1 for a summary). This is not to say that a balance between pros and cons should be made, or to suggest that governments should try to “ban” digitalization (which is obviously not possible), namely if the balance looks negative in the short run. The idea is that knowing both sides of the coin may help governments and other stakeholders to take proactive and anticipatory action in the face of a fast changing digital reality.

3.1 URBAN ECONOMIC CHANGES

In many European cities, digitalization has changed traditional urban economic activities, which have been gradually moving online (e.g. video and music retail, travel agencies, banking, commerce, etc.). Digitalization is changing consumption habits, with the number of people buying online and through mobile devices rising fast (Figure 5). From the perspective of consumers, digitalization provides convenience and allows for more informed choices and information gathering. However, in the short run, it means that many urban activities are disappearing and ordinary shopping streets suffer the most.

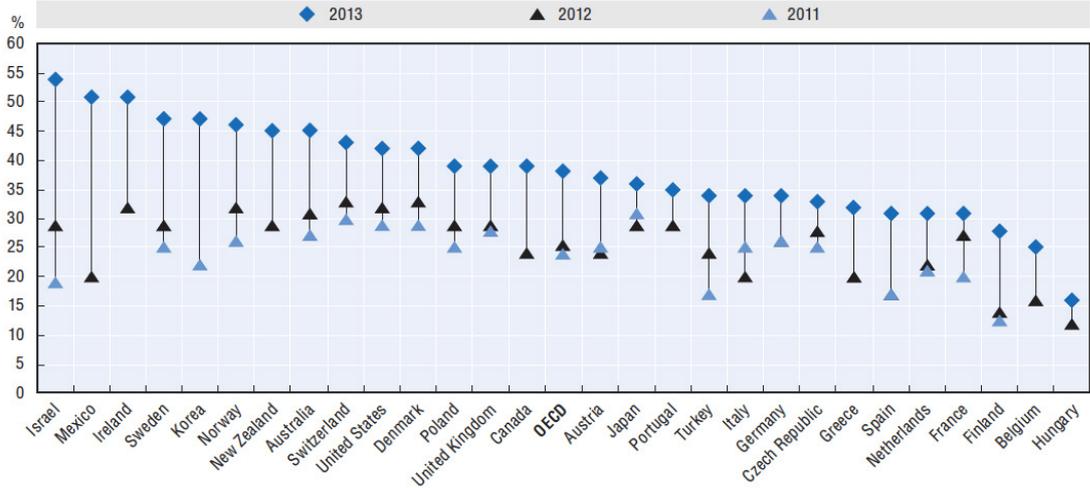


Figure 5. Purchasing of goods or services on smartphones, as percentage of smartphone users who use the Internet — Source: OECD (2015), based on research from My Mobile.

On the other hand, digitalization opens many new business opportunities and creates new jobs. During the economic crisis (2009-2012), the ICT sector – even if narrowly defined (Figure 4) – continued to grow at a high pace, and its value added in most advanced economies is rather significant (OECD, 2014; 2015). This is visible in many cities, in which digital-related activities became very important, not only of large companies but increasingly of startups with good ideas exploring new digital market niches. Big cities and second-tier cities with strong engineering skills have probably been benefiting the most, both from a wave of nascent startups and from new investments in other industries in which ICT skills are increasingly needed (van Winden and Carvalho, 2015). Moreover, namely in Southern and Eastern

Europe, there has been a revival of foreign investment in ICT-related activities and nearshore investments, e.g. related with back-office ICT centres.

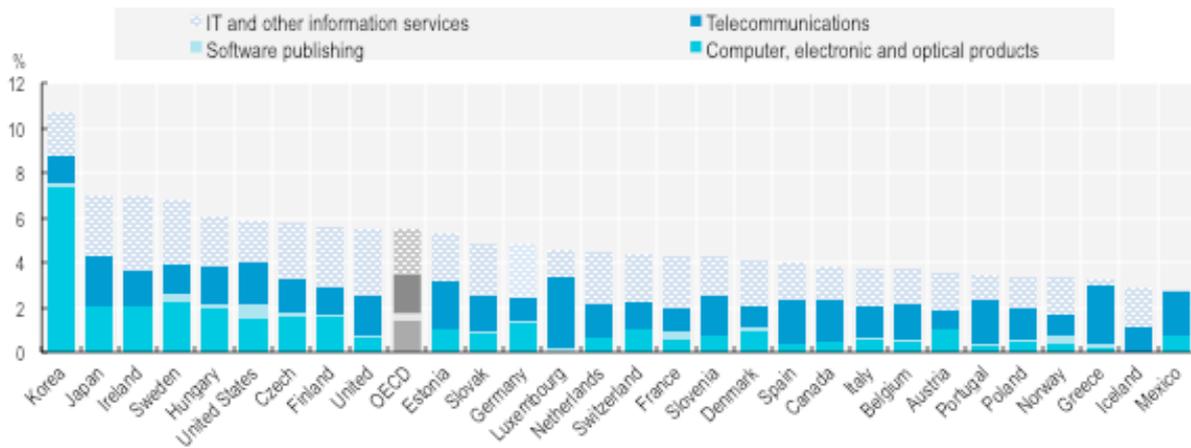


Figure 4. Value added of ICT sector and sub-sectors as a percentage of total value added at current prices, 2013 — Source: OECD (2015)

Digital-related revenue is rising, and new jobs are being created (OECD, 2015). For example, in the more creative branches of the so-called app economy – which is mostly associated with cities – has been estimated to grow in Europe from about 2 million jobs in 2013 to almost 5 million in 2018 (Gigaom Research, 2013), out of which 2.6 million are app developers. Yet, in the short and medium run, the net effect of digitalization on jobs is unclear, and there are many threats. Many jobs are already disappearing, namely the more routinized ones that can be easily replaced by robots and algorithms. So far, digitalisation has already deeply transformed business-to-consumer markets such as music, entertainment, shopping, travel, and finance. The next wave is on its way, in industries like manufacturing, health care and education.

INDUSTRY 4.0

In recent years, we see a growing co-evolution and integration of digital and physical activities. One field where this is very visual now is the unfolding “Industry 4.0”: the development of smart factories, powered by automated data exchange, internet-of-things, cloud computing and cyber-physical systems. Industry 4.0 is associated not only with efficiency improvements in factories (using digital tech and robots to work more efficiently): it also implies major product and process innovations, and may have consequences for the location of manufacturing as well.

In the car industry for example, one can observe major innovations in the field of autonomous driving. The built quality of the manufactured product (the car itself) still matters a lot, but on top of that, information and data handling become ever more important aspects, not only to make the drive safe, but also to add all sorts of additional information services to drivers (dynamic traffic information, info on nearby restaurants, etc.). This puts high new demands on incumbent car producers, especially as newcomers to the industry like Google and Tesla are making inroads very fast.

Another trend, powered by digitalisation, is “servitization”: rather than delivering a finished end product, a manufacturer offers a product as a part of a bundle of services, including maintenance, software updates, online real-time performance monitoring etc.). Philips Lighting is a good example. For its main client Schiphol Airport, rather than selling light bulbs, the company sells a “light solution”: it keeps the ownership of the physical materials, and takes full responsibility of maintenance and recycling. This service orientation requires a new type of thinking and organising in industry sectors, and also sets new parameters for industrial logistics.

3.2 OPPORTUNITIES FOR A MORE EFFICIENT URBAN MANAGEMENT

Digital technologies hold promises to solve – or at least improve – many old urban problems. They can enhance the way a city is run, improve service provision and reduce costs. Sensors, computing and data open up many possibilities that seemed utopian a few decades ago. They allow tracking and anticipating movements (e.g. car mobility and congestion), may improve efficiency and reduce waste (e.g. in water and energy distribution), facilitate urban logistics and can support the development of more evidence-based and anticipatory urban management. Many cities are embedding sensors in urban infrastructure and using video cameras to track movements, prevent congestion, intervene in natural disasters, nudge tourists into less congested city areas, reduce waste and become more energy-efficient. As urban populations grow, digitalization is seen as a way to reduce urban ecological footprints and make sure the city functions efficiently.

Notably, such a move towards what is generally called a “smart city” poses many risks as well (see Kitchin, 2016, for a sensible review on promises and perils of digitally-powered smart cities). For example, the deployment of such technologies also raises risks of vulnerability and security of critical infrastructure; of citizen’s privacy; of focusing on technical fixes versus social-political solutions and citizen participation, among many others. More fundamentally, digitalization also raises the question on who actually controls the city, and what is the role of citizens in it. The development of the (commercial) sharing economy – clearly powered by digitalization –, with AirBnB and Uber as spearheads, raises similar types of issues. While they promise more efficiency, the sharing of idle goods, savings, convenience and lower costs, evidence suggests that their economic, social and environmental impacts must be put into a broader perspective (Frenken and Schor, 2017). The impact of AirBnB in urban touristification and real estate markets, or of Uber championing new types of labour practices are just a few examples to illustrate the point.

3.3 SOCIAL DIMENSIONS

Apart from the job-related impact of digitalization, associated social issues in cities have somehow received less attention. Digitalization is sometimes said to help people participating more in society, namely by facilitating access to information, creativity and empowerment. Moreover, as digital devices and access become more ubiquitous, there are examples of citizens contributing to the development of new ideas to old urban problems (e.g. through smartphone apps), and the development of solutions that are more appropriate to different types of social

needs (e.g. digital solutions to facilitate the life of elderly or disabled population). Many sharing economy narratives also promote it as “social” in the sense that digital solutions may help people with less resources to access shared goods, to share their own and make extra money with it, or even to facilitate sense of community in neighbourhoods by sharing goods and services (e.g. a repair, a tool, carpooling, etc.).

Dimensions	Benefits	Threats
Economic	<ol style="list-style-type: none"> 1. New digital business formation, start-ups, jobs and revenues 2. More convenience, information and consumer choice (e.g. with e-commerce) 3. New opportunities in urban manufacturing 	<ol style="list-style-type: none"> 1. Routine jobs replaced by robots and algorithms 2. Closing down of traditional shops in cities 3. Lack of product and business model innovation in incumbent industries
Efficiency	<ol style="list-style-type: none"> 1. Reduce cost and make urban services more efficient 2. Make urban management more anticipatory 3. Facilitate sharing of goods and services in a city 	<ol style="list-style-type: none"> 1. Top-down and conservative city management 2. Vulnerability and security of critical infrastructure 3. Predatory labour practices and unintended urban consequences (e.g. touristification)
Social	<ol style="list-style-type: none"> 1. Enhanced civic participation and access to information 2. Fitter solutions to different social needs 3. Heightened sense of sharing and community 	<ol style="list-style-type: none"> 1. Digital exclusion in civic participation 2. New social and spatial divides

Table 1. Potential benefits and threats of digitalization in cities — Source: own elaboration.

Yet, the picture is not only rosy. For one thing, many are concerned that, at least in the short-medium run, digitalization will raise and even widen divides in citizen participation, as the digital savvy can participate the most, leaving other cohorts unheard. For example, one could imagine a situation in which people in affluent neighbourhoods can make themselves heard increasingly through digital planning tools (e.g. Fix-My-Street apps) than the elderly and uneducated in other parts of cities. In support of this hypothesis, a report from NESTA (2014) found out that participation in digitally mediated collaborative activities in UK cities vary widely by age, ethnicity and social condition, with the wealthy and educated benefiting the most. All in all, besides facilitating participation and empowerment, digitalization also risks opening up new social and spatial divides in cities.

4. URBAN (RE-) ACTIONS TO DIGITALIZATION

Digitalization is unfolding very fast, and it raises many urban challenges and opportunities. How can cities cope with the tendencies and impacts of digitalization?

4.1 LABOUR MARKET

As said, digitalization has deep effects on urban labour markets. On a structural basis, many mid-level and low-level jobs will disappear (or change to a large extent), especially those that can be replaced by algorithms (Brynjolfsson and McAfee, 2014). Highly skilled jobs are not immune. Routine financial trades are processed by technology and we may have cargo-carrying commercial aircraft without pilots before lorries without drivers. At the same time, there will be a growing demand for high-level knowledge workers, for creatives, for ICT experts and for types of manual work such as personnel services or other jobs that cannot be easily substituted (i.e. in the construction and health care industry). This reshuffle asks for a massive retraining and re-integration in the coming years, in order to facilitate job-to-job mobility. Also, digital skills are becoming more important, which should have implications for education and life-long learning. Cities have an important role to play here, together with employers, trade unions and the education system. Cities need to closely analyse how their labour markets are changing, what skills are needed, make scenarios, and develop new types of strategies. In this respect, Amsterdam set up a “house of skills” project, in which all stakeholders collaborate for greater job mobility.

Porto Tech Hub is an association formed by three leading and fast growing digital companies (Blip, Critical Software and Farfetch) with the ambition, among others, to improve the labour supply in the Porto region. These companies are world leaders in their niches (e-commerce of luxury goods, cyber-security, etc.) and the region’s supply of IT graduates is not coping with their demand anymore, leading to job poaching and endangering the ecosystem. Porto Tech Hub teamed up with the City of Porto and educational institutions to jointly identify needs and develop tailor made training programmes to re-train people from other fields. One example is the SWitCH programme, focusing on retraining graduates from several science and technology fields to work on specific IT segments whose demand is growing very fast.

<https://www.portotechhub.com/switch/>

Moreover, individual entrepreneurs and startups play a key role in digitalization, namely as agile disruptors and creators of new business models (see sections below). Fostering a vivid startup scene is therefore of crucial important to Europe in general, and to cities in particular. Also, there is a need for better connecting startups with existing firms (large or SMEs) that have more

difficulties to radically innovate, and that face the risk of losing competitiveness (Kollmann and Schmidt, 2017).

4.2 DIGITAL SKILLS

Digital skills are in great need, but the education system – on all levels – is slow to adapt, and also further education is needed to empower and update employees with digital skills. Cities need to actively drive the change in this respect, even if they do not have competences in all levels of education. Amsterdam starts a “digital society school” where higher educational institutes work together with industry partners and the city. This School will offer a variety of short specialised “tracks”, applied courses in digitalisation, accessible for everyone.

At the same time, digitalization poses many challenges for the elderly and the less tech-savvy populations. In order to mitigate these issues, many cities started broad digital training programmes for different social segments. For example, the City of Manchester started some years ago a programme of “Digital Champions” to organize a network of volunteers to encourage and support elderly people to use computers and new digital technologies in their daily life. And in order to cater for young people, many cities joined forces with companies, training organizations and other associations to launch coding and programming academies for youths under the risk of social exclusion.

Due to the speed of digital change, the skills to implement many of the aforementioned initiatives are scarce within most city administrations. Some cities have nominated chief technology officers in order to mitigate this situation, but digital skills are far from widespread. Some cities have launched internships and recently hired coders for the city staff. The ambition is often not to turn the municipality into a coding powerhouse, but to train other staff and to be able to interact with external ICT providers and communities of innovators. These have been relevant in order to open city data, and to develop small digital prototyping units in cities, making the most of the possibilities opened by digitalization.

4.3 DATA INTEGRATION AND SECURITY

The amount of data generated is growing tremendously, and more and more city services depend on them. Thus, in the digital age, cities will need to get rid of silos in the field of digital infrastructure and data management. As economy and society become more data driven and data dependent, cities need a clear strategy on data collection, ownership, access, (re-) use, and security. A new infrastructure must emerge out of a complex wood of ICT legacy systems. Such strategy forms a foundation under the development of all sorts of new services that become possible when data from many different sources are shared, combined and recombined.

To do this properly, cities must have sufficient capacity and skills to understand what is needed, and they need to engage in partnership with sometimes powerful and knowledgeable private ICT companies in such a way that the public benefit is maximized. Also, it requires new partnerships between key players in this field: city hall, public transport organisations, hospitals, and private players (e.g. utility companies). Many cities around the world are acquiring “urban operating systems” (Carvalho et al., 2014), developing control rooms and dashboards (Kitchin et al., 2015) to reap the benefits of better data integration and visualization, but how actually those

new types of “computational urbanism” (Marvin and Luque-Ayala, 2017) will impact the city is still to be seen.

Also for privacy reasons, better frameworks are needed as to who can collect, own and use data generated in the public space. The same goes for data protection and security, also because critical public services are increasingly at risk because of hacks. Cybersecurity is a growing issue, and cities must invest heavily in human resources and technology to protect themselves. Moreover, besides technical issues, cities must think deeply about what data mean for cities and the ways they are managed. There are deep social, political and ethical issues and implications associated with the use of data –e.g. the types of data chosen to profile a neighbourhood are not value-free and have implications on the types of policies that will be designed for it.

4.4 OPEN DATA

Together with the need to assure privacy and data security, cities also need to consider how to open some of their data to wider audiences. Over the last decade there was a rising recognition that (non-sensitive) government data should be increasingly available online through easy-to-access formats, namely through open data portals and other sorts of interfaces. Many cities did this in order to enhance transparency and accountability to their constituents, but also to improve efficiency within the administration and promote local economic development (e.g. by facilitating new urban digital services using government data). Some local governments (e.g. Helsinki) make bold steps in this direction and established an “open-by-default” data policy, meaning that all data produced by City (meeting minutes, statistics, data on mobility, planning, the built environment, etc.) must be open and of easy online access (e.g. machine readable), unless stated otherwise.

Opening government data has many potential benefits, but many barriers lie ahead. Opening city data requires technical expertise, breaking silos and vested interests within and outside the administration, getting buy-in from data users and providers, bold political action and continuous action to carve out change in cultural mindsets (PwC, 2014; Carvalho et al., 2017).

Dublinked is a pioneer open data initiative in Europe. It was launched in 2011 with the ambition to nurture a fully-fledged “digital innovation ecosystem” in the city, drawing on the presence of many global companies and entrepreneurs. Dublin City Council’s Executive Manager championed the (innovative and risky) project within the administration at a time of budget constraints. His leadership was important to ensure “connectedness”, both outside and inside the City Council and to deal with legal challenges associated with releasing the data. His leadership was also central to legitimise it within the administration, e.g. by making sure that departments would share their data for a fast implementation. Since the project was backed at a high-level, it could overcome the capture of bureaucratic departments and responsibilities were delegated to a newly created department, with less crystallized routines and interests. This way a group of city managers (with the right technical and communication skills) could emerge and act as central facilitators within the organization, driving the process forward. Moreover, the early involvement of communities of innovators (e.g. through many events and “hack” sessions) contributed to collect knowledge about the flaws, added value and future needs of Dublinked (e.g. new types of data required, visualization tools). Such events contributed to involve “unusual suspects” and individuals not frequently involved in policymaking and urban affairs, such as young entrepreneurs and IT enthusiasts, largely improving the reach and quality of the project.

Sources: PwC (2014); van Winden and Carvalho (2015).

4.5 HACKATHONS AND CHALLENGE-BASED PROCUREMENT

Related with the previous point, cities are wise not to try to digital-innovate all internally, but capitalise on the creativity innovation capacity of individuals, startups and other companies in the city and beyond. Most cities have launched some sort of hack-days competitions in which they ask groups of programmers, together with designers, business people, etc., to think about new solutions and new ways to think about urban challenges, namely by making use of several types of data (open or not). From early grassroots movements and one-off unstructured events, the organization of hackathons has evolved substantially over the last years towards planned digital innovation competitions, backed by external sponsors, venture capitalists and experimentation follow-up in real urban environments (Almirall et al., 2014).

Examples of the latter are so-called “challenge-based procurement” initiatives. A growing number of city administrations are exploring ways to engage startup companies in the prototyping and implementation of new solutions for urban problems and challenges, ranging from reducing bicycle theft, separating waste streams more effectively, promoting tourism beyond the city centre, among many others. By tapping into local entrepreneurial talent and ecosystems, they hope to improve urban quality of life, and simultaneously promote the local

entrepreneurial scene, by opening procurement budgets and experimentation opportunities to startup companies.

Amsterdam is a frontrunner in this respect. Amsterdam's Startup in Residence programme was set up as intermediate structure between the city departments and the start-ups. It is charged with the tasks of collecting and (re)defining relevant challenges from the city departments, organising a competitive process in which startups could bid to develop solutions, and guiding/supporting the selected startup to co-develop and implement the solutions in connection with the relevant city department.

4.6 ENERGY EXPERIMENTATION, SETTING UP LIVING LABS AND TEST ZONES

Digitalization pervades many urban domains and provisions, namely associated with mobility and energy. Most so-called smart city projects and experiments have some sort of linkage among these domains – e.g. using new digital possibilities to improve mobility and test low carbon energy sources simultaneously. For example, large electricity companies have been active deploying smart city pilots in many cities to test new ways to produce and distribute electricity through IT-powered “smart grids”. The idea is to test and develop new knowledge about these solutions, and to progressively embed them in society. These pilots are often deployed in concrete city neighbourhoods (e.g. football stadiums, university campuses, inner city districts, squares, “corridors”, etc.), and often take the form of living labs, in which companies, government entities, knowledge institutes and citizens are involved in experimenting new solutions.

These initiatives have given rise to a so-called “experimental city” (Evans et al., 2016) and aim to develop new knowledge and visualize what new low-carbon, “digital futures” would look like. These projects raise many opportunities and challenges for cities, first of all because local governments are, in general, not prone to work in an experimental fashion, preferring projects whose final results can be controlled and predicted beforehand. In order to reap benefits and develop better test beds, cities need to marry their planning competences and knowledge of the city with the technical-market skill of private companies, keeping a close look into how citizens become involved in the process (Carvalho, 2015). Another key issue concerns the upscaling of developed solutions into broader city arenas and beyond (van Winden, 2017). Finally, in setting up or supporting experimentation, cities are also wise to facilitate experimentation of less conventional solutions instead of picking just the “low hanging fruit” (e.g. IT-powered lightning systems), and to support also experiments of non-corporate players and tech giants – who tend to dominate urban digital experimentation and test zones – to involve also collectives of

citizens, cooperatives and other unusual suspects. The development of clean energy producing cooperatives is an example of the previous.

4.7 MOBILITY

Driven by digitalization, cities will gradually develop new mobility solutions. The current buzzword is “mobility as a service”, providing for seamless and multimodal mobility for citizens, moving away from owning assets (cars, bikes etc.) to renting them on demand. This asks for the creation of new consortia between many players in the mobility system (car renters, public transport, bike renters, parking garage managers, etc.). Also, the ongoing trends towards driverless cars will have major consequences; many experts expect a decrease in car ownership, and a growing use of mobility as a service. This has large implications for the organisation of public spaces and roads. But also regulation must be adapted to the new reality. Cities are wise to experiment in this field, in order to learn faster and prevent big mistakes by making them early on a small scale.

Since 2016, Helsinki residents have been able to use an app called Whim to plan and pay for all modes of public and private transportation within the city—be it by train, taxi, bus, car share, or bike share. Anyone with the app can enter a destination, select his or her preferred mode of getting there—or, in cases where no single mode covers the door-to-door journey, a combination thereof—and go. Users can either pre-pay for the service as part of a monthly mobility subscription, or pay as they go using a payment account linked to the service.

<https://dupress.deloitte.com/dup-us-en/deloitte-review/issue-20/smart-transportation-technology-mobility-as-a-service.html>

4.8 HEALTH AND ELDERLY CARE

Aging is an important issue all around Europe, and digital technologies have the promise to deliver better care, and enable people to live active and independently for a longer period. But often, progress is difficult. New, collaborative and innovative approaches are needed, but they require a high level of organising capacity. Moreover, cities need to be careful not just to promote tech-driven solutions, but dig deep to understand what the real problems are – some of them may be social in nature (e.g. develop networks of care takers) and not to push the latest sensor or digital gadget.

Eindhoven Smarter Living: How Eindhoven managed to promote innovation in the regional health and care sector

In Eindhoven, partners have learned how to do it. In 2011, key actors in the region set up Slimmer Leven 2020, a cooperative with more than 70 members (elderly homes, hospitals, health and care providers, health insurers, housing companies, and public bodies). They jointly develop solutions for distance care, home automation, apps for “self-management”, enabling elderly or chronically ill people to live independently at home. The aim is to improve the life of people, and make the health care model efficient and cost sustainable. The prediction is that at least 2% of savings can be achieved through these types of approaches, and perhaps considerably more. The collaboration also helps innovative companies to develop, test and sell new solutions on a larger scale by offering the population as a willing test bed for new ways of organising.

One successful project is called “care circles”. Its partners worked together to provide a higher quality of care and extra security during the night and weekends for people in need of (unplanned) care. Before the project, each of the participating care providers had its own (costly) night emergency service. Now, they have shared night teams who provide care for every citizen in a specific area during the night irrespective of which care-organization a specific person is a customer of. The hardest part was, in the very beginning to convince the care providers to collaborate. They were not immediately prepared to leave their own silos and give away some control.

<http://www.slimmerleven2020.org/>; http://ec.europa.eu/research/innovation-union/pdf/active-healthy-ageing/partners_conf_slimmer_leven.pdf

4.9 URBAN MANUFACTURING

A big question is how Industry 4.0 will affect cities. Some see a trend of reshoring (plants from cheap labour countries being relocated to Western economies) because industry 4.0 allows for an increased efficiency of production, higher quality and lower lead times, which would favour developed countries. There are remarkable cases (like the new Adidas factory in Ansbach, Germany (The Economist, 2017) but overall there is no convincing empirical evidence for a reshoring trend. While the net effect of job shifts and re-creation has been estimated as (potentially) positive for western European developed economies overall (e.g. Roland Berger, 2016), it is likely that emerging and developing economies will lose millions of jobs (ILO, 2016).

Several commentators (i.e. Kollmann and Schmidt, 2017) stress the possible urban impact of robotization and 3D printing: it would allow for manufacturing in smaller batches and much closer to the customer. That would imply more localised production, in or near cities, and also bring key changes in logistics. For urban planning, a big challenge is how manufacturing can become more embedded in mixed urban neighbourhoods (rather than “put it aside” in suburban production sites), when production becomes smaller scale, more automated, cleaner,

and more knowledge based. Several cities are experimenting with these forms of “urban production 4.0”; Examples are Hamburg’s Billebogen project (in Hamburg East), or AS-FABRIK in Bilbao. The latter case is an integrated approach: it includes to plan a manufacturing hub as part of a new mixed urban zone, but also includes measures to help manufacturing firms with servitization, to improve digital education, and to promote industry 4.0 related startups⁵.

4.10 TOURISM AND LEISURE

Besides manufacturing and technology-related industries, in many cities, tourism and leisure related activities have become a major segment of the urban economy. The tourism market has been growing constantly and also for the decades to come will continue to offer economic and social development opportunities to metropolitan regions, where a large part of the cultural and natural attractions is located. In fact, the UNWTO expects global tourism demand to double by 2035. This offers opportunities but also poses some serious challenges, such as the impact of growing visitor numbers on the urban transportation system and on the residential and social function the cities are performing (in cities like Amsterdam and Barcelona, for instance, the explosion of Airbnb seems to have taken of the market a substantial number of dwellings). Clearly, de-materialization and de-intermediation associated with digitalisation has been having critical impacts on how urban tourism unfolds and impacts cities.

Moreover, cities are experimenting new digital solutions to tackle tourism-related challenges. Managing the growth of tourism requires competences and knowledge about the behaviour of visitors and tourism entrepreneurs. Embracing open- and big data paradigms might help local administrations to manage tourism and leisure activities much more effectively. Using, among others, almost real-time information regarding mobility, reservations made through portals like Airbnb or Booking, security cams, cell phones, payments made with credit cards, and tickets sold at the principal attractions, allows them to manage visitor flows efficiently and timely.

5 <http://www.uia-initiative.eu/en/uia-cities/bilbao>

5. CHALLENGES AND PROPOSITIONS

Digitalization is an on-going socio-technical transition. It is about new technologies, but essentially about how they become embedded in society. As observed in the previous sections, it is already having deep impacts in cities, and many challenges lie ahead. It promises great changes in urban life, but not all of them are necessarily positive; moreover, in order to reap the benefits, cities must act proactively, often in articulation with other stakeholders. Thus far, many leading cities are actively embracing the challenges of digitalization, but much more has to be done. A key challenge is how to cope with the pace of change, in a context where digital skills and organising capacities do not abound in many local governments around the world. Instead of (re-)acting to change, we make the general proposition that cities need to keep innovating and anticipating change in order to deal with the digital urban economy of tomorrow.

In order to stimulate discussion, we wrap-up with a number of propositions:

- To drive digitalization, cities must be more active to promote an urban startup scene and to connect the startups to existing companies in new ways;
- Digitalization implies a shift of power to new platform companies that have headquarters far away, often in the U.S.A.;
- Digitalization asks for a new labour market strategy in which employers, unions and the education system must prepare themselves for an economy with higher job-to-job mobility and a higher need for digital skills;
- Cities need an integrated data strategy urgently;
- The city administration should work to facilitate digital transitions, but also must think deeper about the social and ethical implications of digital technology and data;
- In health care, new collaborations between players (hospitals, elderly homes etc.) is needed to reap the benefits of digital technologies and turn small pilot projects into real implementation;
- Cities must invest heavily in having digitally savvy and socially aware staff that can link the city administration with a growing number of digital civic innovators. Chief data and technology officers cannot do it alone;
- Cities need an overall vision on digitalization
- Cities and universities must develop digital living labs together to make urban experimentation more diverse and reach wider audiences and users;
- All public services must be accessible online and offline;
- Cities must combine data security with data openness;
- Cities are too dependent on tech giants like Google, Microsoft Siemens and IBM, and must act on that;
- Cities must act more like a “lean startup” and thus need a cultural revolution.

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