Innovative Solutions for Creating Sustainable Cities

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This book is dedicated to all the passionate thinkers and innovators that are working to affect change and make communities more livable and sustainable places.

I would like to thank all chapter authors for sharing their stories and ideas, but also for providing guidance in the development of this book.

Finally, my deepest appreciation and love for my family's patience and for feeding my passion by asking questions and continually sharing articles and videos.

Dr. Sylvie Albert

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INTRODUCTION: THE CHALLENGES AND OPPORTUNITIES AHEAD

DR. SYLVIE ALBERT

(WITH CONTRIBUTIONS FROM CHAPTER AUTHORS)

According to research from Goi (2017), more than half of the world's population now lives in towns and cities. From 1950 to 2010, 1.3 billion people live in small cities [*sized at 200,000 to 500,000 people according to the OECD*], 632 million people live in medium-sized cities [*500,000 to 1.5 million people*], and 570 million people live in large cities [*1.5 million+ people*]. By 2050, the population living in cities, especially in developing countries, will have increased twofold. Thus, the problems created by rampant urbanisation are among the most important challenges of our time.[1] They also represent one of the greatest opportunities – and responsibilities – for the private sector, for public and non-profit organizations, and for citizens living in these communities.

Moreover, cities need to contend with challenges that are multidisciplinary, multi-organizational, and require engagement. This changes governance and requires new financial models, new innovations to deal with size and complexity, new solutions that will be people rather than object-oriented. Smart technologies may be part of the answer, but we believe that intelligent collaborative planning will make a more robust difference. This book will provide many challenging thoughts and ideas for city stakeholders (which we are all a part of) to consider in planning its future.

Introduction

How do we prepare for and manage the 4th industrial revolution or digitalization? For the global population movement toward urban centres? For upcoming changes in our economy, socio-cultural fabric, and our

environment?

We think that cities will need to do more than look in the rearview mirror and move beyond using standard practices or digital tools to fix problems. Cities will need to start thinking about how we re-engineer with new technologies and with new disruptive ideas, to find the solutions to our individual challenges and the opportunities that we will want to develop for the benefit of citizens and the environment. As Architect Jan Gehl describes – we need to move away from a single focus on objects (such as cars and pretty buildings), and towards lively, livable, sustainable, healthy, and elderly 'cities for people'.[2]

The world is undergoing the largest wave of urban growth in history. The United Nations predicts that the proportion of the world's population living in cities will grow from 54 percent to 66 percent by 2050, adding another 2.5 billion people to urban areas.

Economic power is shifting - of the 424 cities that will generate over 80% of the world's GDP by 2030, 315 will be in Asia.[3] The OECD reports that the new middle class in China, India, and Brazil will lead to a shift in the economic centre of gravity and account for nearly half of the world output by 2050, surpassing the G7.[4]

Jobs are shifting – a McKinsey report on 2000 job tasks predicts that half of the current tasks of workers could be automated by 2055.[5] That is still 35+ years away, but it will be important for cities to start training to reduce vulnerabilities since even a small shift could have serious consequences in the short to medium term. According to the Wall Street Journal, 4 in 10 workers are unsure if they will remain professionally relevant, but 87% are optimistic about the impact that technologies could have on their jobs.[6] Leveraging this optimism could help us make changes faster.

Agglomeration creates new benefits such as economies of scale, improved productivity, wages, and innovation, but it also creates challenges - congestion, social isolation, waste, pockets of underemployed, and unsustainable practices and systems.

This book provides many different opportunities for planning livable and sustainable cities. In doing so, the intention is to establish a basis for an inspired conversation followed by action by local stakeholders. It is

derived from the work of many thinkers, and a journey which many of us have been involved with for decades, including city officials, governments, urban planners, researchers, engineers, architects, and the private sector. What this book seeks to capture are the issues, challenges, and opportunities that politicians, economic development professionals, community stakeholders, and policymakers now need to address. Cities are increasingly recognized as the main engine for change and have an opportunity to think creatively about its future.

Cities need to tackle a wide range of problems, from hindering conditions in urban slums to the lack of basic services such as clean water, sanitation, food insecurity, inadequate housing, and broadband access. The exclusion of the poor from the city's socioeconomic fabric, the management of natural hazards and pollution, disenfranchised cultural groups, loneliness, and economic inflection points that threatens employment are all serious issues that need to be dealt with at the local level. There is not one solution for all, but how quickly we deal with these issues will make a difference in competing globally as livable cities.

The Challenges and Opportunities Ahead

Currently, cities are not efficient. We still think in silos and 'smart city' concepts are largely based on layering technology to fix problems in silos. We really need to start thinking about the city as a biological system[7], as a web of networks (global and regional) that need to be developed and enhanced to become more effective and efficient. Resources are not always the problem, we could do a lot more with what we have if we collaborated and shared resources, a vision, and a plan, rather than think about building yet another body or a program to handle a new issue. Some interesting examples of governance and financing are offered in Chapter 5 and 6.

Some things we should perhaps recognize about cities….

Almost **everything starts with the city**… Very seldom will you have a fairy godmother (usually a government agency) come over and 'Zing', give you that thing that you want or need. Cities have to fight for and build schools, hospitals, industry, knowledge workers… The community as a whole (not the municipality or government on its own) is the **point of convergence** or the focal point for anything to happen.

At a very basic level, a community has to ensure two things: it has an **Infrastructure** that is effective, efficient, and sustainable, and that its **people and organizations** are productive and have access to a good quality of life (which includes health, education, and so forth). These are elements controlled by diverse stakeholders – they are not the responsibility of a single organization. Which means that **to keep it in balance**, we need these diverse stakeholders to play well together… a **collaborative environment** that builds, envisions, and fixes things together. New open source environments and distributed sourcing concepts are allowing cities to crowdsource, crowdfund, develop commons to share knowledge[8], and provide free access to intellectual property in books and research. This represents an opportunity to think unconventionally about how to solve problems and engage citizens (Chapters 6 and 7 provide some excellent examples).

For any team(s) of local stakeholders to get things done (this includes municipalities, other governments, and NGOs, industry, health & educational institutions, innovative thinkers and activists, and local citizens), they **need data and engagement**. Data, to figure out what doesn't work or whether a fix has worked. Data is the new source of 'energy in the modern city'.[7] Engagement is important because solutions and access to resources need a variety of stakeholders including the public. After all, why create an application if no one is willing to use it? This again means that we need to share and make decisions based on a common vision, rather than operating in silos. What more could your city accomplish if it aligned its resources rather than duplicating and wasting?

Being smart is step one toward becoming intelligent. **Smart** is about using technological tools to become **more efficient**. **Intelligent** is about making tough decisions to become **more effective**. Adding sensors on traffic lights or cameras to control speed through fines may be more efficient (and even add revenues) but does little to solve the growing congestion problem or build quality of life for people. In intelligent cities congestion is solved through mobility-related initiatives – enlarged pedestrian and bicycle spaces, on-demand public transportation and shared rides, flexible work, and in the future – autonomous vehicles. In my humble opinion, it is not an engineering problem where we widen streets for cars that continue to be driven 80% of the time by single riders; nor is it about building further out into suburbs, an infrastructure that we cannot afford long-term. Intelligent

cities can plan solutions that are cost-effective, greener, more inclusive, make use of technologies, and enhance the quality of life.

Related to all of the points above, with an economic, socio-cultural, and natural environment in turbulent change, we need to be able to react appropriately and quickly to change. This may mean that we disrupt the status quo. Since change is difficult, we need **courageous leaders** at the wider community level to help us implement intelligent city agendas. These leaders need to be able to inspire and work with significant support to guide a transformation. Some may come from the ranks of politics, but let's remember that political terms are short and sometimes constraining. Since many initiatives may be long term, we should draw from a larger pool of leaders to help guide change.

With significant changes occurring as a result of global warming and digitalization, this urbanization is a challenge both for cities in emerging countries and from developed countries. For example:

The need for smart infrastructures. The first hurdle is our growing need for new infrastructures (roads, housing, public service buildings). For the renewal of existing infrastructure to become in tune with current technologies and environmental factors, there are many issues that may need to be addressed: building for extreme weather conditions, expanding broadband and wireless infrastructures, improvements to buildings to create efficiencies (smart systems), and remodeling buildings for new purposes (such as those left over from the disappearance of some industries). To each of these issues, there are innovative solutions that will be attractive to different communities, but also that will mean change and adaptation.

The need for building sustainable environment models.[9] The world has to face the question of sustainability and cities can and must play a significant part. Cities generate approximately 70% of worldwide CO^2 emissions and are the primary cause of air, water, and environmental pollution, and the key places of consumption. Cities are also exposed to an increasing number of risks due to climate change, those risks will affect a large part of the global population. For example, the frequency of severe weather conditions causes damage to buildings, infrastructures, and agriculture. In Miami for example, roads have been uplifted several times already to meet rising water levels and will continue to negatively affect

the city. We have also heard of several examples of flash floods in largely cement-based cities, where water is not absorbed quickly enough and is causing security concerns as well as severe damage. Extreme weather conditions also have negative effects on people's health (e.g. heat or cold-related deaths) or bring about new challenges in managing wildlife, thus the cities affected by those climatic changes need to craft strategies and means to adapt to those new risks and begin to change a culture of excess and inefficiency that exacerbate the problem.

Paradoxically, economic growth is also a source of risk. The consumption and resource consumption that accompany the development of the economy and society need to be tackled in cities. As resources are consumed we experience shortages, overloads, and the destruction of ecosystems (i.e. biodiversity), these lead to overpriced goods and a further shortage of resources (financial and human). This can restrict the ability of cities to invest or attract investments. A variety of solutions on growth are offered throughout the book, such as better using telecommuting opportunities (Chapter 17); encouraging the development of a circular economy (Chapter 15); or using nature-based solutions (Chapter 16). Development and economic growth needs to become more accountable and sustainable now and for the future.

Citizen engagement is critical to the success of smart cities. These initiatives are not about single improvements such as mobility or better access to municipal services. A smarter or intelligent city thinks about all of its strengths and weaknesses and how technology and people can help to solve challenges. Many reports have pointed out that citizens need to play an integral part in making cities more livable and sustainable[10]. Some of this involvement can be facilitated through technology platforms (such as linking people through a phone app), but others will necessitate a change in culture (such as rethinking conventional ownership of a car or innovative ways to re-use). As pointed out in an open access report by Gartner, to develop smart citizens, the focus cannot be only about the use we make of technologies but about the "enhancement of services and experience toward a valuable outcome […] citizen-government dialogue is a key component that will ensure that the right issues are tackled"[10]. In addition, we have proposed that the concept of a quadruple helix (government, industry, academia, and civil society) working together should be expanded to include the environment, so that whatever we

decide to do to improve cities will include the long term sustainability of Mother Nature.

To keep pace with the changing needs of citizens, and the development of new business, cities are now striving to become not just smart, but also innovative. Some are using a portion of their yearly expenditure budgets to encourage local innovators to propose and pilot new designs and processes. Machine learning and chatbots are being used to engage with citizens or with infrastructure to provide new data that can help us make better decisions. Some cities are using disruptive technologies like AI for elderly care, autonomous driving, or delivery bots. In addition, there are emerging uses for blockchain in more than transactions and record keeping. Understanding the importance of data and its management systems, we have provided some explanations on how data science works in Chapter 4.

Technology is expected to replace a large proportion of jobs and create new opportunities – as many as 58 million net new jobs by 2020 according to a 'Future of Work' report[11] and the World Economic Forum.[12] It will allegedly expand our lifespan and threaten our middle-class.[13] Although technology creates a number of benefits lets remember that it also opens the door to risky behaviour. There is a continuum of ethics that need to be discussed and risks to be abated. In Paris for example, police headquarters can take hold of all cameras (private and public) to follow an event. Using a combination of technologies run by a math algorithm, the artificial intelligence system can detect abnormal behaviour from smart cameras. When used to solve real crime, most of us would identify this as a positive impact. However, we know that this technology can also go too far – but what it too far? In another example, biometric data has raised a number of questions – the collection, ownership, usage, and security are important topics for community discussion.

Digitalization and its Impacts

There are options in managing growth for urban centres, in developing sustainable opportunities in an age of disruptive change, and in developing livable and sustainable cities for people. We can continue to apply engineering solutions by building bigger and broader, or we can gather our network of resources to think critically about solving some key challenges in a more effective way. The real **future** needs of citizens and organizations

need to be considered – an aging population, a population living longer, the reduced lifespan of our businesses, the growing demand for flexible work, the financial health of upcoming generations, the need for people interaction in accessible, green, and public spaces, the need to reduce our carbon footprint, the changing demographics of our cities, future need for food and energy, for countering loneliness, for affordable and good housing, and for planning the changing nature of our economies – these are all questions that need more than an engineering solution, they need thoughtful and network-based strategic action using the best of our technologies and innovation (Chapter 11 and 12 provides some lessons from failed experiments and thoughtful examples for consideration).

Emergent and disruptive technologies are poised to radically change how we work and live. It already has, every citizen connected to the Internet can find out how to do almost anything by themselves, how to take better care of their health, learn and share what they have learned. Technologies will continue to transform our cities and workplaces, shifting jobs and entrepreneurship in new directions, and spurring new ways to manage our lives. All of society will be affected, up to and including how we interact with machines themselves. Sophisticated machines and applications that communicate online will accelerate demand for broadband internet and challenge existing information and telecommunication norms.

All of this will require ongoing discussions about security, infrastructure, how we use data, and plan for livable and sustainable environments now and in the long run. We need to move past: "We know it's coming and have to do something" to "Here is how we can implement and collaborate to make it happen with the least disruption and the most beneficial impact for citizens and the environment".

The question of where we are going with digitalization is puzzling, but nevertheless critical to discuss in its entirety in terms of its impacts, opportunities, and change management. There are several examples of 'out-of-the-box' thinking about what cities could do, for example in Barcelona (Spain) where community activists are working on a fabrication city[14] (described in chapter 15 of this book), where "we might step away from importing most things into the city and export our waste, and instead introduce a circular model, where all resources flow in a closed-loop system within the city itself." If cities are able to produce themselves many of the items that are currently imported by downloading design

specs from the cloud, what changes or planning needs to occur to make this happen? The UN documents cities that focus on food production[15] to improve the food security in urban and rural areas, another important aspect of making cities more livable and sustainable. This book will describe several examples of cities that work on important initiatives, such as reducing CO2, improving quality of life, becoming more walkable (see Chapter 14) and with viable options for transportation (see Chapter 10), more condensed (see Chapter 13), more attractive for teleworkers (see Chapter 17). These examples are meant to expand our thinking around what needs to happen in the planning of future cities.

Digitalization impacts every sector, thus it plays a large part (but not the only one) in the new ways we need to envision and work collaboratively to make cities more livable and sustainable. The World Economic Forum white paper on health[16] for example, identified four key trends: smart care, care anywhere, empowered care, and intelligent health enterprises that will provide much more flexibility and self-management opportunities. Robotics, wearables, and AI will be among the tools to increase efficiency and effectiveness in health care (see Chapter 8). Health care disruption has been slow to show real progress where it needs it the most, but is beginning to take hold.[17] IBM's Watson, Intel's deep learning for diagnosis, Dell, HP, Apple, Hitachi, Luminoso, are only a few of over 826 companies identified by the Medical Futurist in 2016 using AI technology in health care.[18] Health innovations are wide-ranging, alter egos are being created as brain-controlled wearables,[19] and we have a growing amount of research and uses for implants. Although difficult to forecast what will happen, we still need to think in terms of how we will deliver health care in the future so that we prepare the groundwork and avoid investing in a mature service concept.

Wearable fitness devices with personal plans link us to team members to set and achieve group goals, robots vacuum our floors and personal robot assistants will increasingly grace our homes because they perform tasks that we as consumers want and these options are becoming more affordable. We can build our own chatboxes to have conversations with robots and befriend an AI application to share our deepest thoughts. These technologies are changing the way that we live our lives and adding new tools to meet personal challenges. They are also creating new needs, eliminating others, and evolving new ways of delivering services.

Robotics and artificial intelligence (AI) will "permeate a large part of our daily life by 2025 and affect most of our industries," as reported in a Brookings article.[20] We see some of these industry changes today - robots already perform tasks as diverse as dispensing frozen yogurt in malls, monitoring rail systems, and keeping millions of elevators running smoothly worldwide. Of course, automation has good and bad sides. Drones, for example, can pose threats to privacy but also have benefits as new delivery carriers, as cellphone service providers in disaster areas, as "quadcopter" to provide imagery to firefighters, or as airplane safety inspectors.

Even education is poised for change (see chapter 9), at a recent smart cities conference, I met a robot being used to interact with students in primary schools. Robots are used in labs in post-secondary institutions but it is only a matter of time before they are tutors, providing testing and evaluation services, and even teaching. AI can certainly provide a much greater array of content and can disseminate content to a much larger population at once or in sequence. These technologies will not replace teachers and professors, since we do need humans to interact and innovate, but they will play a significant role in delivering content in the future. Our chapter on education will provide additional perspectives particularly around what needs to change in education going forward.

Over the next five years, more than a million new mobile broadband subscribers will be added per day worldwide, according to Ericsson's 2018 mobility report.[21] More people have multiple mobile phone subscriptions, and more will choose mobile (95% by 2023) over conventional wired, landline options. Desktop computer demand is now flat in contrast to the growing demand for tablets, laptops, drones, smartphones, and other mobile gadgets, causing broadband internet subscriptions to increase exponentially. This will strain our broadband infrastructure as we expand the Internet of Things, in which every object has a wireless chip that connects it to everything else. Ericsson further reports that by 2023, 20% of mobile data traffic will be carried by 5G networks.

The number of connected objects — including sensors in cars, wearable devices, electricity and gas meter readers in homes, point-of-sale terminals in businesses, and drones — is already at 26 billion devices, according to Statista[22] and will grow to 75 billion by 2025. Demand for sensors in fixed locations such as our homes (security cameras and motion sensors,

smart fridges, meter readers, etc.) continue to increase. They save money and labour, and make our lives easier and safer. The volume of devices will give us a lot of data to analyze, which calls for improved policies on security and privacy as all of these home and wearable sensors monitor our personal spaces (see Chapter 2 for details on disruptive technologies and concepts).

As noted earlier, the addition of another 2.5 billion people to urban area[23] will create new challenges and stress current models of development. We may have to rethink the way that we plan cities, the way that we live, how we educate, and how we provide affordable and good housing to name a few systems in flux. On the topic of housing, some cities are in-filling and allowing narrow housing and granny-style mini-homes to enter the realm of allowable property development. The greater focus by some European countries on coop housing may be another solution for communities (see Chapters 5, 6, 11, 13 for more information).

We are finally seeing a small improvement in telecommuting (see Chapter 17). This flexible work option has been possible for 20 years but slow to take hold. This is mostly due to our desire to hang on to old paradigms despite an increasing proportion of knowledge workers and our need to lessen our carbon footprint. As with any change, it is possible to go overboard and the rise of the Gig economy can create slums and underemployment. This is why cities need to be proactive in their policies, planning, and programs on development.

We are seeing some change in thinking around the paradigm between space for humans and space for cars. Cities in Europe and Asia, for example, are focussing on pedestrians and shared mobility options. Several chapters will provide visionary examples of cities attempting to shift the way that we have historically planned and managed our responsibilities toward new ways of thinking (see Chapter 10, 13, and 14 as examples).

All of these changes and applications have been termed the fourth industrial revolution, a blurring of the lines between the human and the digital. It means that new players are entering the market and offering very different alternatives to living our lives and planning our cities. Airbus' new concept merges a car, a drone, and a train all in one[24] and cities worldwide are developing micro-grids or city scale discrete grids powered

largely by renewables.[25] Change is happening so fast that we need to think more holistically about our next steps before we build infrastructure that will no longer be needed in 3-5 years.

Cities – Some Interesting Examples of Strategies

There are many things we could learn from one another and the following are a few examples provided throughout the chapters of this book:

a. Barcelona and its Fabrication City Concept. Why transport things from far-away locations when we have tools such as 3D printing that allows us to fabricate locally? We can find innovative solutions to age-old problems – a house can be 3D-printed for $4,000 in as little as 24-hours and social innovators are rebuilding devastated areas and making the technology available to other transformers.[26] The 3D printed car went into production in 2018.[27] GE announced that its turboprop engine will have 1/3 of its parts 3D printed from various metals.[28] These represent a decline for industries producing parts, but also an opportunity for cities to develop localized manufacturing and decrease the impact of transporting goods long distances.
b. Copenhagen whose pedestrian strategies have transformed their metropolis for people rather than cars, and has become a place where people love to walk. Eindhoven, in a similar stream, was nominated as the best cycling city. Toronto's (Canada) waterfront land has been remediated for public green spaces in the downtown area, is cleaning water, and using nature-rich ravines to educate youth. These cities are attempting to move the attention toward livable urban spaces for people.
c. Issy-les-Moulineaux and its digitalization agenda attracted more jobs in media and digital technology than it has in residents. It has an open data environment, a smart grid with renewable energy serving 10,000 of its residents, a cluster of artists working together at the digital Cube, and a smart mobility system. An old Fort was transformed into a digital eco-district working on home automation, geothermal energy, and air-powered waste collection systems.
d. Edmonton (Canada) turned a waste problem into an opportunity. "Children hold their parents accountable" according to contributors in a David Suzuki video, and the city expects to divert 90% of its waste from landfills. They are producing energy, composting, and

re-using materials. Similarly, Windsor (Canada) is planning to use carbon dioxide from its tunnel to the USA to grow algae and turn a negative into an opportunity to produce clean energy and reduce emissions.

e. URBINAT is a European project where several cities are providing derelict and public spaces to co-create new urban, social, and nature-based solutions within and between neighbourhoods. These projects must be cost-effective, resource and energy efficient, and resilient to change. It is an example of urban regeneration, using innovation and new business models, driven by sustainability as its key. For example, they are building urban farms and community gardens, converting old rail lines into green spaces, and using new concepts for social housing.
f. In Kenya, M-Kopa offers rural Kenyans a solar kit at a very reasonable cost to meet energy needs.
g. Wasteless, a company founded in New York and Israel is helping to manage food waste thereby saving money and diverting from waste sites by providing good quality food where it is needed.
h. In Montreal (Canada), McGill University, Les Jardins Suspendus, and Santropol are producing fruits and vegetables for local distribution from natural greenhouses in previously closed down industrial areas.
i. Nairobi[29] is using nature-based solutions to answer its water shortage problem - moving toward sustainable agricultural crops, using cover crops, and rain gardens. Similarly, in Louisville, Kentucky, the community is planting trees in lower-income neighbourhoods to provide better canopy cover as part of an effort to prevent medical problems (such as heat stroke). In fact, 33 cities and organizations in Europe, South America, and China have launched a 'Clever Cities' project which uses natural intervention such as building new green spaces to address social, economic, and environmental problems.[30] The World Bank and the Global Environment Facility have launched an urban sustainability framework to help cities in this regard.
j. Canada funded a smart challenge program, asking municipalities to use data and connected technologies to fix a problem of their choice. This has encouraged multiple and varied stakeholders to come to the table to talk about how we make our cities more livable and ways to collaborate to accomplish objectives.

k. Europe has an advanced perspective on making cities livable and sustainable, and a wide variety of initiatives in support of smart cities: the Innovator's Forum[31] provides video descriptions of initiatives in several cities, the European Commission[32] has defined policies and strategies with regards to smart cities, there are universities regularly updating research on smart development, and associations such as European Smart Cities[33] who share their knowledge on projects, and there is a marketplace for European Innovation on Smart Cities and Communities[34].

These are only a small handful of examples meant to further spur discussion. Thankfully there are many more cities engaged in some pretty exciting and intelligent initiatives.

What you will find in this book

Section A: Technological platforms and governance of the city - in this section you will find some explanations of technologies, governance, and financing mechanisms as well as what describes a city as intelligent over smart.

Chapter 2: Technologies and Cities (Dr. Sylvie Albert) will provide an overview of the various technologies and new business models that cities will need to think about now and in the future. Several definitions with examples are provided to better acquaint the reader with concepts and functions.

Chapter 3: From Smart to Intelligent Communities (Dr. Sylviane Toporkoff, Dr. Gerald Santucci, Dr. Sylvie Albert). Today, all major countries in the world are developing both private and public strategies to provide a better and more connected life to citizens and make cities more sustainable and efficient. Smart Cities have recently evolved from a collection of discrete flagship projects to a sizeable market opportunity that will drive significant technology investments in coming years – according to IDC, smart city technology spending across the globe is anticipated to hit $135 billion by 2021. Smart cities apply information and communications technology to accurately monitor, measure, and control city processes, ranging from transportation to water supplies, to the performance of electric grids. Intelligent Communities adopt and use technologies but do not make it

their focus. Instead, they find vision-driven, community-based, and technology smart solutions to their most urgent problems. All Intelligent Communities are smart cities, but not all smart cities are intelligent cities!

Chapter 4: Data Excellence and Networks (Dr. Walid el Abed) will explain how data science and systems are evolving, how they are fundamental pillars for establishing the human-machine dialogue, and are a key to surviving in the digital era. We are heading to an era where linear thinking has no place since the myriad of possibilities for the creation of our cities and our enterprises is limitless and every scenario is possible. The value creation ecosystem in the industrial era vibrated at the physical speed of the machine while in the digital era it vibrates at the quantum speed of thought. How we manage data will be a crucial part of everything that happens in a community.

Chapter 5: Urban Governance and Financing (Dr. Luise Noring, Dr. Jeremy Millard, and Dr. Marie Nicole Sorivelle) evaluates how the interests of different actors are best aligned and marshalled to achieve successful results, which ultimately comes down to governance and finance. On the one hand, collaboration brings many benefits, not least in terms of additional finance and other assets, as well as through the consideration of a wider set of competencies, ideas, and experiences. On the other hand, many actors within cities can slow decision-making, increase bureaucracy and organizational inertia, and thereby degrade efficiency. In this chapter, the focus is on the roles of the public and private sectors, whilst in the subsequent chapter attention switches to civil society.

Chapter 6: The Role of Civil Society in City Governance and Financing (Dr. Jeremy Millar; Dr. Luise Noring, and Dr. Marie Nicole Sorivelle). Traditionally, city governance and financing have been in the competence and power of both the public sector and the private sector, each playing various roles, sometimes cooperating, sometimes competing, as exemplified in the preceding chapter. In recent years however, there has been an increasing involvement of civil society into this mix, often in cooperation with these two actors, but sometimes taking place without reference to them and even under their perception radar. Civil society is composed of a very large number of diverse organizations and institutions, ranging from very informal to formal

(including individual citizens, families, neighbourhood groups, communities, NGOs, social entrepreneurs and the alike), which means their roles and impact are highly diverse and dependent on the local context. Their activities encompass both direct monetary as well as in-kind initiatives, so measurement and impact assessment can be challenging.

Chapter 7: Social Media and Digital Platforms (Daniela Patti, Levente Polyák, Simone D'Antonio). Using the experience gathered within the URBACT Interactive 10 Cities Network, the chapter will frame the conceptual framework and practical considerations on how cities can make use of widely available technologies to improve their collaboration with citizens while ensuring data protection as well as providing an equitable share of resources generated by the use of these technologies.

Section B: Solving key challenges for cities - the authors in this section provide some challenging thoughts on growing cities as more livable and sustainable spaces including ideas to improve and think about designing better systems for health, education, mobility, and inclusivity.

Chapter 8: The Healthy City (Dr. Alan Shark). One undisputable identifier of smart cities is individual and community health – both physical as well as behavioral. Smart cities require healthy and happy residents. Using an essay approach, this chapter goes beyond the literature and offers a framework for planning regarding the future of smart health for smart cities. Those aspiring to be smart cities must promote a healthy environment and devote the necessary resources aimed at ensuring their residents are as healthy as possible. Concurrently, public managers must recognize there are limits to what government can do since much depends on residents' willingness to be healthy: taking the time to exercise, not smoking, eating healthy, moderate alcohol intake, and avoiding drugs. Nevertheless, failure of governments to adequately address how to make their cities healthy will ultimately lead to dramatic increases in costs due to poor health conditions such as addiction, substance abuse, behavioral instability, homelessness, obesity, alcoholism, smoking, and diabetes, to name a few. Smart technology can serve as an enabler for positive change while promoting the framework for a holistic approach towards more effective management and planning. Ultimately, smart cities are about

people and quality of life factors that transcend all other smart city factors. Smart technology is already playing a key role and will only expand its influence and benefits.

Chapter 9: Smart Learning for Smart Cities (Dr. Stephen Murgatroyd). Skilled and highly qualified people who will engage in life-long learning and collaborative, community- based work are the essential life-blood of smart cities. Yet such people are in short supply, especially in the developed world. Part of the reason for this is the reliance within education on models of knowledge and understanding, teaching and learning, personal development, and problem-solving which are outdated. Many have suggested the need for significant change and pockets of innovation exist throughout the education systems around the world, but a collection of pockets do not make a suit. In this chapter, six specific skill gaps and their implications are identified together with some of the developments which are occurring and may lead to the closing of some or all of these gaps. Universities, colleges, and polytechnics provide a focus for these changes, though all three types of institutions are slow to transform and change. Until they do, smart cities will be slow to develop and underperform against their promise.

Chapter 10: From Smart to Intelligent Mobility (Dr. John G. Jung). Urban transportation and efficient logistics are at the heart of vital, thriving metropolitan areas. Unbridled growth can result in congestion, pollution, and undesirable daily stress which can evolve into impoverished environments leading to inefficiencies, unproductive land-uses, and a diminished quality of life. Solving the mobility challenges of moving people, goods, and services is one of the most pressing issues in modern and growing cities around the world, especially given that by mid-century three-quarters of the world's population will be living in urban centres. With our cities ill-prepared for this massive migration, mobility and its impacts: social, economic, environmental and political, will all need to be addressed before it is too late to save our cities as liveable ecosystems. Mobility challenges impacting trade and the attraction and retention of investment and talent can seriously undermine the sustainability of a city and region from an environmental, fiscal, and social perspective. This chapter will look at international smart technologies to manage urban assets and systems to improve efficiencies, increase transport productivity, and harness enhanced mobility options. But it will also introduce several

international examples of a more holistic approach called intelligent communities that aim to solve transportation, sustainability, and livability issues.

Chapter 11: Inclusive Growth in Smart Cities (Jacques Putzeys, Anne Bailey). The chapter will provide a business case for inclusive growth in a globalized digital environment. The role of the firm and consumers' expectations are changing rapidly and cities can develop a joint agenda for public and private investment in inclusive growth. If we are not careful, in a digital economy a segment of the population will have greater difficulty accessing new jobs and occupations. Inclusive growth and innovation considers the part that technology can play, and how new concepts can diminish the divide.

Section C: Next-generation intelligent cities - in the final section, we provide innovative ideas for moving cities from old paradigms to new ways of thinking - for fabricating and using local resources locally, for thinking about more flexible work arrangements, for designing cities for people and for new economic and social realities.

Chapter 12: Megacities, Utopian Cities and Planning our Cities for the Future (Dr. John G. Jung). Utopian smart communities, whether they are gated technology clusters or large commercial developments built by a single entity, are often criticized as elitist, even soulless, and merely aim to benefit its investors. It could take many decades before they may begin to become real communities. Authentic smart communities are not exclusionary and elitist. They attract the interest of those who want to participate in a diverse, inclusive, and engaging community that has developed its smart infrastructure to help improve the quality of life of all its citizens. This chapter deals with the evolution of megacities, the reasons for their development, and its relationship with the creation of today's "utopian" smart cities. It also identifies other potential options for the planning of our cities using case studies and examples from around the world.

Chapter 13: Compact Cities (Johanna Hurme, Shannon Wiebe). As the 'smart city' movement continues to gain momentum and global influence, local governments are racing to rebrand their communities with cutting-edge data analytics and digital infrastructure investments. The belief that disruptive technologies will revolutionize how we

occupy our urban fabric has dominated news feeds from Guangzhou to Palo Alto. Yet, a serious consequence of embracing such a singular vision of our collective future is the absence of any immediate responsibility over our urban environment. This chapter challenges us to think about the cost of 'business as usual' and proposes new solutions. Regardless of the technological advancements that the future holds – whether it be autonomous vehicles, enhanced digital networks, or new energy sectors – human patterns of behaviour and the spatial qualities and experiences that allow us to thrive in our physical surroundings have changed very little over a millennium of development but we do need change.

Chapter 14: Engineering the Perfectly Pedestrian City (Shyam Khandekar). Every year a substantial proportion of our population is killed in urban mobility related accidents and from air pollution. At the same time, the livability of our cities has suffered from an over-reliance on automobiles and the space that they occupy in our lives and on our streets. This article provides new ideas on development including changes to current municipal policies on set-backs and space usage that could make substantial improvements to the quality of life of citizens in larger cities and create more engaging work environments in condensed areas.

Chapter 15: Fabrication City (Tomas Diez, Dr. Jeremy Millard, Marie Nicole Sorivelle). In 2011, an innovative and disruptive urban model called the 'fabrication city' – or Fab City – emerged. Originally they were structured around single Fab Labs as new forms of local and often municipal fabrication shops and university-led workshops, where 'makers' could obtain training in 3D printing and other tools to make things, for themselves or for selling. However more recently, the fabrication movement is seen as potentially forming neighborhood or city-wide clusters for the growing maker movement. Linking clusters together nationally, regionally, and internationally, as well as with complementary activities in the creative, knowledge, flexible, and mainstream industries, provides the basis for locally productive and globally connected cities, designed for sustainable and resilient urban development through distributed and digital manufacturing. This potential is seen as a strategy for ensuring that Industry 4.0 will be efficient and effective as well as socially and environmentally sustainable.

Chapter 16: Nature-Based Solutions for Smart Cities (Dr. Jeremy Millard, Dr. Luise Noring, Marie Nicole Sorivelle). Nature-based solutions are increasingly being deployed in cities and elsewhere to address a variety of interlinked environmental, social, and economic challenges that enhance resilience and sustainability, as well as contribute significantly to innovation across all parts of society. Nature-based solutions are "*solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions"* (European Commission, 2016a).

Chapter 17: Telecommuting City (Dr. Sylvie Albert, Dr. Manish Pandey). Telecommuting has been identified as 'an imperative' based on shifting workforce requirements, as an opportunity to decrease real estate costs, to promote work-life balance, to meet the requirements of legislation on Disabilities and Access, and to reduce traffic and congestion costs. Despite a potentially positive effect on traffic congestion and pollution in cities and an opportunity to increase productivity, telecommuting is still not fully exploited (OECD).[35] This chapter is meant to provide some economic arguments for actively promoting a city that telecommutes, as well as some successful implementation examples.

A consultant, government advisor, researcher, author, and chief jurist in the smart/intelligent community movement for over 25 years, ***Dr. Albert*** *is a Professor of Strategy at the University of Winnipeg. She authored several books and articles on the topic of connected/smart/intelligent communities and presents regularly at regional and world conferences. Dr. Albert's interest in technology started in the early 1990s with the development of the first video-conference network in Ontario (Canada), a partnership she established with post-secondary institutions and hospitals for elearning and tele-medicine. She was subsequently called upon to sit on several governmental boards to fund technology and innovation as well as consult with communities and regions across Canada on the establishment of new broadband networks and online projects.*

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