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General Contractor Business Model for Smart Cities

Fundamentals and Techniques

Elie Karam

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I dedicate this work to my family who have supported me in both the good times and the bad. Above all, I bestow it to my wife who cheerfully sacrificed time, energy and bread so that I could fulfill my dream. Her infallible love and absolute backing allowed me to get to the shore when I was drowning in doubt. Not forgetting my four, beautiful little angels – my raison d'être

I would also like to mention my parents, as well as my brothers and sisters, and their respective families; I am truly grateful for all the encouragement you have given me and the love you have shown me. Though it has been a long road, together, we have made it through. No words could truly express how appreciative I am. This success is for you – you were part of it – you always will be – now and in the future

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Contents

List of Acronyms

AIIB	Asian Infrastructure Investment Bank
AMT	Additive Manufacturing Technology
ART	Augmented Reality Technology
BIM	Building Information Modeling
BM	Business Model
BMI	Business Model Innovation
BT	Business Technology
CCTV	Closed-Circuit TeleVision
CLD	Causal Loop Diagram
CM	Construction Manager
CPLC	Construction Project LifeCycle
CVP	Customer Value Proposition
DSR	Design Science Research
EU	European Union

GC	General Contractor
GDP	Gross Domestic Product
GHG	GreenHouse Gas
ICT	Information and Communication Technology
IDI	In-Depth Interview
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IS	Information System
IT	Information Technology
LCA	LifeCycle Assessment
MIS	Management Information System
MSP	MultiSided Platform
PM	Project Manager
R&D	Research and Development
ROI	Return On Investment
TLC	Technology LifeCycle
U-	Ubiquitous-
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America

USD	United States Dollar
VRT	Virtual Reality Technology
WW	World War
WWW	World Wide Web

Preface

The WWW (World Wide Web) – the Internet – and the ICT (Information and Communication Technology) – are all key, fairly recent and successive inventions that have substantially altered and shaped the world we live in (as we know it!). They have turned our existence upside down and affected every aspect of our lives, even the tiniest ones. Having said that, let us now reconsider how life is organized on Earth. To do this, let us simply think of the planet as an inhabited human body (an interlocked system). It is the transit system of roads and railways, bridges and tunnels, as well as air and seaports that enable our mobility across the continents – much like the vascular system that powers the human body. It is also the oil and gas pipelines and electricity grids that distribute energy and ensure the unblemished work of the nervous system of communications; additionally, it is the Internet cables, satellites, mobile networks and data centers, which allow for the smooth exchange and storage of information. Like the human body, the main components of the Earth system are interconnected by flows of energy and materials. And so we believe that a disruption of any of those flows would unquestionably sway the system in its entirety.

Today, this ever-growing infrastructural system – *connectography* as labeled by Parag Khanna[1] – consists of several million kilometers of roads, railways, pipelines and Internet cables. It represents a quantum leap in the mobility of people, goods, resources, knowledge and ideas. It is an evolution of the world from *political geography* (how we legitimately divide the world) to *functional geography* (how

1 This Preface was inspired by Mr. Khanna's Ted Talk: Khanna, M. (2016). How megacities are changing the map of the world? [Online]. Available at: https://www.ted.com/talks/parag_khanna_how_megacities_are_changing_the_map_of_the_world/discussion?; anguage=en [Accessed March 31, 2021].

we actually use the world). It is hence quite evident that *connectivity* – rather than *sovereignty* – has developed into the organizing principle of the human species.

"Our yearly spending on global infrastructure is anticipated to rise to USD 9 trillion within the coming decade," Mr. Khanna indicated. "We will build more infrastructure in the next forty years than we have in the past four thousand years."

Thus far, Asia is topping the list of continents whose countries are investing the most time and money into promoting their connectivity, both regionally and internationally. In collaboration with some adjacent countries, China, for instance, announced in 2015 the creation of the AIIB (Asian Infrastructure Investment Bank), a multilateral development bank that aims to support the building of infrastructure in the Asia-Pacific region. Beyond connectivity, the 21st century seems to be characterized by a second megatrend: *planetary urbanization*. According to Parag Khanna, "over 67% of the world's population will live in cities by 2030 – megacities in specific" – a justly rational argument, as megacities are nowadays on the rise and could easily be dotted anywhere in the world:

– the technology powerhouse of Silicon Valley (USA) is a very good example of a megacity extending from San Francisco, going south through Palo Alto, all the way down to St Jose;

– the sprawl of Los Angeles is another good example of a megacity, spreading south all the way to San Diego, crossing the Mexican border, to finally reach Tijuana. San Diego to Tijuana is a binational conurbation, comprising over 5 million residents as well as a joint airport terminal;

– one additional example of a megacity is the USA's northeastern megalopolis – stretching from Boston to New York, to Philadelphia and Washington – the so-called *Bos-Wash corridor*. The latter is the second most populous megacity in the USA, with over 50 million residents.

However, the megacity trend looks like a viral phenomenon; Asia remains by far the area with the biggest megacities in the world:

– from Tokyo, to Nagoya, to Osaka stretches the world's largest megacity. It comprises over 80 million people and accounts for most of Japan's economy;

– China's megacities seem to be on the rise as well, as clusters are coming together with populations reaching 100 billion people. The Yangtze River Delta, for instance, which is a triangle-shaped megacity cluster, covers an area of about 100,000 square kilometers and is home to over 115 million people (as of 2013). In 2018, the Yangtze River Delta had a GDP (Gross Domestic Product) of about USD 2.2 trillion – roughly the same size as Italy today.

These facts are weighty – also to some extent amusing – especially when we picture global diplomatic institutions (e.g. the Group of Twenty) basing their memberships on economic size rather than national representation. Under a similar scenario, some Chinese megacities would be granted access and have seats at the table, while whole countries like Argentina or Indonesia would see their partaking being revoked. The exact same leaning (*towards increased connectivity*) could be found in other countries, say India (Delhi), Iran (Tehran) and Egypt (Cairo-Alexandria corridor). And there is Lagos too – Africa's largest city in Nigeria's commercial hub – with its plans to create a rail network that would make it the anchor of a vast Atlantic coastal corridor – stretching across Benin, Togo and Ghana, to Abidjan (in Côte d'Ivoire). In other words, in some parts of the world, whole and entire countries could in time become suburbs of megacities – a plausible setup in a megacity world.

Going forward, it is worth noting that people normally move to cities to be connected, and connectivity is why these cities ultimately prosper. Whether it is São Paulo, Istanbul or Moscow (really!), any one of them has a GDP approaching or exceeding 33–50% of their entire national GDP. Bringing up the case of Gauteng province in South Africa – comprising Johannesburg and Pretoria (the capital) – it too accounts for more than 33% of the country's GDP. Equally importantly, the latter is also home to the offices of almost every single multinational that directly invests in South Africa and (circuitously) the entire African continent.

As-is, planetary urbanization seems to be a good thing, a promising megatrend. Yet, we ask, is it *risk-free*? For some, urbanization is a source of negative externalities that would lead to frustration in the long run. In their opinion, urbanized cities are destroying the planet – and will continue to do so in the future. Hitherto, today, there are over 200 intercity learning networks booming, focusing on a single goal: *sustainable urbanization* – and having a lone objective: *upholding the well-being of people*. Fair talk indeed, nevertheless, could we put our faith in such upmarket promises? Yes, we can. Looking into the matter from a different perspective, we may ask ourselves the following question:

– Do we really believe that developed nations, through summits held recurrently, would eventually succeed in reducing GHG (Greenhouse Gas) emissions and stop climate change? No, we do not.

We could reverse global warming by injecting sulfur into the stratosphere – an unconventional solution to an exceptional problem. Yet, until now (thank goodness!), there has been no need for such eccentric tenacities, especially since human beings have started to mitigate the carbon intensity of their respective economies via intercity handovers of technology, knowledge and policies. That is, that cities used to be part of the problem, but now, they are part of the solution. What is more, if we travel through megacities from end-to-end, one could easily

notice extreme disparities within the same geography – another serious challenge for sustainable urbanization – and still, our global stock of financial assets has never been greater, approaching 300 trillion dollars. That is four times the actual GDP of the world. Indeed, since the latest financial crisis, we have taken on some huge debts, but – sadly! – did not invest them in *inclusive growth*. Therefore, it is only when sufficient and affordable public housing projects are built and robust investments in transportation networks are made that alienated cities and societies will come to feel complete again.

According to Parag Khanna, "connectivity is an opportunity — one of the most important asset classes of the present century". Besides *connectivity* and *equitability*, megacities could also make the world more peaceful. How? By looking at regions of the world with dense relations across borders, we see only trade and investment trails, as well as stability. Following World War 2, once industrial integration had kicked off, it in due course led to the rise of the EU (European Union). In North America, the most important streaks on the map are not the USA–Canada or USA–Mexico borders, but the dense network of roads and railways, pipelines and electricity grids, as well as water canals.

Now, let us go back to Asia – Southeast Asia in particular. This region of 600 million people is evolving into the so-called *Pax Asiana* – a period of peace among Southeast Asian nations. A similar phenomenon is taking place in East Africa where six or so countries are investing in inter-nation railways and corridors so that noncoastal countries can get their commodities to the marketplace. At last, we wonder whether connectivity could overcome the patterns of rivalry among the great powers. And to amply answer this question, what would be better than to look at the experience of East Asian countries in this respect? After all, this is the region where WW3 was supposed to break out.

China and Japan, on the one hand, have had a long history of rivalry, often deploying their air forces and navies to show off their strengths in island disputes. Then, just some time ago, Japan started making large investments in China – Japanese cars are selling big in China – and guess where the largest number of foreigners residing in Japan comes from? *BOOM*, you guessed it: China. China and India, on the other hand, have also fought a major war and have three outstanding border disputes, but today, India is the second largest shareholder in the AIIB. The two countries are currently working together to build a corridor distending from Northeast India, through Myanmar and Bangladesh, to Southern China – and their trade volumes have grown from USD 20 billion a decade ago to USD 80 billion today.

We end with these words by Parag Khanna: “connectivity has remarkably developed into a new reality – a reality that has allowed cities and nations to aggregate over time into more diplomatic and well-off wholes”. “Though no one could swear for sure today that World War 3 will not break out, anyone could realize why it has not happened yet.”

Elie KARAM
October 2021

Introduction

When we try to pick out anything by itself, we find it hitched to everything else in the Universe.

John MUIR

Connectivity has become a reality today – and the upsurge of megacities at the international level is not expected to cease anytime soon. Neither is the flow of the world population leaving for urban centers. In fact, UN data[1] shows that over half of the world's population lived in cities in 2015, and this figure is likely to rise by an extra 10% in 2030. As previously evoked, people tend to migrate to large urban centers in search of opportunities and connectivity. And these same reasons – we suppose – will continue to drive this kind of migration towards big cities. Consequently, those big cities would eventually capture a significant share of the world's wealth and their giant potential would attract further newcomers. With that said, it is valid to enquire whether today's big cities are all equally and sufficiently equipped, urbanized and structured enough to receive superfluous inhabitants (the answer is obviously: No, not at all!). Also, we may ask: *what would happen if an increase in population ends up being unaccompanied by a comparable increase in economic performance*? (normally, the quality of life of inhabitants would plunge!).

Tokyo (Japan), Delhi (India), Shanghai (China), São Paolo (Brazil) and Mexico City (Mexico) are the world's most densely populated megacities today – with respective populations exceeding 22 million. Lagos (Nigeria), Kinshasa (Democratic Republic of the Congo), Dar Es-Salaam (Tanzania) and Bombay (India) are megacities of the future; currently in the making. However, strange as this may

1 United Nations, Department of Economic and Social Affairs, Population Division (2018). World Urbanization Prospects: The 2018 Revision [Online]. Available at: https://esa.un.org/unpd/wup/Publications [Accessed March 31, 2021].

sound, urbanization has proved to be a contagious phenomenon that is spreading fairly swiftly across the world (Schaffers *et al.* 2011). Overall, this phenomenon (of urbanization) will eventually defy any nation, from the perspective of basic goods and services, and with minimum infrastructure required – a challenge that could not be resolved except through satisfactory innovation: *the creation of smart cities*[2].

Though the notion of smart cities is not new, it is the managerial approach that policy makers, city governors, mayors and project owners frequently opt for when building smart cities that could make the whole difference, mainly by rendering smart cities – smart again. Often, smart city projects are conceived and built following a *top-down approach* with the aim of improving the places we, the people, live in, yet they repeatedly fail to hit the target and don't reach envisioned goals (Turok 2014). Why? Conventionally – and mistakenly – construction companies used to (and sometimes still do!) overweigh the significance of technology, data and cutting-edge computing, while disregarding the foremost component of any successful smart city: *people*. To be sure, for a smart city to succeed and reach its full potential, it should not solely focus on the technology or the infrastructure. Instead, it must be about, must reflect the needs and wants of, and must be built for – *the people*. Otherwise, *the people* will reject it. When building smart cities, by choosing a *people-centered approach*, we inspire collective thinking, the exchange of ideas as well as the democratization of the development of cities, and instigate the city-as-a-platform concept. Consequently, projects would then be conceived with a thorough understanding of real city problems – following a *bottom-up approach*, exactly as opined by city stakeholders: *citizens*, *businesses* and *visitors*.

We add that human-centric smart cities can only be planned and developed when citizens have the opportunity to make their voice heard by governments regarding plausible methods that could be implemented to better city operations. This concept goes farther than thinking of the citizen as a source of data – but as a source of new ideas too (Neirotti *et al.* 2014). Definitely, engaging members of the public early in the conception–construction process could help eradicate disapproval when smart projects or initiatives are implemented. Smart cities formerly focused on connecting infrastructure for better insights, but the attention is nowadays shifting bit-by-bit towards engaging governments, citizens and businesses with the objective of providing upgraded city services and a higher quality of life (i.e. enhancing the citizen experience). That is, smart city projects are now deemed successful if and only if they are accepted and validated by the people – this is a prerequisite.

While the motivation of cities remained intact over time, that is, the founding of livable environments, where people and businesses could thrive together – the setups used to this end evolved favorably. Data is now put in the hands of both end-users

2 Ibid.

and policy makers to drive better decision-making, and collective thinking and intelligence are laying the groundwork for the creation of hands-on solutions to some of the toughest urban snags encountered today.

Within this framework, it is worth mentioning that a number of cities (Barcelona, London, etc.) have already started – only a few years ago – to upgrade their infrastructure systems via the implementation of sensor technology and data analytics. They are doing so in an effort to lift the performance of their physical infrastructures and the use-value of their urban assets: public transit, waste management services, wastewater systems and roads (among others). The *SmartSantander* project in Santander, Spain (Hernandez-Munoz and Munoz 2013) – an extensive real-world experimental facility, spreading across four European countries (Spain, Germany, the UK and Serbia) – is a great example of a human-centric smart initiative. Truthfully, as big cities around the globe will, in the future, be expected to shelter superfluous people, smart initiatives and enablers like the *SmartSantander* framework have been growing in strength and gaining momentum in recent years, hence underlining the need for better and more efficient methods for the management and development of big cities overall.

I.1. Relevance

Hurried urbanization puts an incredible amount of pressure on urban centers, presenting challenges for cities to provide economic opportunities and environmental sustainability, and ensure the safety, protection and well-being of their inhabitants (Moir *et al.* 2014). Prosperous cities tend to overcome these challenges by seeking sustainable and resilient growth. The IoT (Internet of Things) in smart cities – and smart city technology – account for only part of the solution. The other part, however, has to do with *adaptability*: the adoption of a new business model that allows for the optimization of the construction industry's value chain. This is valid as the conception and construction of smart real estate, often grasped as megaprojects, take years to be completed, *up to 20 years*. Whereas the TLC (Technology Lifecycle) is relatively shorter, *up to 15 years*, which signifies that there is a high risk that the implemented technology would reach its tipping point – and so become obsolete – even before the construction project has been finalized or delivered to clients (Kordas *et al.* 2015).

On another note, it is worth indicating that businesses as much as governments are facing the challenges of urban growth – and their capacity to drive continued growth is being put to the question. Actually, for businesses to be able to attract the educated talent desired, they need (at least at first) their head offices to be based in livable (and blooming) cities (Nam and Pardo 2011), meaning that the attractiveness of cities is a function (among other factors) of their respective economic power and

influence – which means that talented people would not choose to migrate to big cities unless they have a good reason to do so. In this sense, cities are responding by finding ways (adequate platforms, business models, frameworks, structures or ecosystems) to speed up construction works and improve decision-making processes, not only by consulting with governmental entities – but with businesses and residents too, thus tapping into the collective intelligence of the city in its entirety (Termeer and Bruinsma 2016).

I.2. Importance

Big cities (or megacities) have long been engines of economic growth and opportunity. A World Bank analysis[3] of 750 cities around the globe found that, from 2005 through to 2012, economic growth in almost three-fourths of cities outpaced their respective national economies. By 2025, the world's top 600 cities are estimated to account for more than half of global GDP. London today accounts for almost 20% of the UK's GDP. In the USA, the Bos-Wash corridor – and the Los Angeles metropolitan area – account for nearly 35% of the country's GDP[4]. The world is now seeing a nonstop concentration of population in cities. And cities that are not suitably equipped to handle growth (or fail to adapt to this new reality) are likely to see their environments and residents suffering from negative consequences. Now, this challenge is becoming increasingly relevant as quite a few big cities around the world (e.g. Lagos, Bombay, etc.) are undergoing such an explosive growth.

To recap, a smart city is not only about implementing smarter things (conversely to what is believed today!); it is also about endowing stakeholders (policy makers, residents, project owners, project managers, etc.) with the right tools and frameworks so they can make smarter decisions. For example, in Amman, Jordan, the city authorities have lately adopted a data-driven approach to streamlining the waste management process, which allowed for the successful optimization of existing fleet management systems[5]. Not only in Amman, but also all over the globe,

3 The World Bank Group (2015). Competitive Cities for Jobs & Growth: What, Who, & How? [Online] Available at: http://documents.worldbank.org/curated/en/902411467990995484/pdf/101546-REVISED-Competitive-Cities-for-Jobs-and-Growth.pdf [Accessed April 5, 2021].

4 CityLab (2014). The Dozen Regional Powerhouses Driving the U.S. Economy [Online]. Available at: https://www.citylab.com/life/2014/03/dozen-regional-powerhouses-driving-us-economy/8575/ [Accessed April 5, 2021].

5 ASCIMER (2014). Facing the challenges of a new era: Smart city projects [Online]. Available at: http://eiburs-ascimer.transyt-projects.com/files/14_MaqousiAli_Presentation_%20%5BASCIMER%5D.pdf [Accessed April 5, 2021].

cities are adopting shrewd managerial approaches to building their own smart cities. All of this sounds great, yet we note that there is currently no unique, matchless and unrivaled smart-city model that countries around the world could use – at any time, in any way – to refurbish or build their own. And that the conception and development of smart cities is almost certain to vary from one country to another, based on each country's specificities and available resources. Furthermore, any smart development, we presume, involves numerous key players and it is the interplay between these players throughout the lifespan of the construction project that determines whether the latter will eventually succeed or fail (Ke *et al.* 2015; Komninos *et al.* 2015). This in fact sheds light on the key role of the *general contractor* who brings all stakeholders involved in construction projects together, hence tying up the construction value chain, downstream to upstream.

I.3. The managerial question

This book revolves around five major themes. From the most wide-ranging to the more specific they are as follows: *connectivity*, *smart cities*, *smart constructions*, *general contractors* and *business models*. Indeed, the main puzzle that we aim to solve can be written as follows:

– How can we design a *general contractor* business model in order to build smart cities?

Thus, as a means to an end, we assume that the most successful smart city projects (in France in particular and around the world in general) are run, managed and built by general contractors, in partnership with other construction actors. As a result, the value chain of the entire construction industry – we expect – can be optimized through improved connectivity between various stakeholders and, ultimately, so can the livability of big cities and the quality of life of residents in general.

(These assumptions are still to be validated in due course of this book!)

I.4. Outline of the book

This book follows a funnel structure and is split into six chapters, as follows:

– Chapter 1 focuses on smart cities. An extensive overview of smart city concepts and theories is proposed. That is, a full review of the existing literature on smart cities is presented, coupled with a full description of relevant theoretical models, notions and concepts. A historical synopsis of the emergence of the concept of smart cities is also given. Moving forward, some detailed, real-life examples of successful smart cities around the globe are examined. Global smart-development

best practices are depicted too – in an attempt to inform an expert managerial business model on building spot-on smart cities.

– Chapter 2 explains the key roles that general contractors could play in building smart cities.

– Chapter 3 embarks upon business model theories. The features, constituents and importance of business models are methodically examined. Additionally, light is shed on recent literature relating to business model innovations.

– Chapter 4 describes the business model design process, primarily how our idea of a new business model developed over time, and how it cultivated year-after-year to finally turn into something tangible, a dual-use business model, at the end of this book.

– Chapter 5 classifies the main problems faced in French construction today and suggests plausible solutions for their resolve. Specifically, using the triple layered business model canvas, problems and solutions are dispersed across the different dimensions of a construction project: *economic*, *social* and *environmental*. To these, you may notice, we add an extra one: the *technical* dimension. In addition, the links between problems and solutions are highlighted, narratively and visually through dependency graphs and construction process maps. Additionally, an in-depth explanation of the research findings is proposed throughout this chapter. The main discussions revolve around topics such as the need for a central operator to lead smart developments, the potential benefits of a new business model in construction and the opinions of key stakeholders apropos the envisioned business model and the role of general contractors in improving the configuration and enactment of the construction industry's value chain. Lastly, Chapter 5 elucidates how innovation is part of construction processes on various levels – and how innovative procedures in general are likely to soar over time from augmented managerial and technical connectivity.

– Chapter 6 discusses our theoretical and methodological contributions to the literature on smart cities, general contractors and business models.

– Finally, we summarize all this research by putting forward some recommendations for both industry players and policy makers as to what could be done to better crack smart developments' inherent problems, irrespective of whether those problems are of a technical and/or legal nature. Hence, we call for all stakeholders to join forces to embolden the development of smart cities – and render them – literally – smart again. Research limitations and avenues are also marked in the conclusion.

1

On Smart Cities: A Literature Review

Thus far, we have established – with a fair amount of confidence – that *functional geography* has gradually come to prevail, overshadowing the significance and governance associated with *political geography*. We have also highlighted that *global urbanization* is putting serious pressure on big cities in terms of their ability to accommodate additional inhabitants, and that this pressure is being passed onto the construction industry which is currently hastening developments: *smart cities*. Furthermore, we have shed light on the importance of promoting macro-level connectivity as a means of boosting economic growth and sponsoring environmental sustainability and political stability[1].

Besides macro-level connectivity, we endeavor in this work to demonstrate that connectivity is critical at the micro-level too (Hanna 2009). Clearly, there is now a need to institute strong micro-level connectivity (within the construction industry) and rethink existing stakeholder management approaches, for the most part to improve stakeholder engagement throughout the various stages of the CPLC (Construction Project Lifecycle). In fact, establishing strong links between construction actors – maintaining open channels of communication at all times – has become a prerequisite to successful construction projects. This is palpable – in our opinion – because stakeholders often have distinct interests and concerns, and therefore strong connections at the micro-level – if they could exist – would ensure timely, consistent, relevant exchanges of information between them. The result is the successful execution of smart development projects.

1 The Smart City in 2030. First Workshop on Network 2030, Otthein Herzog. New York City, October 2018. Available at: https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201810/Documents/Ottein_Herzog_Presentation.pdf [Accessed April 7, 2021].

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However, connections at the micro-level connectivity cannot be established without the intervention of a key industry player who is both a connector and a maven: the *general contractor*.

In summary, this chapter explains the smart city concept in detail.

The research is then explored further to address the crucial role of the general contractor in managing the construction value chain (Chapter 2).

From our perspective, the general contractor role exists because of the presence of (a major issue) broad organizational gaps and weaknesses within the construction industry's value chain, which often hold construction actors back from proposing value-adding innovations to their clients. As for the solution to this particular issue, we declare it is nowhere to be found except in a newly-designed – centralized – stage-based business model.

Over the course of my professional career as a *general contractor*, I have had the opportunity to handle numerous construction projects and amass sufficient knowledge about the current state of the market: its strengths, weaknesses, the threats faced and future prospects to be seized. In my personal view, smart cities are likely to shape the future of urban developments. The smart city market in France, as well as in other countries, has lots to offer and has been growing exponentially, especially with the global urbanization trend which has erupted in recent years and has been on the rise ever since.

Practically, smart city projects refer to long-term construction projects that are generally labor-, capital- and technology-intensive. To say the least, they are a source of value, creating various revenue streams that could potentially benefit all construction actors[2].

Currently, the number of construction actors – those intervening at different stages of the construction value chain in order to execute smart city projects – is significant; however, the difficulty encountered in this context has very little to do with the number of those involved. Instead, it stems from the absence of an entrepreneurial entity that could resourcefully orchestrate these interventions, avoid overlapping roles and guarantee the successful delivery of projects (Flyvbjerg and Holm 2002; Flyvbjerg *et al*. 2003).

2 Xiong (2018). Cost–benefit analysis of smart cities technologies and applications. A thesis submitted to the Faculty of the University of Delaware. Available at: http://udspace.udel.edu/bitstream/handle/19716/23818/Xiong_udel_0060M_13359.pdf?sequence=1&isAllowed=y [Accessed April 7, 2021].

1.1. Historical synopsis

The concern surrounding sustainable development of urban centers has been a central preoccupation for many years, and the aspects that typify the cities of tomorrow have been embraced during this time. Furthermore, the vocabulary associated with the features of these cities has been unequivocally enhanced over the past few decades, mainly to explain the substantial number of concepts endorsed by stakeholders (Eremia *et al*. 2017). Today, this vocabulary has changed once again, with specific terms gaining or losing ground over time (see Tables 1.1 and 1.2).

Domain	Social	Economic	Governing
Garden cities	Participative cities	Entrepreneurial cities	Managed cities
Sustainable cities	Walkable cities	Competitive cities	Intelligent cities
Eco-cities	Integrated cities	Productive cities	Product cities
Green cities	Inclusive cities	Innovative cities	Efficient cities
Compact cities	Just cities	Business-friendly cities	Well-led cities
Smart cities	Open cities	Global cities	Smart cities
Resilient cities	Livable cities	Resilient cities	Future cities

Table 1.1. *The cities of tomorrow, conception of success (source: adapted from Guerrero-Pérez* et al. *(2013))*

Post-1950, *sustainable city* was the most popular English term used to label future urban developments. *Digital city* followed in the late 1990s; its popularity resulting from its inherent ability to connect with and reflect the increasing importance of ICT at the time. Nevertheless, in 2009, the term gradually fell out of favor and was replaced by a new one: *smart city*. This new term embraces elements of sustainability and social inclusion, while at the same time being suited to the evolution of the IoT (Deakin 2012). In the following sections, we shed light on the two concepts of *sustainable* and *smart cities*. Then, in the chapters that follow, we embark on deep dive into the main features and models of smart cities and present a quasi-complete inventory of all definitions of smart cities.

Term	Popularity	Regional Popularity	Popularity in Countries	Popularity in Cities
Future cities	Stable	Global	India, USA, Canada, Australia, UK, Mexico, Brazil	Minneapolis, Singapore, Mumbai, New Delhi, Phoenix, San Francisco, Pune
Eco-cities	Stable	Asia	The Philippines, Singapore, Malaysia, India	Chandigarh, Tianjin
Smart cities	Fluctuating interest	Europe, North America	Italy, Spain, Belgium, UK	Barcelona, Bologna, Turin, Rome
Intelligent cities	Stable	North America	USA, UK	London
Sustainable cities	Stable	Commonwealth	Australia, UK, Canada, USA, India	Vancouver, Singapore, Washington, Auckland, Portland, Dubai, London, Austin
Compact cities	Stable	Mixed	Australia, UK, USA	Salt Lake City, New York City
Liveable cities	Rarely used	Commonwealth	Australia, UK, Canada, Singapore	New York City, Singapore, Melbourne, Pittsburgh, Vancouver
Digital cities	Stable, following a drop in popularity	Mixed	USA, Ireland, The Philippines, UK	Kansas City, Oklahoma City, Dublin, Minneapolis
Innovative cities	Stable	Mixed	USA, UK, India	Bangalore
Green cities	Stable	Northern America	USA, Australia, Canada	New York City

Table 1.2. *Geographic trends in future city term usage (source: adapted from Moir* et al. *(2014))*