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“What are the key strategic success factors that enable smart cities to accelerate and ensure effective implementation?”

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As a prelude to this brief, I would like to thank all those who have supported me from near and far during the development of this research.

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FOREWORD

Societies and cities are facing more and more challenges. At the societal level, many major global challenges have emerged such as climate change, rising water levels, population growth, poverty, etc... These global challenges affect cities and push them to move towards a more sustainable way of life by tackling issues such as mobility, energy, environment, education and health.

To counteract these challenges and to adapt to the changing times, cities have had to develop techniques. A commonly used technique is to transform a city into a “smart city”. But then, what's a smart city? To answer this question, we decided to use the definition established by HEC Liège, defining it as : *« A smart city is an ecosystem of stakeholders engaged in a process of sustainable transition in a given territory using new technologies as a facilitator to achieve these sustainable objectives (Smart City Institute, 2017) ».*

To learn more about these smart cities and mainly about what the transition from city to smart city involves, we decided to study the strategic aspect and learn more about these key success factors. To do so, we will answer the following research question: *« What are the strategic success factors that enable smart cities to accelerate and ensure effective implementation? ».*

The current research started with an overview of secondary research conducted by academics and industry experts on the topic of strategic implementation of smart cities, in order to gain more insight and as a preparatory step for the case studies based on Amsterdam Smart City (ASC) and Brussels Smart City (BSC). These case studies were selected to discuss the framework of smart cities in Europe, but also because of their different approaches, which led them to different results.

In order to compare them as accurately as possible, we assessed most of the strategic frameworks from the scientific literature and selected two of them: the SMART framework (Letaifa, 2015) and the Smart City Reference Model (Zygiaris, 2012). Indeed, we found them to be the most comprehensive, cross-sectoral and addressing transition as a process and not as an exhaustive list of themes to be addressed.

Research results showed that Amsterdam was ahead of Brussels in all action fields as a result of its strategy, vision and leadership. In addition, through this research, we were able to extract an exhaustive list of 17 key success factors, which we have categorized into 3 scales corresponding to the SMART model (Letaifa, 2015), because each strategic success factor has a specific importance over time.

The limitations of the research are the use of qualitative data and reliance on secondary research only. Moreover, we have only used case studies of two European cities characterised by a strong proximity and some similar characteristics, thus, our assessment on the strategic implications cannot be extend beyond these cities.

For future research, we will recommend the use of mixed research methods and the use of more case studies in order to reach a consensus on the strategic success factors when implementing a smart city strategy. However, we advise to always keep a geographical focus on a particular region when selecting cities.

TABLE OF CONTENT

LIST OF ILLUSTRATIONS

FIGURES

TABLES

LIST OF ABBREVIATIONS

Abbreviation	Meaning
ASC	Amsterdam Smart City
BSC	Brussel Smart City
SCSI	Smart City Strategy Index
EIP-SCC	European Innovation Partnership on Smart Cities and Communities
SCP-EU	Smart Cities Project – European Union
NSRP	North Sea Region Programme
SSD	Strategic Sustainable Development
FSSD	Framework for Strategic Sustainable Development
DESI	Digital Economy and Society Index
BRIC	Brussels Regional Informatics Centre
RDC	Regional Data Center
AMS-IX	Amsterdam Internet Exchange

INTRODUCTION

The exponential growth of the world's urban population projected for the coming decades has created serious challenges for cities, which face a variety of difficulties in overseeing such rapid demographic change, including urban settlements (United Nations, 2011). Indeed, 55% of the world's population lives in urban areas and this percentage will rise to 70% by 2050 and at the same time the world's population will increase from 7.5 billion people to 10 billion (Pictet Asset Management). These challenges appear in social, natural and urban areas, along with the objective of improving the satisfaction of the citizens.

To counter these difficulties, cities need to develop techniques: a commonly used technique is to transform a city into a “smart city”.

Over the last twenty years, the strategic preparation of urban development has been organised to make cities increasingly sustainable, bearable and complete, both socially and physically. Achieving dynamic urban economies, overseeing urban frameworks, and promoting sustainable urban structures are important factors when building smart cities. As a result, new challenges have emerged in economies and the needs of various cities have emerged.

Little research has been done to find out whether there is a more efficient strategic method to build a smart city or whether some frameworks are indeed better than others and, in some cases, accelerate and ensure effective implementation.

In this research thesis, finalizing my master’s degree, I therefore decided to analyse the strategic orientations and directions in smart city planning and identify critical success factors in the design, planning and implementation of smart city strategies.

The main research question I will try to answer throughout this work is:

"What are the key strategic success factors that enable smart cities to accelerate and ensure effective implementation?”.

The two sub-questions raised by the main research question above are as follow:

- **RQ1:** In order to reach resolutions and create rules about strategy making arrangements for the advancement of smart cities, by what method can a smart city system be planned successfully?

- **RQ2:** How have the cities of Amsterdam and Brussels implemented their smart city strategy? And what are the key success factors we can identify?

To answer theses research questions as objectively as possible, we first carried out a review of the scientific literature, which enabled us to learn more about the concept of smart cities, its background and its development within the European Union. Following this, we came up with one definition of smart city, who served as a guideline throughout our work and allowed us to extract the key dimension, characteristics and concepts.

Secondly, we discussed the different stages of setting up a smart city, which deals with the strategic aspect and proved to be relevant to our study. Theoretical frameworks for strategic planning and strategic reference models are discussed in detail. We extracted the five most popular strategic frameworks from the scientific literature, compared and evaluated them. We then made a selection, kept the most appropriate ones to pursue our study and to apply them to the cities of Brussels and Amsterdam.

These cities have been chosen mainly for three reasons: firstly, because they are cities that are close to each other, with a rich historical background, and both are located in the European Union, which allows us to maintain a geographical context. Secondly, because they offer a different strategic approach, Amsterdam has opted for a bottom-up and top-down approach and Brussels has chosen a top-down approach, that will allow us to make a comparison. And thirdly, for the fact that they have both made progress in the ranking of smart cities over the last five years.

This investigation based on secondary data has several objectives:

1. Determine the framework for the implementation of smart city strategic models. The first step is to combine surveys on smart city methodology, complemented by the latest available research. It examines the current assumptions for structuring a smart city system, presenting the components of such a methodology and how they are identified with each other. As a result of this research, five frameworks have been discussed: SMART framework (Letaifa, 2015), smart city reference model (Zygiaris, 2012), IBM's smart city model (IBM, 2008), smart city innovation framework (Nam & Purdo, 2011) and smart city success factors framework (Charoubi & al, 2012).

2. The second objective of this study is to apply the theories of strategic analysis to the smart city methodology. More explicitly, it compares the frameworks of the scientific literature with the strategies effectively implemented by Amsterdam and Brussels.

3. The third objective is to analyse the important elements of the strategic frameworks of the selected smart cities, to extract a comparative grid and to arrive at a conclusion that synthesizes the key success factors of the strategic and frameworks. Finally, this thesis seeks to provide a practical strategic guide to smart cities and fill a gap in the scientific literature as it is a relatively recent and still under-treated topic.

CHAPTER I: RESEARCH METHODOLOGY

Section 1.1: Introduction

According to Saunders et al (2012), qualitative research methods are increasingly being used in social sciences and applied fields, such as management. This type of research is defined as interpretative and pragmatic, meaning that it largely relies on practical experience rather than theoretical aspect. The current research started with an overview of secondary research conducted by academics and industry experts on the topic of strategic implementation of smart cities, in order to gain more insight into the matter and as a preparatory step for the empirical part which focuses on secondary data collected in a case study based on Amsterdam Smart City (ASC) and Brussels Smart City (BSC).

Section 1.2: Case study research

Case study strategy is primarily selected for this research as it allows in-depth investigation of a topic from multiple perspectives, but it is set in a "real-life" context. Its purpose is to provide deep understanding of professional practices, systems and organization's processes. The case studies of Amsterdam Smart City (ASC) and Brussels Smart City (BSC) are selected for detailed analysis due to the importance of ASC as a leading smart city in Europe, and the BSC as an emerging smart city among other new smart cities in Europe.

Amsterdam is one of the cities which have put and keep on putting resources into smart city projects. Over the previous years, Amsterdam has reliably been positioned in the best 10 of Europe's smartest cities (IESE, 2016). Also, there is extensive literature and academic research on the development of the infrastructure of the smart city of Amsterdam, as well as several auxiliary sources that provide important insights.

On the other hand, Brussels is considered to be the economic capital of Europe and has a rich historical context. The city has transformed the smart city plans for the central Brussels region into a strategic policy statement for 2014-2019 and has achieved remarkable success in the five years up to 2019. The BSC's important strategic policies and the analysis of the components of the BSC's smart city models are important elements of the analysis.

An analysis of five frameworks from the scientific literature was carried out, which allowed us to evaluate them and to extract the two most complete. We then applied them to the cities of Amsterdam and Brussels to assess whether the strategic frameworks actually in place allowed a match between strategy and project implementation. We then made a comparison of the two cities which allowed us to determine which one of the cities performed the best. This analysis also enabled us to identify key success factors and frameworks when implementing a smart city.

Section 1.3: Data collection and analysis

For the realization of this thesis, we mainly carried out an indirect observation, by the fact that we focused on literature and did not take part in smart city projects. The main element of this research was the case study through document analysis. This range from formal documentation, which includes annual or audit reports, vision and mission statements, regulations, etc., to informal documents such as memos, newsletters, etc. Although this approach is not as widely used as primary data collection through surveys and interviews, it nevertheless helped us to better understand smart cities and their strategic initiatives.

The literature that was used to carry out this secondary research consists mainly of academic journals retrieved from UCLouvain Libellule, Google Scholar, Science Direct and Emerald Insight databases. Further, books and several different industry reports from global consulting agencies for smart cities projects are also examined. The literature review is followed by the empirical research, which is, as stated, based on a case study performed on digitalization in the smart city projects of ASC and BSC.

The secondary data collected from ASC and BSC project documents, smart cities research reports and independent expert analyses were evaluated. The main objective of this exploration was to review the available literature on smart cities strategic planning and how it relates to the implementation of the smart cities pilot projects. As the pace of smart city development and idea generation is quite recent and has become a widely discussed topic nowadays, we considered appropriate to use only literature from 2009 to 2020.

CHAPTER II: THE SMART CITY

Section 2.1: Background of smart cities

Population growth and urbanization are forcing city specialists to offer propelled types of assistance to a growing number of individuals. Municipal organizations must now deal with the subtle questions of how to adapt to a growing number of residents and organizations, while successfully distributing their resources.

At the same time, constant advances in information and communication technologies (ICTs) are changing urban life and offering creative ways to improve it. Cities and countries are striving to combine these two trends in an effort to harness the new ICT scene. In this way city planners can provide inventive administrations for capital attraction and sustainable development while preserving the environment.

In the past, the rivalry that regularly existed between cities was becoming more and more exceptional. The rivalry sought to attract speculation, strong organizations and talented individuals on a global scale. These new developments have triggered the improvement of many models of urban improvement. The new city models are expected to address the challenges of utility, sustainability, improvement and seriousness in a globalized high-tech economy. For instance, a calculated improvement model that tries to utilize ICT for the advancement of a city's human, aggregate, and mechanical cash-flow to accomplish sustainable urban improvement. We therefore understand that sustainable development is a key feature of cities trying to recreate themselves to meet global challenges.

For this research and in order to select a definition for the continuation of our work, it seemed important to us to draw a portrait of the origin of the expression and then to provide an overview of the various definitions available from both Anglophone and Francophone scientific literature. Once these different definitions have been presented, we will select the one that seems most appropriate. Following this and still in this section on the background of the smart city, we will have a look on the different regulatory bodies and strategic plans to understand the evolution of the smart city in the European Union.

2.1.1 Origin of the expression

The expression of smart city was born in the early 1990s and has been popularized by private firms. These firms include mainly IBM and others such as Cisco Systems, Siemens AG, General Electric, Phillips, and others. IBM's interest was focused on the conquest of a new profit-making market which was associated with information and communication technologies in cities (Söderström et al., 2014). So, it is therefore first of all an expression popularized by private firms.

Secondly, it is a concept or expression that is part of the continuum of other ideas and terms for globalizing the emergence of new technologies within cities. Indeed, 20 years ago there were already a multitude of designations to give a name to the city of the future. The names are such as “smart cities”, “clever cities”, “digital cities”, “information cities” and “eco-cities”. In explicit, obviously, each of these examples of expressions have different meanings because they all referred to assumptions made by different researchers, but we can find central characteristics between them, such as: human, institutional and technological (INRS, 2017). Albino et al. also point out that the term “smart” was chosen purely as a marketing term in order to designate a more elitist perception.

Lastly, it is critical to look forward to the future city and the challenges it faces. These challenges include climate change, growing pollution, energy issues, poverty, and immigration. Moreover, the specific challenges as mobility, education, health, government, energy and environment, are also important in building smart cities (Smart City Institute, 2017). Therefore, we become aware of the emergence of the “smart city” and the various global and specific challenges it will aim to solve. It is thus a matter of reflecting recently on how the city of the future can be built to respond to the problems of its century. It is thus a question of adapting as well as possible to its environment.

2.1.2 Differences from published definitions

Not long ago, the “smart city” term conveyed the meaning of an “intelligent” city with greater innovation and smartness. Whereas, the term “savvy city” conveyed the city's decision to use cutting-edge innovation with the goal of making the city more connected, more technologically advanced so that citizens feel more comfortable and their quality of life increases. In any case, with the increasing promotion of the terms “smart” the past qualification tends to disappear.

Currently, there is no differentiation between “smart and savvy cities” for the most part of “smart city” partners and researchers (Navigational Research, 2011). Another significant perception is that smart cities are the future strategic vision of the developed and intelligent cities; currently this vision is very aspirational (Al-Hader, et al 2009a, Data-Smart City Solutions, 2016).

The term “smart city” is based on a system rather than a reality (Eger. 2009). It represents a reflection on where the city should be in the future and how it envisages transforming itself. Therefore, the exploitation of the capabilities of digital systems for innovation and development are involved. However, it is not something that can be accomplished right now, but at best it is a strategic methodology aimed at satisfying a long-term desire. However, being “smart” at a city level is a matter of approach that involves planned designs (Dicken, 2003). It requires a grouping of large-scale strategic decisions, the commitment of many assets, speculation and the inclusion of partners. All this requires coordination and ownership, which ideally will result in a clearly characterized system of approach.

In addition, there is a lack of public understanding related to “green” and “smart” cities (e.g. green cities, sustainable cities, low carbon cities, green cities). The real difference between “smart” cities and “green” cities lies in the use of innovation to make a city progressively ecological (Bakıcı, et al 2012). In both cases, however, there is a desire for a sustainable transition.

However, in general, the terms used in both cases have encouraging ramifications on the sustainability of city structures and capacities. While the association of ecological cities with the possibility of sustainability is increasingly clear, a city that uses environmental ratings improves its sustainability. Many experts agree that smart cities add it to ecology and urban sustainability (Angelidou, 2014, Charnock, Purcell & Ribera, 2013). Moreover, many cities are considered both green and smart by using new advances and moving resolutely towards environmental sustainability. These cities are transcendently recognized by a sustainable urban structure and ecological innovations. Some of them even incorporate both of these reflections in their authorized brand names, such as “Langfang Eco-Smart City retro-fit”, “Nanjing Eco High-Tech Island”; or even “Fujisawa Sustainable Smart Town” (Dameri, 2016).

2.1.3 Definition chosen and its current relevance

As seen earlier, there are a variety of terms that define the “smart city”. However, for the sake of the work and in order to be able to refer to a key concept throughout, we decided to select the definition established by HEC Liège (Smart City Institute, 2017) as it seemed to us to be the most complete and up to date. This definition has also been used in numerous researchers work and allows us to guarantee a certain reliability.

> “**A smart city is an ecosystem of stakeholders** (local government, citizens, associations, multinational and local companies, universities, research centres, international institutions, etc.) **engaged in a process of sustainable transition** (strategic vision and/or concrete innovative projects) **in a given territory using new technologies** (digital in particular) **as a facilitator to achieve these sustainability objectives** (economic development, social well-being and respect for the environment).” (Smart City Institute, 2017)

Currently, the essential parts are the stakeholders involved, the sustainable transition that reflect the chosen urban framework, the ICTs and networks selected, and an established strategic methodology. The improvement of an appropriate Smart City methodology represents an essential socio-economic incentive for cities, by requesting:

- Better administration and close monitoring of a city's capacities (government, welfare, medical services, vitality, transport, education) (Borja, 2007).

- Growth and intensity by making urban settings progressively more efficient, helping organizations to create, attracting speculation, creating new openings, etc. (Borja, 2007).

- Social manageability and incorporation, by sorting out and making available huge measures of information, improving availability and inclusion, developing new channels of correspondence, encouraging the system of participatory majority rules and customer commitment, etc (Borja, 2007).

- Other important elements in smart cities are environmental sustainability, through the reduction of the use of vitality, the use of elective vitality recourses and the expansion of ecological awareness (Angelidou, 2016).

The meaning of a specific “smart city” has been widely disseminated over the last two decades and fully defined in previous research by Neirotti et al (2014) and Angelidou (2016). However, due to the huge diversity of settings, sizes and assets of each city, Vanolo (2013) argued that a single methodology is not the most appropriate. Moreover, cities that engage in this path need to plan their system in the best possible way to become “smart”, explicitly adapting it to their situation.

As Angelidou (2016) argues, a city trying to become “smart” must have coordinated, forward-looking and visionary strategic planning. This arrangement must characterize a dream and a philosophy that depends on the use of digital innovations to improve urban capacities. Hence, research on the types and scope of different smart cities is needed to understand their success factors.

2.1.4 Development of the smart city in the European Union

The development of smart cities in the European Union is the subject of various agreements and strategic plans proposed by two major regulatory bodies (Bolici & Mora, 2015) which decide to reserve smart city activities in terms of city size, spending plan, number of people and topographical core area”.

The first major decision-maker is the “European Innovation Partnership on Smart Cities and Communities (EIP-SCC)” which was created in July 2012 and has allocated €365 million to “smart city” expansion projects in 2013. This organization works with neighbourhood individuals and innovative companies on vitality, transportation and data innovation. The major function relies on expectation to deliver coordinated, inventive and competent advances for cities. It seeks to improve civil administration, while reducing pollution and increasing the vital productivity of smart cities. The creative and useful “smart cities project” has been decided under the responsibility of thirteen EU partner cities, located in six EU countries (European Commission 2012).

The other regulatory and planning body is the “Smart Cities Project European Union (SCP-EU)”. Bakıcı, Almirall, & Wareham (2012) state that the main foundations of the European Commission are responsible for overseeing and allocating grants, support and funding for these activities.

The North Sea Region Programme (NSRP) is partially supported in the European Union's plan for 2007-2013, with the support of civil societies and residents as direct stakeholders (Bakıcı, et al 2012). The report “Smarter Cities” (2013) stressed that the aim of the smart city project in EU countries is to advance organisation among individuals, to create and deliver better online services to urban residents and organisations in the North Sea District, with a focus on maintainability.

According to the Smart City Strategy Index (Roland Berger, 2019), when it comes to task utilization status, the majority of the top fifteen cities have completed or are leading companies. For example, Vienna was the leading German-speaking city in the world to distribute open information (open data) and is one of the pioneers in open government data. Most cities are also tracking the progress of these projects, but Vienna and London have done more than that. The Austrian capital assesses specific projects, but also assesses progress towards its long-term goals, such as reducing emissions. In the meantime, London has set up an online step that allows everyone to monitor progress on an ongoing basis. Such frameworks ensure a high level of simplicity, highlighting both triumphs and areas for potential improvement.

Achieving a smart status relies on the activities of three key gatherings: city organizers, arrangement providers and national/provincial governments. Based on the analysis of selected our research and information from this work on cities and technology organizations, the next sections discussed the strategic approaches and implementation for smart cities.

Section 2.2: The strategic approach of smart cities

At the level of the international literature, it can be noted that the strategies are organized in two distinct blocks. On one hand, cities can work on structural elements such as telecommunications, open data and the issue of infrastructure. In this case, we are in the process of developing a “top-down” strategy, initiated by leaders and executives. We are therefore in a

downward approach, from government to end-users, which requires a clear understanding of the formal objectives.

On the other hand, cities can develop projects in different fields of intervention in different areas, such: living environment, services to citizens, economic development, sustainable development, urban mobility and communication infrastructures and will be seen in the case study of Amsterdam. In this case, we are in a bottom-up, ascending approach that is set up and carried out by local actors. It is somehow more relevant because the actors directly face the issue or problem.

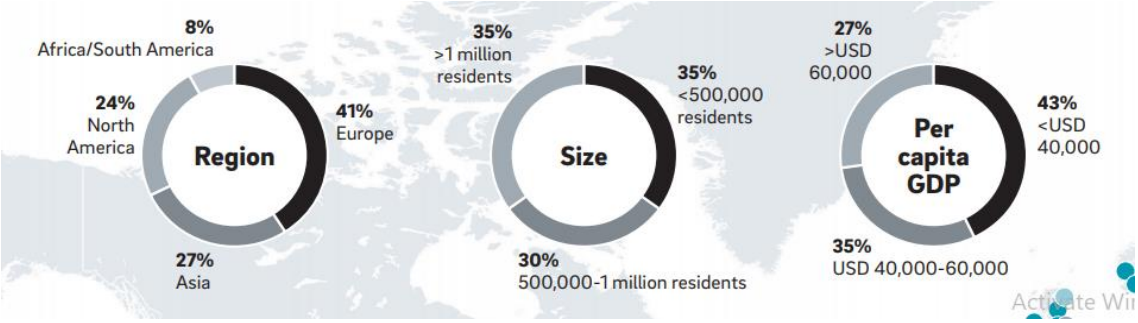
It is up to the city itself to define the strategy that best suits it. The result prevails by the means to achieve it. However, it is important to stress that the ultimate objective is indeed to ensure the sustainability of the territory, the well-being of the citizens, and that the concerns of the citizens are taken into account.

Returning to the process of creating a smart city, this involves three main phases. The first stage is the "strategic planning" which aims to make a diagnosis of the current situation, to define priorities and the evaluation methodology. It is mainly on this stage that we will focus and even more precisely on the methodological approach. The second stage is the "implementation", which concerns the action plans of the projects, including: stakeholders, financing, technologies and legal provisions. The third and last step is "monitoring", which mainly aims at monitoring and evaluating the projects by setting up Key Performance Indicators.

2.2.1 The Smart City Strategic Index (SCSI)

The Smart City Strategic Index (2019) report was published by the consulting firm Roland Berger. According to the findings of the SCSI 2019 report, it is clear that the use of the strategic approach is an essential element in designing and building a smart city. The report identified a total of 153 strategies and compared them for large and small smart cities with an official smart city strategy. The three top-ranked smart cities were Vienna (Austria), London (United Kingdom) and St. Albert (Canada). The categories of 153 smart cities included in the SCSI 2019 ranking are based on region, size by population and GDP per capita, as shown in the following figure.

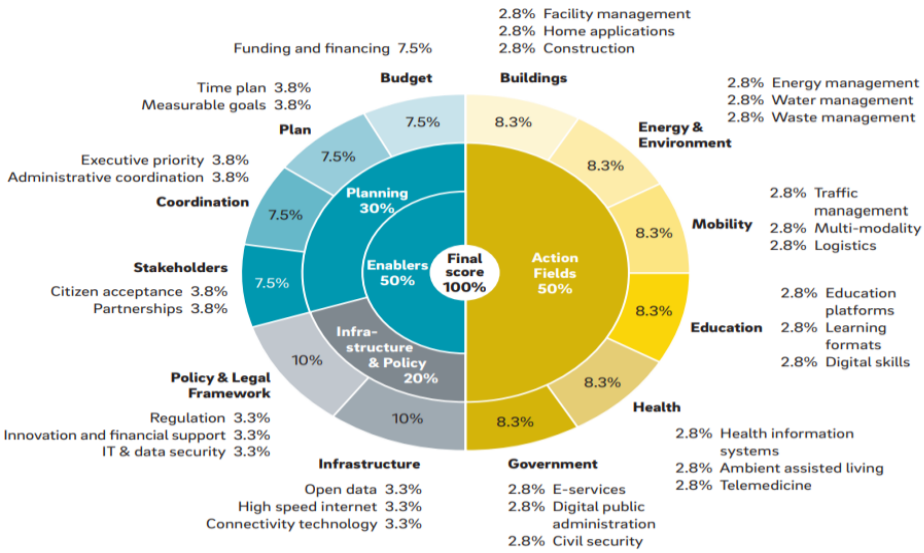
Figure 1: Categorization of Smart Cities in SCSI 2019 (Roland Berger, 2019).



The above figures show that 41% of smart cities are located in Europe, 27% in Asia and 24% in North America. In the ranking of these, 35% have a population of more than 500k residents, and 43% smart cities have per capita GDP above $40,000. In addition, taking into account the availability of official strategic documents, SCSI 2019 used 12 major criteria divided into two categories: action fields and enablers (subdivided into two: planning and infrastructure & policy) for a comprehensive smart city strategy.

The main success drivers for these criteria, are the mobility solutions and buildings as a field of action. Other important criteria serve as catalyst, such as energy, communication, sustainability goals, education and health-related factors. Coordination factors, stakeholders and infrastructure have also contributed to major enablers in SCSI criteria of success factors for smart cities.

Figure 2: Success Criteria of Smart Cities in SCSI 2019 (Roland Berger, 2019).



The analysis conducted for SCSI 2019 based on the above criteria and sub-criteria concluded that Europe and North America have the largest number of cities and some of the best strategies. However, this is not enough to rival Asia, who is at the top of the ranking with an average score of 48.2 out of 80. The average score for North America is 41.8 and 37 for Europe and we can find Africa far behind with a score of 32.1.

Moreover, SCSI 2019 indicated that the smart city strategy is spreading rapidly into major cities around the world and that the number of smart cities has grown rapidly over the past five years. However, the presence of a specific official smart city strategy document is evident in only 49 cities out of approximately 500 cities worldwide, with populations over one million (Roland Gerber, 2020).

2.2.2 The Strategic Sustainable Development (SSD)

As outlined beforehand, the conditions of urban development present a reality wherein human conduct on the planet is becoming increasingly unsustainable. Nam and Pardo (2011) have indicated that understanding the vision of the smart city requires a thorough understanding of the difficulties and problems of the city related to the interconnectedness between the environment, technological levels, social segments and the benefits of the physical state of cities.

Similarly, Cocchia (2014) has argued that strategic initiatives and policies are needed to achieve a sustainable city that can address the complexities of the smart framework in a comprehensive manner. Strategic Sustainable Development (SSD) is the approach mentioned to involve the characters on screen inside, allowing them to cooperate to effectively progress from the current, indefensible condition of society to achieve a better society in terms of social and biological sustainability (Smarter Cities 2013).

The strategic application of sustainable progress is achieved through frameworks for strategic thinking, an understanding of sustainability that depends on established experimental standards and achieved through a step back from the system of standards. The Framework for Strategic Sustainable Development (FSSD) is responsible for implementing the strategic sustainable development approach in an appropriate system. This structure allows the different

partners/stakeholders to be part of a psychological model that helps in understanding the of the mind-blogging issues recognized in the smart city idea.

2.2.2.1 The system thinking approach

Davidson and Venning (2011) have argued that understanding the conditions and factors that impact on sustainability, explicitly in urban settings, requires a framework thinking approach. This point of view requires an awareness of frameworks and sub-frames of any topic, along with the critiques and practices displayed by the framework's communications (Robèrt et al. 2002). An understanding of frameworks is important for judging the sustainability perspective in cities that determine city capacity.

According to the Copenhagen Cleantech Cluster (2012: 6), the fundamental reason for advancing smart cities is to "understand the city as an arrangement of frameworks", including information, vitality supply, council waste, foundation, transportation, etc. (Robèrt et al. 2002).

Individual frameworks can be quite smart and well-coordinated. Thus, considering that a smart city takes into account a superior understanding of interconnectedness, and makes use of important frameworks to create comprehensive sustainability activities. In addition, the strategic thinking approach considers the inspection of any smart city within the framework that operates beyond the boundaries of the smart city. Ny et al (2006) explained the principles of sustainability as the conditions under which any society operates to achieve sustainability.

To characterize sustainability, a logical and thorough assessment process was conducted, which resulted in the development of four sustainability standards. These standards are referred to as the *four sustainability principles* to provide the foundation for smart cities. These principles express this (TNS Canada, 2013):

- **Mineral resources:** « substances from the earth 'crust must not increase in nature ».
- **Synthetic materials:** « substances produced by society should not accumulate in nature ».
- **Biological productivity:** « no physical degradation of nature; - plant and animals harvested sustainably; - biodiversity not reduced ».
- **Equality:** « people are not subject to conditions that systematically undermine their capacity to meet their needs ».

Section 2.4: Key dimensions of the smart city

As explained above, there may be different dimensions of smart cities depending on the framework and the definition chosen. However, for our work, we have decided to focus on the most important and the most regularly occurring ones in the scientific literature. We will therefore address the following four: physical, environmental, collaboration and innovation.

2.4.1 The physical dimension

Innovations in urban planning are classified as "space-contracting advancements" (Dicken, 2003), which have led to the development of an information society and a global network. It can be said that place no longer matters, and then all we need is a decent combination of links that puts the whole world together. However, the proximity of individuals is always an essential condition for the concentration of correspondence and information exchange.

There are a variety of reasons why physical measurement is probably necessary at this time. One progressive explanation is the plausibility of a fifty-fifty city (material as well as virtual), which is an experimental obscuration among the internet and virtual space (Zook et al 2008). The undecided link between the "supposed" physical location of the internet and the importance of location points are at the centre of concern for smart cities (Boulton, et al 2011).

Thus, spatial fixation creates fiendish urban problems. Specialists in the field of needs point to negative impacts on neighbourhoods, for example, by developing wage polarization and the framework of decay networks. Neighbourhoods in a similar city are often not equivalent in terms of the openness and usability of traffic frameworks, digital foundations and different administrations. For example, computerized partitioning in some urban areas becomes an explicit spatial area issue. The zone sets the preferences of some areas while disadvantaging others.

2.4.2 The environmental dimension

Urban planning for smart cities is closely linked to and influenced by the broader mainstream (social, political, economic) framework (Pinnegar et al 2008). Odendaal (2003) analysed the activities of Brisbane and Durban as smart cities in relation to the wider social, political, economic and social framework. The realisation of these two cities depends on logical contrasts

in the links that exist between the key characters on the screen and the terrain of legislative and economic issues. Examining the changing geopolitical context, Eger (2009) argued that there is no single strategy that can accommodate all smart city developments. Municipal governments essentially aim to put in place many clearly explained methodologies developed in the natural setting. Difficulties encountered in the broader natural setting reflect the increasing exclusion of certain parts of the population due to socio-economic gaps (McCarthy, & Vickers 2008).

Another important parameter is the ecological fixing of the urban intensity on the overall weight. The strength of the rivalry between cities around the world can form a multiple set of policies for the development of a smart city. There are some evaluation measures to position and assess smart cities and their innovation activities. A delegated evaluation of the European ranking of smart cities is being developed and could be a powerful instrument to locate, benchmark, and mark cities. Measurements, however, produce some uncertainties, i.e. they do not take into account complex interrelationships, neglect a long-term perspective, and present current activities as generalizations (Giffinger, & Gudrun, 2010).

However, as we have understood before, whether by the definition chosen or by the Strategic Sustainable Development principles, the primary goal is the sustainable transition. It is extremely important to prepare the city for its future. It is relevant to remember that today one out of three people live in the city and that tomorrow it will be two out of three. Indeed, today's cities are facing new problems and new solutions are required. To give an example and to link the physical dimension to the environmental one, when cities have to build new neighbourhoods, they have to face new very high environmental standards but also energy constraints.

2.4.3 The innovation dimension

Smart city innovation simply indicates “the strangeness in real life” (Potts & Kastelle. 2010) and “new thoughts that work” (Giffinger & Gudrun, 2010). The “smart city of innovation” emphasize not only another thought but also an education. The meaning of a smart city is the innovation in the city. The “smart city” brand focuses on modernization to manage metropolitan issues related to urban collections (Caraglin, et al 2009).

ICTs have given the smart city the power to be an open division, an innovation made in the urban environment. It reinforces a long-term preparation to improve operational and administrative competence and personal satisfaction by developing ICT drivers and foundations. Innovation in the smart city occurs at the foundation level and furthermore are the procedures for recognizing dreams. New technologies are opening up new perspectives and possibilities hardly imaginable, leading to new practices and lifestyles.

The literature has found the three components of innovation in city government organizations: frameworks, technology, and organization. According to Fitzgerald (2016), innovation in a city can occur at the level of the article, administration, process, position, technology, administration, and discourse. It is indeed necessary to think or rethink differently in order to face new challenges, and this is where innovation comes into its own. It is about solving new problems by using new information and communication technologies.

2.4.4 The collaboration dimension

The vulnerability of the condition and the complexity of the innovation significantly affects innovation (Capdevila & Zarlenga, 2015). The stages of complexity changes with the idea of collaboration. Smart city activities are based on the intergovernmental, inter-organizational or intra-organizational model, and can also be explicit in terms of timing or be undertaken in an inclusive manner (Pardo & Burke, 2008).

The range of smart city activities can extend beyond urban boundaries to the multi-jurisdictional framework. The topics of collaboration integrate information, data and intelligence. Connection exercises can be shared, correspondence or combined. Different potential mixes make up the changing degree of the multi-dimensional nature. Smart city activities, which include more characters on screen, larger levels, would be increasingly confusing.

The success of smart city innovation depends on the ability to understand the extra level, the environment of unpredictability (Toppeta, 2010). This dimension of collaboration acts on several levels and its objectives are mainly to bring together the three previous dimensions, to gather the stakeholders around the projects and to act as a companion towards the expected result. It also involves cross-sectorial solutions, such as the creation of platforms and multi-services.

Section 2.5: Action fields of smart cities

We focused a lot on the history of the smart city, on the theoretical aspect and on what the approach had to involve. Before going back, on this more theoretical aspect and to present the different frameworks that allow us to set up the smart city approach, it seemed important to us to devote a section on what it implied at the implementation level.

As seen previously in the Smart City Strategy Index (SCSI) 2019 of Roland Berger *(figure 2),* they based their assessments of smart cities on three axes: action fields (50%), planning (30%) and infrastructure & policy (30%). Due to the established limit of our research, we will only focus on the action fields.

2.5.1 Buildings

One of the observations that can be made in the smart city is that there is a focus on usage. In the buildings, we can distinguish them in the way we will use them, whether for work or for living. They must serve as a continuity in the experience of the citizen, in the use of public and private space. Inside the building, this has been noticeable with the implementation of software based on artificial intelligence such as Google home, which allows to manage all the parameters of the house (lighting, heating, sound, atmosphere, etc.). And on the other hand, in public use, it is a question of constructing buildings that are eco-responsible and that adapt to the structure of the city or to the environment.

2.5.2 Energy and environment

As the name suggests, we are in the business of managing natural resources, specifically energy, water and waste. The goal of the smart city here will be to make it the greenest possible, the most efficient, the most sustainable and obviously the least polluting. It is about having a greener and lower energy production. In terms of the environment, it will be a question of integrating intelligent solutions for water and waste management and guaranteeing their quality and future use. In the long term, the aim would be to move from a circular economy to a circular city. For example, we have noticed that several cities have set up a lightning system that is triggered by sensors. This device has in fact made possible to reduce energy consumption by more than 65%. But it can also be implemented by greener energy sources, such as wind turbines or solar panels.

2.5.3 Mobility

When we talk about mobility, we often tend to refer to the number of hours we spend per week in traffic to get to work. This is indeed one of the main characteristics of this axis. The aim would be to improve citizens' lives by offering more accessible and faster journeys while respecting the environment. A lot of progress has already been made through the introduction of intelligent traffic lights, through the creation of applications that allow people to find a parking space more quickly, and so on. The aim would indeed be to continue on this momentum and to continue on the path of connected objects allowing to give information in direct time for the implementation of adapted solutions.

2.5.4 Education

One of the flagship objectives of education within the smart city is, as its name suggests, is the education of citizens to include them in this development. It is an approach that aims to put citizens at the centre of concerns and to make them autonomous from their own education. This program aims to give better quality education while training them on current issues of the smart city, so that it can become a place of self-creation. This is done through the creation of online educational platforms, the creation of hubs dedicated to the smart city, and the inclusion of courses within university programmes.

2.5.5 Health

The health and well-being of citizens is also one of the main fields of action. The whole population must therefore be taken into account and senior citizens, who often tend to get lost in new technologies, must also be taken into account. This can be set up by connected watches to collect health information, by ambient assisted living or even telemedicine.

2.5.6 Government

The government is one of the most important players, if not the most important when setting up a smart city because it is the one with the highest hierarchical level. It must be able to develop a participatory and integrated system, while at the same time exploiting innovative solutions from ICT. It is necessary to know how to integrate the citizens to better meet their requirements and this can be done through the implementation of e-services or by digital public administration.

Section 2.6: Strategic frameworks of smart cities

The success factors as well as the strategic decisions outlined previously explain the various reflections that strategy-makers can develop to transform municipalities into smart cities. In any case, they do not provide guidance on the overall strategic process, referring to planning and the use of technology to transform urban areas into smarter cities. We will present all the frameworks we found in the scientific literature and that were relevant to our research. Then we will make a summary grid and explain which ones we decided to use in our case study.

This section therefore addresses the different frameworks that can explain the strategic process of establishing a smart city. All of these frameworks are equally unique and provide singular moments of knowledge about potential ways of dealing with the organization of a smart city methodology.

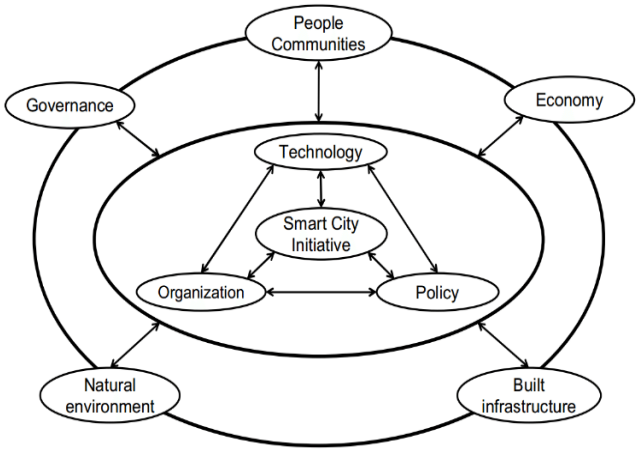
Some of the frameworks as the SMART framework (Letaifa, 2015) or the smart city reference model (Zygiaris, 2012), for example, describes the planned arrangements of a smart city as a process, and others as the smart city success factors framework (Charoubi et al) or IBM model includes different forms that consider planning separately and that make up the structure of the components of a general smart city methodology.

2.6.1 The smart city success factors framework

This framework was one of the first invented, and it can be noticed by the fact that there is little scientific literature on it. However, it still brought a great scientific breakthrough on the subject because it allowed many other scientists to use it as a starting point and to rework certain elements. We have therefore decided to include it not for its quality but for the launch that it allowed.

Charoubi, et al (2012) decided to explain their framework by setting out the fundamental elements for imagining the city of the future. These elements are grouped into eight groups: governance, people communities, economy, built infrastructure, natural environment, technology, policy, organization.

Figure 3: Smart city success factor framework (Charoubi et al. 2012)



The two circles, as shown above *(figure 3)*, reflect the distinction in force or the impact of the elements. They demonstrate that technology, policy and organization are most directly powerful in carrying out smart city activities. It is important to note through this framework that technology is already placed as one of the key drivers. The five remaining dimensions have a reduced impact on the implementation of a smart city initiative; however, they support the three main dimensions.

2.6.2 The smart city innovation framework

Figure 4 below shows the multi-dimensional structure of smart city innovation, emphasizing the equal importance of technology, organization, policy and context.

Figure 4: Smart city innovation framework (Nam and Purdo, 2011)

Dimension	**Innovation** How can we change the way government delivers service?	**Risk** What are risks from innovation?	**Way to Success** How can we deal with risks while innovating?
Technology (to serve as a tool for innovation)	▪ Leveraging transformational potentials of advanced ICTs	▪ Lack of knowledge ▪ Incompatibility ▪ Too much hope ▪ Security	▪ System interoperability ▪ Integration of systems and infrastructures
Organization (to manage innovation)	▪ Enhancing efficient, effective management (front-office and back-office) ▪ Improving interoperability within or across organizational boundaries	▪ Organizational conflict ▪ Resistance to change ▪ Misalignment between goals and projects	▪ Enterprise interoperability anc business modeling ▪ Cross-organizational management and managerial interoperability ▪ Leadership
Policy (to create an enabling environment)	▪ Redesigning relationships between government and actors ▪ Policy experiment	▪ Inconsideration of multiple stakeholders ▪ Political pressure ▪ Conflict with other policies	▪ Policy integratior ▪ Marketing ▪ Governance ▪ Collaboration ▪ Partnership
Context	▪ Physical dimension ▪ Environment ▪ Level of interactions		▪ Consideration of context

It is a framework that is particularly interesting because it has a transversal perspective, which takes into account: dimensions, innovations, risks and way to success. It also includes the same main dimensions as the previous framework established by Charoubi & al, i.e. technology, organization and policy as key dimensions or key success factors. They have almost the same publication date, but we can see that this one is much more complete and that it deals with dimensions that are still strongly present and that we have even defined beforehand without knowing it (physical dimension, environmental dimension and level of interactions).

Currently, the main dimensions of this smart city innovation framework are as follows:

1. **Technology innovation:** is seen as an instrument to change and update innovative devices in order to gain benefits and improve infrastructures.

2. **Organization innovation:** it is about managing innovation, to respond to it through the different dimensions and context, and to improve intertemporally.

3. **Policy innovation:** support systems to address institutional urban issues and improve relationships with the aim of creating the right conditions for the creation of a smart city.

Innovation in Smart Cities is about the transformative capacity of smart innovations, multi-purpose advances, virtual advances and distributed computing. These innovations create technological uncertainties. To make a smart city, innovations need to be rapidly incorporated into all settings, including organizations (Al-Hader and Rodzi, 2009a).

We can see in this framework that innovation is present across all dimensions and that it is an end in itself. According to this framework, it is necessary to be able to innovate in order to progress. They also set out the risks to be kept in mind and how this can be achieved. It's a framework that marks a step forward and is quite comprehensive.

Compared to the smart city innovation framework, we can notice that it is more complete on the basic key success factors but that it does not include support dimensions such as the natural environment or governance.

2.6.3 IBM Smart City Framework

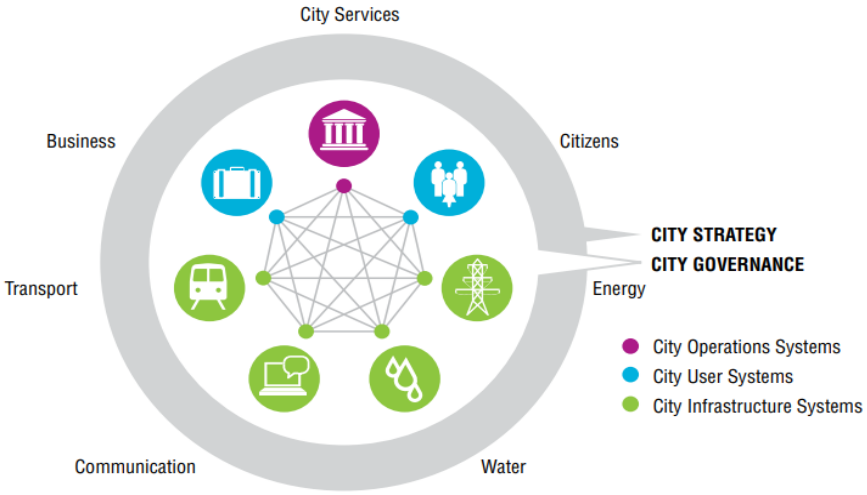
According to IBM's Smart City model (2010), the business system of smart cities is based on the environment in which businesses operate and refers to the policies and regulations of municipal departments. Citizens and businesses are two important stakeholders in municipal services. Thus, city services enable these two stakeholders to move around in the transportation system, to communicate in the communication system. In this integrated system of systems, businesses and residents use facilities such as energy and water resources. The main components of this integrated and interactive smart city model are as follows:

Table 1: Components of the IMB smart city model (IMB GBS, 2010)

City Services	The smart city authority's operational system coordinates the delivery of services to residents and businesses. Planning and funding allocation are the main activities of the smart city authority, which involves a variety of agencies.
Citizens	The system comprised in social and human systems that include health and public safety, housing, education, and maintaining quality of life.
Business	This system is based on policies and regulations relating to business enterprises, the labour market, foreign trade and investment options.
Transport	System comprised on roads and rail networks, sea and air transport frameworks of the city.
Communication	The system includes telecommunications infrastructure for wireless telephone and broadband networks, print media, and other mode of communication.
Water	The system of water services covers the fresh water supply, sanitation, sewerage, and control of water cycle.
Energy	Electricity transmission, generation and storage systems make it easier for businesses and citizens to monitor their activities.

The core components mentioned above are integrated and interconnected in IBM's Smart City model, in which municipal services are linked to citizens and businesses to facilitate their lives and develop policies and regulations. Citizens and businesses are connected to utility systems as shown in the figure below:

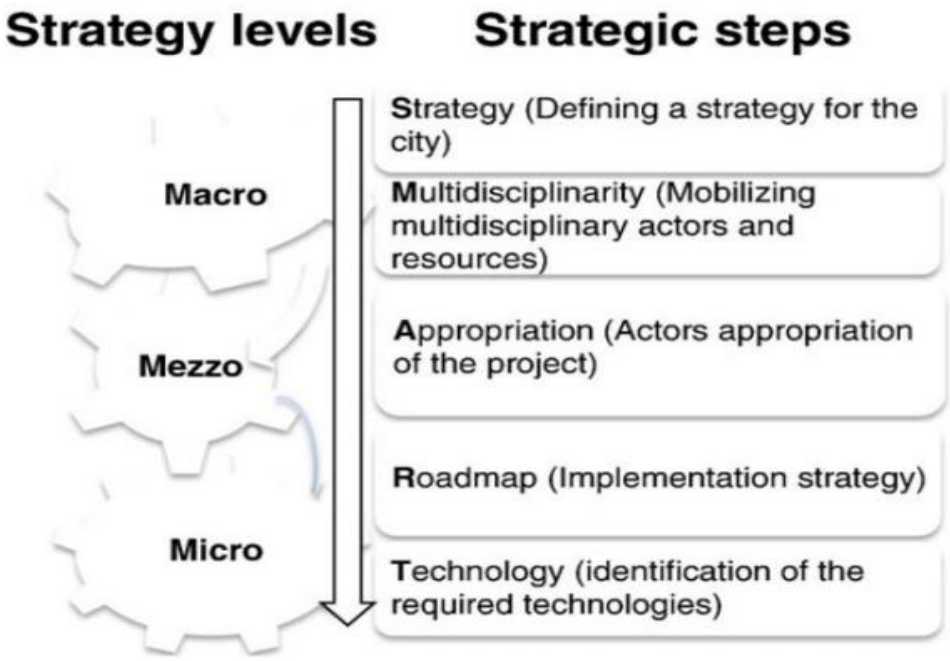
Figure 5: IBM smart city model



2.6.4 The SMART framework of smart city

Letaifa (2015) built up a SMART structure to represent how cities have planned and structured their smart city system, on the basis of broad writing and inclusive subjective research in three significant cities (Paris, London, Stockholm). It ought to be notice that although these smart cities pursue a comparable planning process, every city has an unmistakable technique relating the city's vision, personality and qualities.

Figure 6: SMART framework (Letaifa, 2015)



SMART stands for Strategy, Multidisciplinary, Appropriation, Roadmap and Technology. These acronyms refer to the planned steps a city can take in its approach. The components of the SMART model each have a place with a particular level: macro (large scale), mezzo (middle scale) or micro (small scale). The strategy and the activation of a multi-disciplinary asset have a place with the full-scale level, while the appropriation and guidance step have a place with the mezzo level. Technology or innovation change at this stage has a place at the last level, the small-scale level.

This "Strategy" stage refers to the structuring and controlling of a distinctive idea for the city that requires strong leadership and a careful understanding of the network. It is about establishing a strong common vision among all stakeholders and the steps that need to be put in place to achieve it. At this level, the city must set up a system of priorities on the projects it would like to implement.

The second phase, the “Multidisciplinary” step consists of bringing together the assets and resources of different regions and partners to assist the collaborative process of the smart city. This step should also bring together the different disciplines (health, mobility, energy and environment, etc) and the links between different departments (economics, data management, government, etc).

The next step is the “Appropriation” stage, which focuses on increasing the social value to ensure that the process is welcomed and realized. Actors must take ownership of their projects and make sure they have all the necessary resources. The final aim of this phase is to include the citizen and to ensure that he is taken into account in the process and that the innovations are appropriate.

After this stage, a guiding or more precisely a “Roadmap” stage allows the process of working on the best way to change the city to be subtly implemented. It is a matter of establishing a plan to know how to go about it, what each actor has to do, as well as the deadlines to be respected. This is a project management program.

At long last, to update this roadmap, transformative technological advances are needed, and it’s where the “Technology” step comes. We can see that this technological step comes last and acts on a small scale to better respond to specific problems that take place at the regional or

neighbourhood level. Contrary to previous frameworks we can notice that technology or innovation is not an end in itself. We can also notice that in this framework we are in a kind of project management or process development that is broken down into several stages, not like the previous ones that simply had key elements.

2.6.5 The smart city reference model

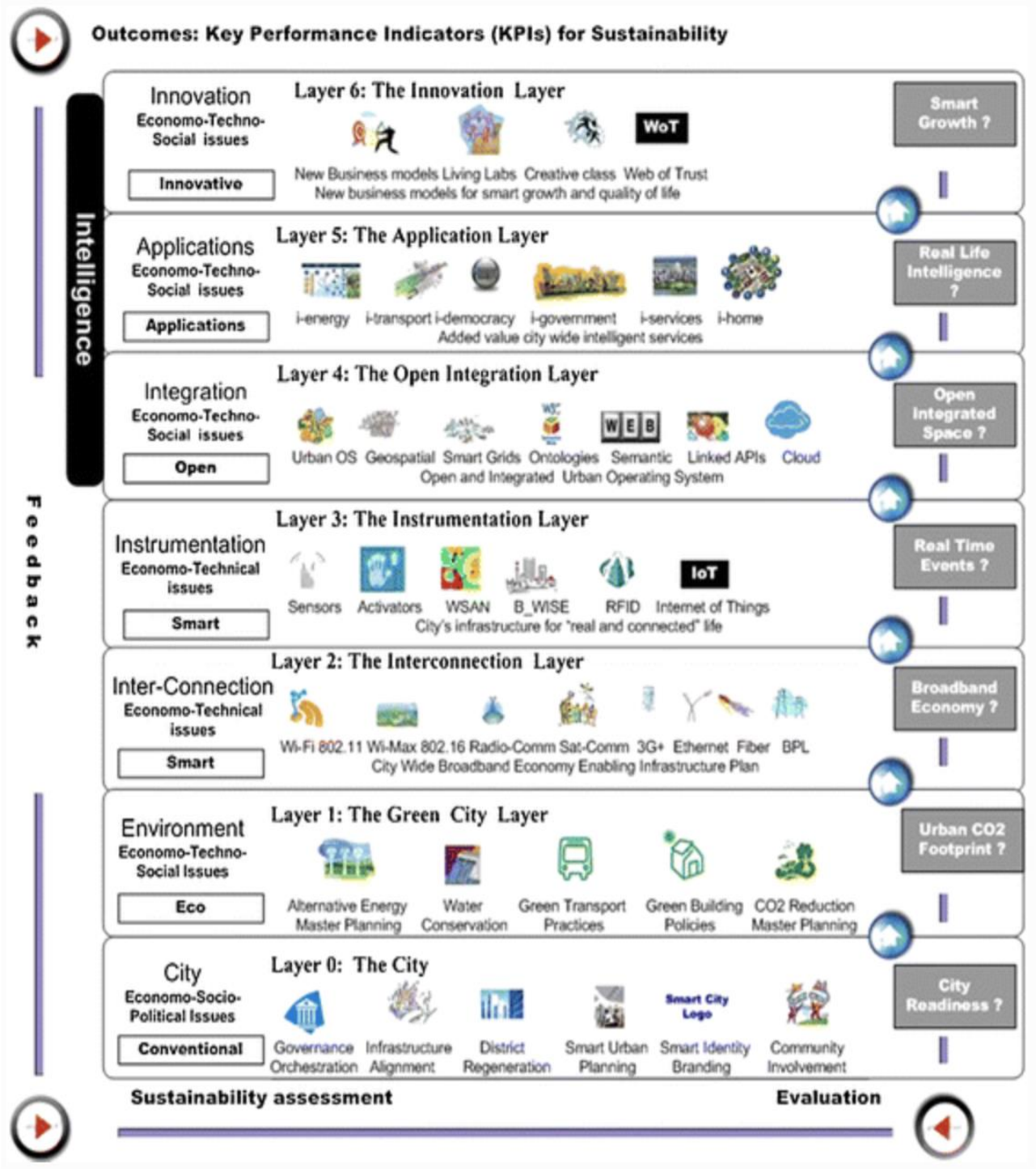
Zygiaris decided to create a framework and as its name indicates a reference framework in the establishment of a smart city. He wanted through it, to achieve a comprehensive system that integrates the identified origins, policies and procedures with smart city planning. Its model is divided into seven layers, each of which is designed to respond to specific issues. This model is seen as being functional for intelligent urban development in an exclusive and autonomous way, as each step can be, since each layer can be customized according to the strengths and needs of an urban area.

We will now take a closer look at *(figure 7)* below and detail each of the layers. The city is positioned as Layer 0, because before it can embark on the smart city transition process, the city must have good foundations. It's a conventional layer that takes into account: the governance, the infrastructures, the districts, the clusters, the heritage, the citizens to figure out if the city is ready. We can see that this is the first time we find a start-up phase in one of the frameworks.

The first layer, *"**The Green City Layer",*** deals immediately with the urban CO2 footprint that the city has. We are directly involved in the sustainable transition that is present in our definition and which takes up the characteristics of Strategic Sustainable Development (SSD). It deals with the alternative energy, water-sewer, green city, green buildings, green transport. Through this dimension we are present both in the field of energy & environment through energy and water management, in buildings through their eco-friendly construction, and in mobility through responsible transportation.

The second layer, ***"The Interconnection Layer",*** serves the purpose of connecting people, networks, communities, devices and systems. It includes: wi-fi, wi-max, radio communication, satellite communication, 3G+, Ethernet, BPL, or more advanced version of those ones. It is the first smart axis within the model, and it takes care of the broadband economy.

Figure 7: Smart City Reference Model (Zygiaris, 2012)



The third layer is also a smart and is the ***"The Instrumentation Layer",*** which can refer to the hardware of the smart city. Hardware in the sense that it refers to the physical equipment that is in the field, such as smart traffic lights that turn green when you get to a crossroads. The objective of this axis is thus to have connected objects such as sensors, detectors, tracers, allowing to collect real-time data and to manage the city more effectively.

The fourth layer, ***"The Open Integration Layer",*** refers to the establishment of a storage system to store data from different hardware and therefore different technologies. That includes urban OS, geospatial, ontologies, semantic, open date, linked applications, cloud. We are here, contrary to the previous layer, at the level of software. The purpose of this layer is to give meaning to what has been collected and to be able to make efficient use of it. Here it is not the use of real-time data that is relevant but the storage in order to be able to extract statistics, trends and forecasts for the long term.

The fifth layer, ***"The Application Layer",*** aims to link the previous layers and the different major axes. We are at the level of technology, intelligence, its goal is mainly to make optimization in all areas. Whether it is at the level of energy, mobility, governance, services or buildings. The goal is to improve and in fact simply make the city smart. This is done by increasingly removing, banning, regulating or reducing what is bad for the land and its inhabitants and by improving, subsidizing, encouraging behaviour and technological advances.

The sixth and last layer, ***"The Innovation Layer",*** aims to make the growth smart, on the various economic, cultural, social and technological levels. We are in innovation, and this is one of the key points that has been put forward by all the frameworks. However, this one proposes different things, such as: new business models, living labs, creative class, web of trust.

To give a global feedback, it is a reference framework by the fact that each city can use it individually when building its transition. Moreover, it has all the dimensions and all the fields of action that we have defined before and that we thought indispensable. It also goes further, by directly integrating certain projects within the axes. As for example by creative classes or the Internet of trust for the dimension of education. It is also important to note that it is a framework that is completely different from the others in terms of its structure, interconnections and projects. We notice that it is not in the continuity of the others but that it marks a change of direction and a scientific breakthrough of its own.

Section 2.7: Comparison of smart cities frameworks

The above section discussed smart city frameworks such as SMART framework (Letaifa, 2015), smart city reference model (Zygiaris, 2012), smart city success factors framework (Charoubi & al, 2012), smart city innovation framework (Nam & Purdo 2011) and IBM smart city model (IBM 2008). The above discussion on these models can generate some similarities and differences of the frameworks and their suitability for this research. We thus have decided to compare them all in the following table.

2.7.1 Selection of the frameworks for the case study

For the good continuity of this thesis, we decided to keep two of the five frameworks presented, which are the SMART Framework of Letaifa (2016) and the smart city reference model of Zygiaris (2012). The selection of these models is based on the fact that they are the models that presented the approach of establishing a smart city as a process in different steps. We have also noticed that these are frameworks that are structured and that allow us to study or compare one or more smart cities.

We found the other frameworks to be minimalist in the sense that they only set out the key success factors at a very broad level and did not go into detail about their application.

Furthermore, all the dimensions that were presented in these frameworks are reflected in the SMART framework and in the smart city reference model. We therefore believe that these two frameworks will be sufficient because they encompass all the others.

A focus will be made on the smart city reference model because we perceive it as the most advanced but also as the most complete as possible. In our analysis of the frameworks, it is the one that we found the most understandable, the easiest to use and the most transversal. And as stated earlier, we believe it can be applied individually to all cities in their smart transitions.

Table 2: Comparison of smart city frameworks

Comparison Parameter:	SMART Framework	Smart City Reference Model	IBM's smart city model	Smart city innovation framework	Smart city success factors framework
Proposed by:	Letaifa (2015)	Zygiaris (2012)	IBM GBS (2008)	Nam & Purdo (2011)	Charoubi & al, (2012)
Structure:	A three-strategy level: macro, mezzo, micro structured model.	A six layered structured model: city, environment, inter-connection, instrumentation, integration, application and innovation.	Model with seven circular axes: city services, citizens, business, transport, communication, energy, and water.	An innovation framework based on 4 dimensions: technology, organization, policy, context and that integrates innovation, risk and way to success.	Three key drivers of smart city initiative: technology, organization and policy. Completed with five support drivers: governance, people communities, economy, infrastructure, environment
Similarities:	Layered structure, organized, priority-based structure.	Layered structure, organized, based on priorities in strategies of smart cities.	Organised and levelled structure with core and related elements.	Dimension based framework on technology, organization, policy and context.	Layered structure with three core elements of technology, policy, and organization.

Differences:	Model that integrates several scales (macro, mezzo, micro) and several stages (strategy, multidisciplinary, appropriation, roadmap, technology).	The layers deal with the addition of physical, environmental, and innovation characteristics in the smart city. New kind of strategic framework. Can be applied individually to smart cities for their smart transition.	Integrated and correlated, links of elements are clearly established.	Focus only on the innovation, risk and way to success.	Governance and policy elements are included as a success factor.
Suitability to current research:	Structured, comprehensive model to compare two or more smart cities.	Structured, comprehensive model to compare two or more smart cities.	Structured and simple to apply on analysis of smart cities strategic approaches.	Not suitable since the holistic approach is not found, an extension of Charoubi & al, (2012) model.	A comprehensive model with layered structure, not used due to the limited information available in the integration of elements.
Disadvantages:	Lack empirical support, subjective analysis only.	Lack empirical support, subjective analysis only.	Too little scientific literature on the subject and difficulty understandable.	Focused too much on the innovation approach.	A generic approach, lack a holistic application of smart city framework

Section 2.8: Risks factors and criticism to smart cities

Now that we have fully introduced the smart city, its key success factors, the different theoretical frameworks, etc., we thought it would be useful to make a small part to address the opposite effect such as the risk factors and the criticism of smart cities.

A smart city is a large-scale innovation and becomes a living research centre for an analysis that fundamentally involves unavoidable risk factors. We have seen over the years that the better the technology tends to perform, the greater the risks and uncertainties tends to happen, including specifically the invasions of privacy. The activity of a smart city no longer becomes simply a centre of innovation but a place that must ensure that the uncertainties of these innovations are monitored.

There is a strong disappointment with the lack of monitoring of the major risks of technology in smart cities. 85% of IT anticipates a shortfall due to difficulties encountered by the specialized parts of innovation, largely due to policy, association and management uncertainties (Toppeta, 2010). Normal reasons include lack of common sense, lack of a business case, lack of support from senior management, lack of initiatives, lack of expert skills, poor alignment between hierarchical and task objectives, weakness in the face of policy fluctuations, considerable technology-induced energy, and political hyper-activism (Dawes et al 2004).

In addition, smart city innovation could be a confusing expression of its own (Gemeente Amsterdam, 2016). Smart Cities embrace different ideas in the scientific community, governments, global corporations and universal enterprises. So, there is no agreement on the idea of a smart city. Hollands (2008) discussed the difficulties of implementing a smart city idea by clarifying the hidden elements related to the designation of smart cities. Finally, he clarified that the meaning of the term “smart” and its association with cities remains debatable.

Furthermore, public institutions impose business models without exerting serious pressure to move forward. Just as the organizations that are set up to carry out the missions of the smart city reliably and consistently, are opposed to change. Those in charge of smart projects must take into account the threats of the smart city such as cybercrime or conflicts at the political-administrative level so that they do not exacerbate existing problems.

Hielkema and Hongisto (2012) express the concern that the creation of smart cities requires a comprehensive framework of innovation, collaboration and learning culture among all components of smart city administration. Similarly, Murray, et al (2011) have argued that smart city frameworks are highly dependent on technological advances and interconnected networks, therefore, a slight error in the generation and transmission of information can lead to the risk of system isolation and malfunction of the entire network. Thus, the requirement for collaborative attempts to improve the establishment of the smart city is a challenging aspect for all the stakeholders.

Similarly, human error and future digital attacks are considered as a significant risk for smart cities. The system security relies on the proper functioning of electronic gadgets and technology-based security frameworks. The market capture of highly technology-based firms limits the growth chances of individuals and firms (Hollands 2008). Roumet (2010) further addressed this issue and expressed concerns about the holistic dependence of smart cities on ICTs data and information security and privacy issues for residents of smart cities.

Clancy (2013) noted that the testing programs of many smart cities are not included and seriously concerned about resident engagement and the culture of open innovation, ended up with negative results as residents' vision is limited and integration of cumulative attempts is not possible. Smart cities are also dependent on the fact that the benefits of this computerized urban disruption will not be able to reach everyone within the city. Rather than reducing the imbalance among residents, this computerized partition may in fact widen social divisions and cleavages by creating a gap between the talented specialists attracted to the city and the unskilled, less affluent and less computer literate occupants (Peck, 2005).

For the success of a smart city, we must not lose sight of the fact that it is the citizen who must remain at the centre of concerns and not the technology. It must take into account the fact that technology must not continue the division between the different segments of the population and that technology should be used as a tool to solve current problems, not as a driver. Otherwise, there is also a risk of over-creating futile applications and devices.

Other scientific research has also shown the following problems and risks: the digital fracture, labour market disruption, cybercrime, invasion of privacy, difficult financing and unnecessary complexity.

CHAPTER III: Case studies of Amsterdam and Brussels

Section 3.1: Introduction

The previous chapters present in-depth discussions on development and strategic decision-making in smart city systems. The development of smart city concepts and the implementation of strategic policies in modern smart cities is the main focus of this chapter. The case studies of Amsterdam and Brussels are selected for detailed examination. The SMART framework (three scales) of Letaifa and the smart city reference model (seven layers) of Zygiaris are chosen as the basics framework for analysing the success of smart city strategies and initiatives in ASC and BSC. The results of these strategic planning models are used to discuss the planning strategies of the two smart cities.

3.1.1 Introduction of the cities

On the one hand, Amsterdam is the capital of the Netherlands, and strategically positioned in the region of North Holland. This city is mainly known for its artistic heritage, its canal system and its narrow houses lining the streets. Geographically, four key canals surround the city of Amsterdam and form a semi-circular ring around the city. The lowland territories have about half their surface area below sea level, thus, preserving the country from the sea has been a major challenge and has become a regular feature of Dutch geography. Amsterdam is one of Europe's most romantic and surprising capitals. Also characterized as a tolerant and diverse city, it combines all the advantages of a metropolis: culture, history, entertainment, art, and varied means of transport, with the bicycle replacing cars for everyone's sake.

On the other hand, Brussels is one of the main European cities, the capital of Belgium, and also seen as the capital of Europe. This miniature cosmopolitan city has all the characteristics of a true European city with a rich heritage and a culture of hospitality for people from all over the continent. The city is famous for its tourist destinations and as a European business centre, but it has retained the tradition of village quarters that provide a friendly environment for visitors. The contrasts between the characteristics of the different neighbourhoods offer diverse experiences to visitors and tourists alike. Brussels' international role offers a unique combination of ethnicities with more than a dozen native and non-native languages spoken. However, French, Dutch and German are the official languages, as well as English as a business language.

3.1.2 Historical development and urban planning

As described, Amsterdam is often known for its heritage and historical features, such as its canals, its scenic beauty and that the city extends around the old centre. However, recent developments, the industrial revolution and some enterprises have supported urban planning and shaped the city as a modern centre of urban activity at the end of the 20th century. The main features of the industrial developments in Amsterdam have been the radio centric progress of the old town, the construction of roads, the identification of orthogonal grids, and the regulation of new settlements. The city still follows the master plan approved in 1935 and forms the foundation of the modern city of Amsterdam (Lee, & Hancock, 2012).

To grow the city smartly, the Amsterdam city council introduced the structural vision Amsterdam 2040 plan. It includes developing office parks into mixed-use residential communities, redeveloping industrial riverfronts and building more high-rises wind farms and public transport networks. The plan also incorporates urban design options to host the 2028 summer Olympics. Complementing that, the Amsterdam Smart City initiative is a collaboration of local municipalities, businesses, residents and academic institutions partnering over 75 smart cities projects and some of them will be presented into this case study.

In accordance with the guidelines of the Amsterdam city council, the standards for urban development planning are in line with the following guidelines:

- Limit the growth of the urban residential and commercial population in order to reduce the use of open public lands in the city to ensure the appropriate junction of private and public development areas.

- Plan intelligent urban expansion, detaching it from existing infrastructure. This west to east expansion plan for the city cuts through the constraints of the old plans and the new master plan will lead to a competent and "smart" orchestration of the city.

- Advance the Neighbourhood Improvement Model through the following steps: the addition of greenways and pathways, a continuous phase of development, and a sustainable advancement of the existing city.

Brussels, for its part, has also shown that it has had different priorities over time. We can highlight the growth of the city in the 19th century, which was very rapid because between 1850 and 1900, it grew from 250,000 to 600,000 inhabitants, marking an impressive demographic explosion. The city had to be adapted, transformed and enlarged. At that time there was an urban planning which was set up by the layout of the roads and next to them, shops were built. In this period, we are in the process of adapting the city to the automobile.

Thereafter, land use planning becomes very important in the city, but the development of the city in the general interest brings about certain conflicts, resulting in the construction and destruction of certain districts over time. We are in a structuring of the main roads but restructuring of the real estate. This is why we can see very significant variations in the image of the city, at the cartographic level.

However, despite the centuries-old tradition, industrial base, and infrastructure components, the city is progressing at a rapid pace to encompass the facilities of a modern and smart city. The Brussels region has thus decided to launch its smart plan with the aim of strengthening its leading position in the ranking of world smart cities. In its 2014-2019 regional policy declaration, the government expressed the wish to make Brussels a digital capital and to include it in its development programme. In accordance with its programme, the standards for urban development planning are in line with the following guidelines:

- Encourage actors to move towards the development of a sustainable city through the construction of green spaces, renewable energy production, efficient waste management. The environment is one of the urban priorities its strategy.

- Set up a coordination committee to ensure the pooling, complementarity and coherence of initiatives.

Lastly, we would like to emphasize that the choice of these two cities was not unconscious. Even if some differences in the historical development smart city plan are perceptible, the two capitals studied show, beyond their geographical proximity, many similarities: relatively equivalent surface areas, an important culture, numerous infrastructures (sports, festivals, theatres), the same average age of the population (38 years), an almost equivalent average salary (a little higher in Amsterdam because life is more expensive), a public health system,..

Section 3.2: Smart city projects strategy

3.2.1 Amsterdam Smart City (ASC) project

In 2009, the Amsterdam Smart City (ASC) programme was launched as a case study of well-structured, well-funded projects combining public and private partnerships. The public administration was allowed to take over the operations and governance of the ASC, as well as the active partnerships of companies such as Alliander, Cisco, Philips, IBM, Accenture and others. The open organizational relationship is crucial; in fact, it allows trust in the achievement of objectives, ensuring open data, long-term obligation, coordinated policies and leadership. Organizationally, the ASC program was mainly supported by the Amsterdam City Council, both economically, in terms of manpower and collaborations with local and foreign organisations from EU countries.

The start-up phase of the ASC program collaboration is based on how the long-term objectives are governed and planned by the funding accessories, related to correcting the issues of the Amsterdam metropolitan area, currently pending and associated with future open entrance accessories. A shipment of new frameworks was underway, allowing for a wide range of new possessions and organisations such as smart grids for energy, aqueducts and infrastructure equipment, the implementation of fibre optic technologies for data management and house operations. Thus, information management and energy sources were at the core of the ASC program. These basic frameworks allowed various organizations to make and realize innovations, bringing reserves of imperatively speculation, more effective social protection, not so much traffic, but rather a more perceptible availability of organizations.

The ASC program is also important because of the emerging and legitimate concern for all building fixtures, with two fundamental objectives, which are the acceleration of smart bottom-up strategy and the funding requirements of projects that will be booming in the coming years. These objectives have resulted in more than 20 pilot projects planned for the three years following the launch of the ASC program, involving more than 72 organizations (Baron, 2011). The collaborating partner organizations have tested a large number of innovations for future smart city markets. Undoubtedly, mutual collaboration is still visible in the ASC itself, which continues to provide a joint effort between occupants, government, and neighbourhood development agencies (Lee, & Hancock, 2012). Essential end-use capability, smart grids, the use of sustainable energy sources for power, and workplace resuscitation for electric vehicles

are among the segments that have been created to achieve a single, final goal of controlling greenhouse gas emissions. According to Baron (2011), the goals are to reduce CO2 emissions by 40% by the end of 2025, and by 75% by the end of 2040 (Baron, 2011).

3.2.2 Brussels Smart City (BSC) project

The smart city articulation sets the stage for the IT and smart city needs in the region. Currently, the city is based on the needs related to the European digital motivation (DESI index, 2020) which stands for "Digital Economy & Society Index" and decides on the different needs related to the framework of the smart city. The important elements of this framework include trans-versatility, mutualisation and reuse. Moreover, computerisation, European measurement, administration and estimation of execution are also important factors. We will deal with this index more precisely in the implementation phase in Brussels.

BSC characterises the work of the Regional government and of the BRIC (Brussels Regional Informatics Centre), main partner in the execution of smart city projects. The region's strategy is to supervise the part of the physical foundations, to develop an information methodology, to work with private organizations in the smart city. In addition, supervision of BRIC to develop new methods to connect to the global population in other cities. Following the approval of the policy declaration in 2014, the Brussels Regional Informatics Centre (BRIC) supported this global technique for the Brussels-capital region in smart city.

The idea of making Brussels a smart city is quite new, only since 2014. We can also mention one of Brussels' major initiatives, which was the creation of its climate plan in 2018 and which will be discussed in the next sub-sections. Despite this, we can still observe a fairly significant gap in comparison to some major European cities such as Amsterdam, Vienna or Paris, which have been studying the subject for more than a decade. As a result, this led Brussels to have to put in place a system and more precisely a governance system that would allow it to get into the race. Here is a descriptive list of these various smart governance initiatives:

- **An information management system:** indeed, at the heart of the smart city is the matching, collection and use of information to improve the lives of the entire population. BRIC is the institution chosen to satisfy the stage of the exchange for each of these information pillars of the BSC.

- **A smart city manager:** has been delegated with the aim of speeding up and uniting the actors and data around the Smart City in the Brussels locality. He is the point of contact for smart city projects and he strives to implement the smart city policy by putting forward concrete proposals according to the circumstances identified.

- **A smart city ambassador:** will transmit his vision to the Brussels, more precisely to the smart city manager, and his skills will be valued. Furthermore, his or her job is to advance Brussels in Belgium and in the world as a smart city.

- **An administrative committee:** different thematic working groups can be set up within this committee, bringing together different members, open or private, to deal with specific issues. Its purpose is to establish an arrangement of activities with expenditure plans to determine the types of undertakings and joint efforts envisaged.

We can already make a comparison between the two cities. We can observe that Brussels is behind schedule with the implementation of its smart city project in relation to the area of time and global competition. The latter was only put in place in 2014, contrary to Amsterdam which started 5 years earlier (in 2014) and which has already allowed it to launch 20 pilot projects through a bottom-up approach in only 3 years after its implementation. This means that Amsterdam has already seen the results and impact of some of these projects, even before Brussels started. We can also notice that ASC is working with many partners for future smart projects that could be sell on the market. But also, this collaborative approach is not only limited to private companies, but also include residents, the government, as well as the different neighbourhoods. At the Brussels level, the situation is a little more complicated and they are dedicated to setting up governance.

Section 3.3: Smart city initiatives

Now that we have discussed the introduction of the two cities, their urban developments, and their smart projects, allowing us to compare one city with the other, we will focus on a practical aspect and take a look at some of the projects that have been put in place. The aim has not been to list all the smart projects, but mainly to extract the most important ones in order to have a critical opinion on what has been done or is being done, to be able to extract key success factors that ensure effective implementation and that are mainly the focus of the study.

To do so, we will refer to the initiatives launched in the four following action fields: sustainable environment, smart energy, smart mobility and smart buildings. We decided to choose these action fields because they are the most important ones, strongly linked to each other, and therefore more adapted to our theoretical models.

3.3.1 Initiatives of Amsterdam Smart City

3.3.1.1 Sustainable Environment Initiatives

Through the coordinated effort of business visionaries, a sustainable commercial street began to take shape in Amsterdam, resulting in a 57% reduction in CO2 emissions. This effort was accompanied by the following interventions:

- Transport stops made with reused material.
- Driving sensors based on open, sun-powered lighting assemble sheets in relation to the highest point of stops.
- Compaction canisters for the free collection of waste filled by the solar generators.

In order to achieve the ambitious goal of reducing CO2 emissions, the municipality has put in place a key strategy, which has fundamentally included occupants. The three basic gauges, which were essential to work on to achieve the objectives, are the economy of essentiality, sustainable age and reuse of waste heat. As mentioned, this is mainly a merged approach to deal with the issue of essentiality and the occupants, which are at the moment, the essential characters on the screen of urban change.

The “West Orange” project is one of the major projects carried out by the city with the help of the inhabitants (Majoor, 2009). This project makes the inhabitants aware of their energy consumption and therefore encourages them to reduce it. Thus, Amsterdam has made vigilant innovations with the aim of changing the care given to the use of imperativeness. Similarly, in the official structure subject to the use of smart meters in 500 families, creative imperatively was attempted, leading to a saving of 14% of the essential used per family and an equivalent reduction in CO2 emissions. The project aims to increase the size of customers to 200,000 households with these smart devices, controlled by digital meters.

Table 3: Sustainable environment initiatives of ASC

Project	Description / target	Outcome
West Orange	To save energy consumption in household by devices and gadgets.	Promotes and encourage the use of smart inverse technology-based devices.
Sustainable commercial street	Transport stops made with reused material, driving sensors based on sun powered lighting, solar generators.	57% reduction in CO2 emissions.
Smart meters project	Innovative energy saving and efficient use of device power management system.	500 families saved 14% energy consumption with a same level of reduction in CO2 emissions.

3.3.1.2 Smart Energy Initiatives

Amsterdam is the house of 400,000 inhabitants, who contribute to 33% of the city's total CO2 emissions. Therefore, the use of energy-saving methods and technologies can reduce the CO2 emissions of these homes. Thus, awareness of limiting energy consumption, preference for renewable energy sources, and switching to green energy sources considered important form the basis for ASC projects. As a result, the ASC's Municipal Smart Energy Strategy has involved citizens in saving energy, producing green energy and reusing energy waste such as home heating. The Smart Energy solutions are part of the imperatives that are central in the city framework.

The generation of electricity from waste (Fooij, H. 2015), is a mega energy project established by the organization of Amsterdam Economics Board (AEB, n.d). AEB employs more than 400 people, working in a waste-to-energy plant and a power station powered by waste. Every year, it manages to transform 99% of 1.5 million tonnes of waste and is the largest waste-to-energy company in the world. By producing energy from waste, it is able to supply the needs of 320,000 households per year by producing 1,000,000 MWh of electricity. This plant is a major step forward in waste recovery, waste management and green energy production, enabling Amsterdam to meet its target of reducing CO2 energy by 40% by 2025.

As a matter of fact, since the inception in 2009, the smart energy initiatives of ASC acted as a benchmark for other smart cities planning in Europe. In addition to Amsterdam's significant waste production, mentioned above, used to produce reliable and sustainable energy sources for municipalities and households, the production of recycled water for wastewater treatment is also a component of this energy plant. Another wastewater treatment plant has been built to use infiltration, a side effect of water filtration, as biomass to transport electricity from sustainable sources through the incinerator.

Smart energy projects that have supported the development of the ASC project are as follows:

- **Execution of a smart grid** in Amsterdam that provides an efficient electricity cross-section. Digital monitoring and control boxes are provided to each household to control the smart power supply and to maintain the ASC workload. Currently, a major smart grid deployment is underway as part of the "City-ZEN" project. This project, which stands for "City-Zero carbon Energy" and deals with attempts related to retrofit efficiency, creative local household heating and cooling frameworks and smart frameworks at the zone level, with the exciting establishment of how the different frameworks are now blending, retrofitting and, at any given time, replacing each other.

- **The Green energy project** focuses on the production of sustainable energy through the installation of more than 3,000 solar panels (photovoltaic cells) on the grid in 2009 (Majoor, 2009). In the Amsterdam Zuidas region, the photovoltaic panels are located on the highest points and the energy production has been able to meet the energy needs of about 30,000 workers in the associated area. In addition, the future modernisation of urban settlements will make families aware of the advantages created by small wind turbines or photovoltaic panels.

The induction of smart projects was the first sustainable energy generation initiative with citizen collaboration under the ASC. Given the lack of consumer knowledge on the energy consumption of household and office appliances, this project promotes and encourages the use of smart devices based on reverse technology that save energy during consumption. Details of some others important pilot projects, with their initiatives and results, are listed below:

Table 4: Smart energy initiatives of ASC

Project	Description / target	Outcome
Access to microcredit facility	Finance the purchase of remote controlled and high-end electrical household devices. Families can pay their mortgage payment after saving towards electricity bills.	728 families already used the microcredit facility and the goal is to increase the reach of the project to the whole ASC.
Onze Amsterdam Noord Energie	Private production with the use of wind turbines for sustainable green energy.	For citizens in North of Amsterdam and Waterland and cover 20% of energy needs.
Private wind power construction	To make citizens cooperative members in power generation from wind and solar energy.	The residents of Amsterdam North produce power for above 8,000 households by installing seven windmills.
Smart grid Alliander	New West district residents reach to sustainable energy.	4,000 domestic accessed smart meters and solar installations.

Currently, the ASC's power generation and transmission system are being widely exploited through the pilot projects explained above, and this success has resulted in many important transformations. These include the use of smart meters, control and monitoring devices, lower energy consumption and a low rate of power outages. Above all, the inclusion of public-private partnerships in solar and wind power generation and the encouragement of customers to join the smart grid are some of the important achievements of the ASC's smart energy strategy. Another essential element that fosters productive collaboration between occupants, organizations and business is the simplicity of the tasks involved. All experiments and exercises are multiplied by an input that is continuously turned on.

3.3.1.3 Smart Mobility Initiatives

Mobility and transport in smart cities contribute to an important element of the smart framework. The ASC's marine transportation system contributes to approximately 33% of CO2 emissions. Prior to the implementation of the smart city's strategy, traditional power generation in cruise ships and cargo ships was based on diesel and other fuels. Ships moored to transport tourists from other European countries also use clean diesel power generation.

The Amsterdam land transportation network is also complex and versatile. Nevertheless, their advances in this field are quite surprising and ASC has also put in place a system of speed limits that can be adjusted according to traffic conditions via illuminated signs that guide motorists, the use of cameras and data collection. The system would have halved traffic congestion and reduced CO2 emissions by 15%. The traffic lights are controlled by software, allowing them to be adapted to the traffic, some car parks are equipped with sensors indicating free spaces, ...

Major transportation projects after the creation of the ASC and their results are presented in the table below:

Table 5: Smart mobility and transportation initiatives of ASC

Project	Description / target	Outcome
Ship to Grid	Installation of 73 distribution units of renewable electricity sources on the riverbanks with 300 connections. Shared energy sources in the form of a pay-telephone framework.	The moored boats (tourist boats) use the renewable source and turn off the generators, thus reducing the city's CO2 emissions.
Elimination of the internal combustion engines	Started 30 years ago with the establishment of the ASC to put green fuels on the road.	It is estimated that there will be 200,000 electric vehicles by 2040.
Charging stations network	10,000 electric vehicles came on road by 2015.	Lead the road mobility to achieve zero emissions.

City cargo project	Transfer freight transport to a city cargo tram that can carry the load of four trucks and weigh up to about 7.5 tons, traveling in all time slots from 7 am to 11 pm.	Around 50 trams and 600 electric vehicles will be operational in 2025, halving the presence of trucks from 5,000 to 2,500 per day in the city, with annual savings of €125 million and the creation of around 1,200 jobs.
Mac bike (bike sharing program)	Bicycle sharing and rental service to reduce the load of bicycles on the road in order to increase the comfort of cyclists.	Control the population of 70,000 bicycles on the city's roads, which congest and inconvenience passers-by (Eltis.org, 2018).

3.3.1.4 Smart Buildings Initiatives

In Amsterdam, as in many large cities, 34% of the CO2 radiation is associated with the structural part and without remarkable structural redesign, the experts have shown that this rate would rise to 36% by 2025. It was then necessary to carry out sustainable estimates centred on the city environment and to test new advances that respect the obvious value and satisfaction of structures.

The fuel cell technology-based system found in modern building structures carries by far the largest portion of the electricity needed by the structure. In addition, the recovered heat is used to boil water for the family, increasing the energy efficiency of the building. Considering that the electrical adequacy of this unit is more obvious than other technologies starting shortly before, the municipality intends to extend the use of this system to a higher number of structures in the city. In addition, force gadgets (FC) are considered by the entire university system as an essential, low-impact, steady-state and highly adequate change technology. The use of such frameworks in the same way ensures liberal economic points of interest in light of the high cost-effectiveness of change. As of today, there are a variety of organizations advancing applications specifically for small plants (ASC, 2020).

Table 6: Smart buildings and environment projects of ASC

Project	Description / target	Outcome
BlueGen project by Ceramic Fuel Cells in De Groene Bocht building	German assembling plant to generate energy.	The system produces all the electricity for the building and the recovered heat is used to heat the building and provide hot water to increase efficiency to 85%.
Grand ITO Tower, business hub project in Amsterdam Zuidas zone	Use monitoring and controlling technologies with efficient and intelligent electronic systems.	38,000m^2 office space has been supported for the testing of energy consumption and the carbon footprint estimation.
Mini grid energy management	Sensor network support the building automation system.	Lighting control, regulation of heating/cooling, security of buildings and lower consumption of fuel.

3.3.2 Initiatives of Brussels Smart City

3.3.2.1 Sustainable Environment Initiatives

The climate plan for the city of Brussels was published on 28 May 2018 and is one of the biggest steps forward on its smart plan. It lays the foundations of an ambitious political project that will grow over time with the aim of making Brussels an exemplary municipal administration. Its main aim is to respond to the issues of sustainable consumption, energy, mobility, awareness, sustainable urbanisation and greening. It is a plan that was born to block the harmful developments that have taken place since the industrial revolution in the 19th century such as: the combustion of fossil fuels, deforestation, intensive agriculture, which gives rise to an increasing production of greenhouse gases and which cause many problems such as rising water levels due to rising temperatures. The objectives of the climate plan are clear: a 40% reduction in greenhouse gas emissions (compared to 1990) and an increase in the share of renewable energies to at least 27%.

To achieve these objectives, the city also wants to engage the citizen by setting up, each year, awareness-raising actions aimed at informing and educating. In addition, the city is also looking for stakeholders such as universities, colleges and NGOs. We can see that this is a long-term objective because the monitoring indicators are as follows: number of annual events by 2030, number of participants, number of actors in the territory, number of activities per event.

The most important environmental sustainability initiatives that we have been able to identify are the following:

Table 7: Sustainable environment initiatives of BSC

Project	Description / target	Outcome
The city consumes sustainably	It is a project that wants to integrate sustainable clauses on services and products intended for sale, through the creation of a sustainable purchasing commission.	Systematize the use of sustainable materials, equipment, solutions and services and add ecological, social and ethical criteria as quickly as possible.
Handy made in Brussels	The city wants to set up companies that deal with the construction site cover to manufacture new products such as bags, aprons, briefcases.	Reuse 1500 m^2 of construction site cover per year.
Brussel papers	Modernization of the administration through the digitalization of work to avoid the generation of paper within the city's activities.	The 2021 objective is to reduce paper consumption by 60%.

.3.2.2 Smart Energy Initiatives

In 2010, Brussels created an energy cell to centralize the implementation of energy skills aimed at reducing the city's energy consumption. Since then, this section has mainly taken part in

monitoring projects. This system allows a follow-up of consumption in (day+1), which speeds up the identification of problems and facilitates their resolution. In the short term, its objective is to raise the awareness of the inhabitants by periodically informing them of their consumption. Few other projects have been identified and are not on a large scale.

Table 8: Smart energy initiatives of BSC

Project	Description / target	Outcome
BXLSOLAR	The city wants to produce locally by promoting self-consumption and the use of renewable energy.	Cover 27% of consumption with local renewable production.
BXLIGHT	Optimising the luminous efficiency of buildings and roads by reducing electricity consumption.	Expected reduction of 16.2 tonnes of CO2 per year by 2021.
Bulk purchase of green energy	Group purchasing system for individuals with the aim of strengthening price negotiation.	Expected reduction of 31.73 tonnes of CO2 per year by 2021.

.3.2.3 Smart Mobility Initiatives

Mobility is a challenge for Brussels, as it is for all other cities that want to embark on a smart approach. It is a main axis and it is unthinkable to not include it in its transition. Indeed, it is a problem that has so many repercussions on ecological, economic and social development. The Brussels-Capital Region has a duty to improve its means of transport, which would provide an alternative to vehicles, and to make more efficient use of this infrastructure, such as through car-sharing.

To meet these challenges, Brussels has already set up car-sharing platforms, as well as the possibility of renting electric means of transport in the city centre (bicycles and scooters). Here is a list of the different projects and achievements:

Table 9: Smart mobility initiatives of BSC

Project	Description / target	Outcome
Teleworking - BXL 20/21	Launching teleworking in order to reduce the number of journeys, make workers more responsible, promote a balance between private and family life and flexible working hours.	Expected reduction of 110.94 tonnes of CO2 per year by 2021. 30% of the workforce will have to telework once a week, reducing commuting by 10%.
All of us on bikes	The aim is to amplify the existing cycling plan, which has already considerably increased the number of cycle paths, and to continue to increase them by 3% per year.	To be quantified according to the number of cyclists.
A diversified fleet of cars	Introduction of less polluting, hybrid and electric vehicles in accordance with legislation.	Expected reduction of 7.5 tonnes of CO2 per year by 2021.
Public car parks	A solution to remedy the parking search, developed by parking. brussels, it makes it easy to find a car park near the destination.	Reduces road congestion in urban areas.

3.3.2.4 Smart Buildings Initiatives

Smart buildings are energy-efficient, sustainable buildings that, through their facilities and connected equipment, are efficiently managed and offer many services to the occupants. The installations communicate with the occupant but also with the environment (for the management of heating, lighting). In the context of Brussels, we were able to find only one project of this large scale and that is the BRUcity. The other projects are smaller, but they allow crucial objectives such as water management and reuse.

Table 10: Smart buildings initiatives of BSC

Project	Description / target	Outcome
Living roofs	Arrange the roofs for: energy production, rainwater recovery, vegetable garden, beehive, etc. ...	That 100% of flat roofs have an additional function.
Rainwater management	Water is becoming the focus of attention and Brussels has its own strategy for water, with multiple objectives: reduction of rainwater discharges into the sewers, water reuse, etc.	Integrate a "water" reflection in the city's pilot projects.
Building BruCity	Construction of a modern building to accommodate 1700 employees of the city of Brussels characterized by photovoltaic panels, cogeneration system, full LED lighting, rainwater harvesting system and rooftop vegetable boxes.	Reduce the primary energy consumption of the administrative centre of Brussels by 65%, reduction of 324.0 tons of CO2 per year.

Section 3.4: Strategy implementation of smart cities

Angelidou (2014) described two major smart city strategies as either an extension of the existing city or the construction of a completely new city (city from scratch). In terms of these two strategic decisions, Brussels and Amsterdam are quite similar. They both have a fairly certain similitude, starting by looking at the underlying state of the numerical status of the city and characterizing the needs and necessities. Both cities allocate explicit territories of the city to try to find pilot projects for smart cities, within the most remote topographical boundaries of the city. This section will compare the ASC's and BSC's strategy in implementing their smart city projects.

3.4.1 Strategy implementation of ASC

As a smart city strategy, the ASC uses existing assets, as its foundation. The climate street project is an example of the vision of the smart city of Amsterdam, which has developed the use of a few advances in roadways, for example, smart meters, green energy and smart electricity varieties. Finally, the city has also sought to implement current improvements and innovations in the city, and then assess whether they can be considered a major aspect of the "smart city" (van Doren, Driessen, Runhaar et al 2016). In addition, the city works intensely with different intriguing parties as well as all of its inhabitants.

As far as the addition of the Angelidou Smart Cities Strategy (2014) is concerned, the last strategic decision is to choose a partially defined reference area. The idea is to first refer to a target area in order to make it smart and then extend it, because cities often have limited investment.

In addition, we have noticed that one of the main obstacles and concerns is the failure to include the citizen as the final client. But, Amsterdam, because of its mix of bottom-up and top-down approach, is gradually becoming intimately associated with the various stakeholders, including its residents. We can therefore extract the fact that the quality of the administration and the role of the citizens is a key decision-making factor. We have also noticed in the literature that many previous agreements on smart cities are disappearing because management did not consider residents as effective, direct and influential stakeholders.

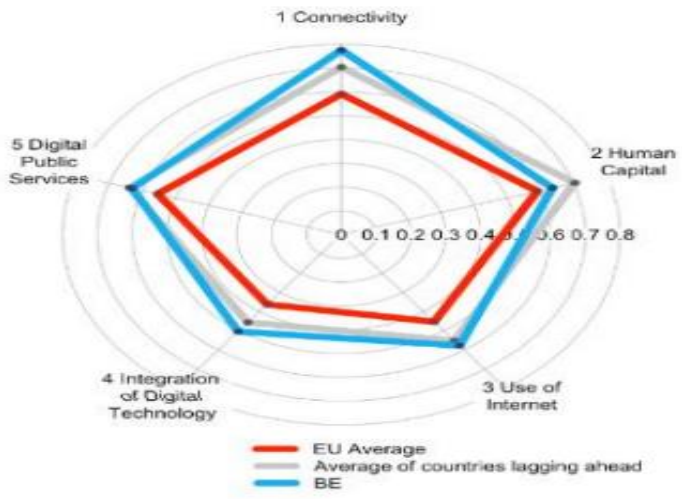
Amsterdam projects' have also made us aware of the importance of technology and its relationship with human beings, it must be built by them and for them. This should be taken into account from the earliest stages of a project in order to pay attention and encourage change if the technology is not in line with the objectives to be achieved.

3.4.2 Strategy implementation of BSC

The BRIC White Paper published in June 2014 is one of the cornerstones of the smart city of Brussels. It identifies four challenges for a smart region in response to key issues affecting Brussels, based on the model of a connected region, a sustainable region, an open region and a safe region. BRIC has followed the BSC strategy's implementation goal to achieve the targets set for each challenge by 2019. The strategy implementation process decided that progress would be measured annually on the basis of key indicators of success of the planned BSC strategies.

The strategic orientations of the BSC have clearly understood the importance of strategy implementation. The five main indicators of the BSC Performance Index are used to estimate the areas of implementation of the strategy. The assessment of the progress of the smart city of Brussels is to be made on the basis of the European Union standard "Digital Economy and Society Index" (DESI). This will help to evaluate the share expressed annually on progress in their digital competitiveness (DESI Index, 2020). The five pillars of the growth of the BSCs according to the DESI assessments are decided as follows:

Figure 8: DESI indicators performance of BSC (DESI, 2017)



Thus, the information provided by the BSC showed that specific measures are being taken in light of the policy directions mentioned. The five performance indicators of the DESI initiative were considered important for the strategic direction, planning and implementation of smart city strategies for the Brussels capital region. These five indicators are explained below (OIOS, 2020):

1. **Communication and connectivity:** the connectivity strategy is based on the adoption of modern 4G and 5G communication technologies, implementation of digital sensors, application of regional Wi-Fi network, and use of optical fibre through IRISnet project to provide broadband network for BSC.

2. **Development of human capital:** improving digital / internet and computer skills, hiring the BSC director and brand ambassador to meet the public relations and event management needs of the Smart City.

3. **Internet support to establish digital culture and environment:** internet penetration in modern civic facilities to be accessible to human capital, residents and children. This open access to the Internet helps BSC authorities to limit the Internet division in the city and differences between disadvantaged and privileged areas become minimal in terms of access to technology.

4. **Digital technology integration:** the use of an open data carrier leads to the objective of integrating digital technology in performance indication as it promotes an efficient and effective data flow. The use of optical fibre, with a shared closed-circuit television platform, the creation of the Regional Data Centre (RDC), the implementation of the Sixth Reform of the State in terms of IT, and the development of UrbIS, the digital map of the region, are some of the important initiatives taken in this regard to facilitate the flow of data in public networks. This strategy makes it possible to offer information services and facilitate the use of Big Data for small and large companies and urban facilities.

5. **Digital public services:** common and subsidized access for the entire population to digital public services through e-government procedures.

Section 3.5: Comparison of ASC and BSC rankings

According to the IMD Smart City Index (2019), the international ranking of smart cities declared Amsterdam the 11th best smart city in the world and the third best smart city in Europe, behind Zurich and Geneva. This index focuses on citizens' perception of their country's smart approach, on how they feel about the economic, technological and human aspects. The transformation of energy, mobility, infrastructure, buildings and sustainable development projects has pushed the ASC ranking up from tenth to third place in Europe in just three years after 2016. The phasing out of car transport and the shift to cleaner cycling by the 90 per cent of ASC households has enabled citizens and local authorities to significantly reduce CO2 emissions. In addition, the strategies of smart buildings and green energy products, as discussed earlier, have played an important role in increasing ASC's ranking. The government will also ban fossil fuels and diesel vehicles by 2025 (Mayor, 2020).

A survey conducted by IMD Smart City Index showed that the five most urgent problems perceived by the inhabitants of Amsterdam in 2019 were the following: affordable housing (65.6%), security (50.8%), air pollution (41.8%), public transport (36.1%), road congestion (32.8%). We can see that in the stated problems, Amsterdam has already launched many smart projects to improve and that its ranking will surely continue to increase.

On the other hand, Brussels finds itself in 64th place according to the same ranking of IMD. We could not find its evolution on the IMD ranking, but according to other sites (cirb.brussels), since the introduction of BRIC in 2014, the Brussels Capital Region seems to be gaining places in the ranking. According to the same study, carried out by IMB, on the five most urgent problems to be solved, but in Belgium, the results were as follows: air pollution (57.7%), affordable housing (52%), road congestion (51.2%), security (41.5%), unemployment (40.7%).

We can notice a similarity between the problems stated in Amsterdam and those in Belgium, this is surely due to the fact that they are two European capitals quite close to each other, with a quite similar historical evolution. However, we would like to point out that each city has to set up its own approach taking into account its territory. Indeed, the urban realities in the European countries are not identical to those in the Western countries and it would be useless to copy an identical technology from one of these countries or from the most performing cities to try to solve problems that are different to them.

In order to investigate it a little further and find out why Belgium had its ranking, we asked ourselves the following question: "What are the obstacles identified in Belgium when implementing a Smart city project?". Through research conducted in scientific literature and mainly theses and PhDs, the three main obstacles encountered in Belgium are the following: « the lack of financial resources, the insufficient expertise in administration, the complexity of the mobilization and involvement of the different stakeholders in the process ».

Section 3.6: SMART framework application

As mentioned earlier, the SMART structure is isolated into three strategic levels: large scale (macro), medium scale (mezzo) and smaller scale (micro). Currently in ASC, it can be noted that governance has succeeded in reaching all the strategic levels and milestones identified in the SMART framework. For Brussels, on the other hand, we believe that its development has stopped at the macro strategy level and has therefore only completed the strategic and multidisciplinary steps. The BSC analysis will therefore stop at the macro phase while the ASC analysis will include all three phases.

3.6.1 Macro strategy level

At this large scale, Amsterdam is specifically guided by both a European and national interpretation of the sustainability objectives as defined by the European Commission. They have a clear vision, a strong leadership, and their objectives are transformed into explicit projects in the city. It can also be noted that ASC, has a common vision oriented towards sustainable development through the reduction of emissions and the production of green energy and that it is declined through the different action fields.

Moreover, the strategy that Amsterdam has, is a mixed between top-down and bottom-up, in the sense that it not only focuses on having a vision and letting the governance implement the projects, but that some projects are born from the field and manage to come and adjust the vision. It is moreover a dynamic strategy that it possesses because the stages are never closed on themselves, but rather that they are linked and adjusted to each other. We can note the fact that ASC used to own 5 smart action fields and that today it owns 6 more complete: infrastructures & technology, energy/water/waste, mobility, circular city, governance & education, citizens & living.

The desire to transform Amsterdam into a smart city was born out of both a political will and a motivation to use new digital technologies as an enabler to achieve sustainable goals in economic, social and environmental dimensions. ASC has stick to its vision and many large-scale smart projects have come to fruition, to the point where it has even become a benchmark for many cities.

Amsterdam has been able to adapt to its territory and to include its own challenges in its smart plan. Amsterdam's vision has been well coupled with its strategy, aligning its priorities with its urgently needed issues. We can see here the fact that Amsterdam is surrounded by water and that therefore rising water levels are a major issue. That is why its vision has been oriented towards an approach that allows the reduction of carbon dioxide and therefore helps to maintain temperatures and sea levels. By 2025, they plan to continue their 40% CO2 reduction and if they succeed, they could become the most sustainable city in the world. We can therefore highlight that their vision is very ambitious and that they are giving themselves the means to achieve it. Moreover, with the help of the Amsterdam city council it has been able to introduce a structural vision for 2040, to incorporate urban design option to host the 2028 summer Olympics and to collaborate with local municipalities, businesses and academic institutions.

Conversely, the situation is a little more complicated for Brussels and we can observe that they're still in a starting phase. The City of Brussels adopted an alternative strategy in 2014, when BRIC took the responsibility of transforming Brussels into a smart city. At the strategy level, this has been put in place through the creation of committees and events, the appointment of ambassadors and managers, allowing through them the construction of a smart approach. BRIC's mission was mainly to propose a realistic and achievable vision for the coming years in order to extend the transformation process approved by the government by proposing projects with the help of external experts. Indeed, these projects are based on the construction of a solid infrastructure and that efforts are mainly focused on digital inclusion.

BRIC's ambition is to continue to improve the quality of life of citizens and businesses within the region through the implementation and use of intelligent, data-based solutions. This is an ambition that requires having indicators that allow for continuous monitoring and we can see that these have been achieved through the implementation of the DESI indicators, previously discussed. Nevertheless, we should point out that BSC moves from a strategic stage to a control stage without taking the time to go through the appropriation and roadmap phases, which

consists of giving ownership to the projects. Concerning the other steps, it can be noted that some innovations have been made in the field but that they are still very minimalist. Despite the fact that Brussels tries to involve citizens as much as possible through their events, they do not really feel concerned by the implementation of the smart city (IMD Smart City Index, 2019). It can therefore be concluded that although the Brussels strategy is still rather weak, it has been put in place at a fairly broad level and it will take some years to judge its effectiveness.

3.6.2 Mezzo strategy level

At the medium scale, and more specifically at the appropriation and roadmap step, the different actors (private or public) of ASC succeed in taking the ownership of their projects and lead them through in the various field (environment, energy, mobility, buildings, health, government).

Through the case-study that was carried out, we were able to notice that the citizen is always present in the projects, and that they are even sometimes the entrepreneurial actors of these, such as in the sustainable commercial street. This has the consequence of offering them a real added value and that the technological innovations at the lower level (micro-level) are beneficial to them. Through this participatory approach, the citizen commits himself and therefore the final goal of this appropriation phase, which consists in including the citizen, is made by itself. The citizens of Amsterdam have clearly understood the role they have to play in this sustainable transition and this involvement is due to the strong and convincing vision that Amsterdam has put in place. Additionally, the projects implemented, allows citizens to see the positive impacts of smart projects and includes them even more.

It was also noted that the number of projects has continued to grow and involve more and more partners such as: financial institutions, technology strat-ups, waste management companies. So, more and more stakeholders are becoming interested in smarts projects because it can offer many economic benefits and become the market of the future. And as we know, the pioneers who will be there will be those who have the greatest knowledge and advancements in the subject. As a result, the competition between ASC's smart players is intending to increase, forcing them to become more and more competitive and innovative

3.6.3 Micro strategy level

This last step, at the lowest scale, is mainly aimed at better responding to specific problems at the regional or neighbourhood level, by proposing technology-based solutions. This level is strongly interconnected with the definition we have chosen of the smart city and as a reminder is: « A smart city is an ecosystem of stakeholders engaged in a process of sustainable transition in a given territory using new technologies as facilitator to achieve these sustainable objectives (Smart City Institute, 2017) ».

In recent years, Amsterdam has been able to become a leader in the smart city through its approach to use technology as an enabler to improve urban connectivity. In the case study, this was seen by: use of smart meters, digital control and monitoring devices for efficient and smart electronic systems, driving sensors-based sun-powered lighting, access to microgrid and solar energy facility, charging stations networks for electric cars, sensors networks to support the building automation system (lighting, heating/cooling) resulting in lower consumption of fuel, etc…

Through all these implementations on the field, we have seen that ASC has been able to distinguish between a city that tries to serve technology and a city that serves people. This connectivity, whether through devices or the city's architecture, which encourages cycling and social contact, connects and strengthens communities, but also makes it possible to share ideas for the improvement of the city.

Table 11: Summary of the application of the SMART framework

SCALE		AMSTERDAM	BRUSSELS
MACRO	**Evaluation**	**Strategic level completed & strong positive impact.**	**Completed & moderate impact.**
	Characteristics	▪ Top-down & bottom-up approach. ▪ Dynamic strategy (stages interconnected). ▪ Strong, common and ambitious vision. ▪ Strong leadership influenced by a political will. ▪ Reduction of emissions and production of green energy as primary goals (aligning priorities to major issues). ▪ 6 big smart action fields: infrastructures & technology, energy & water & waste, mobility, circular city, governance & education, citizens & living.	▪ Top-down approach. ▪ Fixed and administrative strategy. ▪ BRIC as the main actor. ▪ Moderate to weak political will. ▪ Main focus: construction of governance and digital inclusion. ▪ 6 small action fields: environment, people, living, government, economy, mobility.
MEZZO	**Evaluation**	**Strategic level completed & strong positive impact.**	**Not completed.**
	Characteristics	▪ Inclusion of citizens & sometimes are the entrepreneurial actors such in the sustainable commercial street. ▪ Offer a real added value as the projects are built for the citizens. ▪ More stakeholders are willing to enter the smart city market, leveraging the competition and therefore more innovations will be created → reinforcing ASC world leading position.	**Not addressed as not completed.**

MICRO	**Evaluation**	**Strategic level completed & strong positive impact.**	**Not completed.**
	Characteristics	▪ Using technology as a tool and not as end, construction of a city that serves people. ▪ Responding to specific problems at regional or neighbourhood levels. ▪ Improving urban connectivity with the help of smart meters, digital control and monitoring devices, etc … ▪ Promoting connectivity to connect and strengthen communities and the sharing of ideas, for the improvement of the city.	**Not addressed as not completed.**

Section 3.7: Smart City Reference Model (SCRM) application

The smart city reference model proposed by Zygiaris (2012) is a comprehensive and appropriate model for judging the dimensions covered when creating smart projects. It is a framework that aims to follow a step-by-step approach to describe the necessary and innovative components to address the global challenges that cities are facing. It is a model that can be used by the administration and the city planners to judge the seven layers present in it. Furthermore, each of these layers has been designed to respond to specific issues and has specific Key Performance Indicators.

As a reminder, this model is divided into seven layers:

(0) The city layer (city readiness) corresponds to a starting and conventional stage because before the city can begin its transition process, the city must have good foundations. And it includes the following key performances indicators (KPI) of sustainability: governance orchestration, infrastructure alignment, district generation, smart urban planning, smart identity branding and community involvement.

(1) The green city layer (urban CO2 footprint) deals with the strategic sustainable development and include the following KPI: alternative energy, water conservation, green transport, green building and CO2 reduction.

(2) The interconnection layer (broadband economy) refers to any device that connects people and uses the following KPIs: Wi-Fi, radio communication, satellite, 3G+, Ethernet.

(3) The instrumentation layer (real time events) refers to the hardware of the smart city (physical equipment on the field) such as: sensors, smart traffic light, detectors, tracers.

(4) The open integration layer (open integrated space) refers to the establishment of a storage system to store data from the different technologies that are used: OS, geospatial, semantic, open data, linked applications, cloud.

(5) The application layer (real life intelligence) aims to link the previous layers and the different action fields with the aim to optimize all the areas: i-energy, i-transport, i-democracy, i-government, i-services, i-home.

(6) The innovation layer (smart growth) aims to make the growth smart on the various economic, cultural, social and technological levels, with the following KPI: new business models, living labs, creative class, web of trust.

Contrary to the previous model (SMART framework) which was applied, and which aimed to plan a strategy on different scales and time horizons, this one aims to take into account everything that needs to be thought out at the strategic level to facilitate implementation in the field.

In order to be unrepetitive and to not address what has been described previously, we have decided to apply this framework directly to the cities of Brussels and Amsterdam.

We would also like to point out that our judgement and evaluation are subjective because, as explained earlier in our case studies, we only selected a few projects in each city. The aim is mainly to make a comparison between AMC and BSC. In our analysis, we also decided to use only one part of the KPIs, on which we can issue an opinion because we treated them in the case study.

To do so we decided to use the following rating:

(0): means that the character addressed is not present or has not been identified.

(+1): means that the character addressed is present and has a minimal positive impact.

(+2): means that the character addressed is present and has a moderate positive impact.

(+3): means that the character addressed is present and has a high positive impact.

Table 12: Summary of the application of the smart reference model

LAYERS	KPI	AMSTERDAM	BRUSSELS
0 – The City Layer	▪ Government orchestration	+2	+1
	▪ Infrastructure alignment	+2	+1
	▪ Smart urban planning	+3	+1
	▪ Smart identity branding	+2	+1
	▪ Community involvement	+3	+1
1 – The Green City Layer	▪ Alternative energy	+3	+1
	▪ Water conservation	+2	+1
	▪ Green transport	+2	+1
	▪ Green building policies	+1	+1
	▪ CO2 reduction	+3	+1
2 – The Interconnection Layer	▪ Fibre connectivity	+3	+2
	▪ Broadband inclusion	+3	+2

3 – The Instrumentation Layer	▪ **Sensors** ▪ **Smart traffic lights**	**+2** **+1**	**+1** **0**
4 – The Open Integration Layer	▪ **Smart grids** ▪ **Cloud**	**+2** **+1**	**0** **+1**
5 – The Application Layer	▪ **I-energy** ▪ **I-transport** ▪ **I-government** ▪ **I-home** ▪ **I-services**	**+3** **+2** **+2** **+1** **+1**	**0** **+1** **+1** **+1** **+1**
6 – The innovation Layer	▪ **Living labs** ▪ **Creative class**	**+1** **+1**	**+1** **+1**
	TOTAL SCORE	**46/69**	**22/69**

Section 3.8: Research findings

Now that we have studied the different frameworks, that we have evaluated and applied them, we are going to discuss the different results that have obtained from the case studies of Brussels and Amsterdam, but also answer our problematic; which deals with the key strategic success factors and frameworks.

3.8.1 Key strategic success strategies and frameworks of smart cities

Amsterdam is often described as a city where pilot projects are progressing, but which sometimes lacks implementation, which is completely not true. In fact, at its strategic level, Amsterdam has opted for a mix of top-down and bottom-up strategy, which enabled a rapid launch of multiple projects in different action fields while maintaining a common vision. The mixed strategy that Amsterdam has put in place was surely the most appropriate strategy to its past situation and best corresponds to the vision it has set itself.

We can note that Amsterdam ranks among the smartest cities in the world because of the methodology it has put in place, which has made it possible to launch more than 70 projects in just three years and become the benchmark of some of them. Through its strong, common and ambitious vision oriented towards sustainable development, Amsterdam has been able to adapt to its territory and to include its own urgent challenges it its smart plan which are mainly the reduction of CO2 emissions and the production of sustainable energy. As a seaside city, these two main objectives have been urgently implemented to counteract the rising sea levels caused by the global warming.

For Brussels, on the other hand, it is a fairly new subject and we can observe that they are still in an administrative stage. Brussels has opted for a top-down approach, with a maximal focus on government/political actors with the aim of achieving formal objectives. We can also underline that Brussels is facing different obstacles such as « the lack of financial resources, the insufficient expertise in the administration and the complexity of the mobilization and involvement of the different stakeholders in the process », making its realization complicated. The Brussel's situation is controversial and difficult to judge, because most of the projects that have been launched, have not been implemented, expect few small projects with a minimal impact.

On the other hand, one of the great advances in Brussels has been the implementation of its DESI (Digital Economy & Society Index) key performance indicators, allowing it to judge its digital performance and competitiveness on the following five axes: connectivity, human capital, use of internet, integration of digital technology, digital public services. However, while keeping a critical opinion on their last publication, it seems that they are too optimistic about their ranking and evaluation compared to their competitors *(figure 8).* Through its projects, we understand that Brussels wants to launch many projects that will enable it to become smarter, but nevertheless it should judge the importance and urgency of their implementation.

In terms of the strategies to be put in place, whether top-down or bottom-up, it is up to the city to adopt its own strategy, as no one method that takes priority over the other. The most important thing is that the chosen strategy adapts to the existing structure and infrastructure. Similarly, in terms of the innovations to be implemented, it is necessary to innovate in order to respond to the city's challenge and not try to copy and paste solutions implemented by the smartest cities. Innovation should not become an end in itself but remain a mean to solve problems smartly.

However, since the city has decided the strategy it wants to implement, different phases must be respected and that is why a methodology through a framework must be put in place from the very beginning. Having studied the different frameworks, I can confirm that the SMART framework of Letaifa (2015) offers a good strategic guide to follow the different phases according to the different levels. At the full scale (macro), it is necessary to establish a strategy that will give the city a strong vision of its future (strategy) and mobilize different actors and resources (multidisciplinarity). At the medium scale (mezzo), the actors must be able to take ownership of their project (appropriation) and put in place the implementation of their strategy (roadmap). This framework was the most comprehensive, cross-sectorial and which present the strategic method in different steps and levels (macro, mezzo, micro).

This framework, complemented by Zygiaris' Smart City Reference Model (2012), will provide a more global overview of the dimensions and layers of a smart city (city, green city, interconnection, instrumentation, open integration, application and innovation). Indeed, this reference model gives a more global idea of what needs to be put in place. With the help of these KPIs, they give different key ideas of what to include in order to become a smart city. It is a framework that can be used both at the strategic level, as well as in the evaluation phase to

judge/compare one or more cities on their smart inclusion. Therefore, the SMART framework and the Smart City Reference Model are two complementary frameworks and reworked together, they could provide a strategic guide for the establishment of a smart city methodology. Agreeing with our argument, Winden (2016) notes that the development of a workable action plan and the utilisation of a framework are seen as key success factors for the successful completion and transition of the city to the smart city.

3.8.2 Key strategic success factors of smart cities

As defined previously, a smart city is *« an ecosystem of stakeholders engaged in a process of sustainable transition in a given territory using new technologies as a facilitator to achieve these sustainable objectives: economic development, social wellbeing and respect for the environment. (Smart City Institute, 2017) ».* Therefore, a smart city uses ICT as a facilitating tool to improve its productivity, as well as the sustainability of its environment, usually by placing the different dimensions in a smart and intuitive framework.

The smart city constantly strives to become and remain automatic by improving the general knowledge of its inhabitants and networks, as well as their prosperity and personal satisfaction. It achieves this by educating and involving them as entrepreneurs and as citizens, and by strengthening the procedures that make cities enjoyable and suitable for today's individuals and problems.

In order to achieve this smart city, so desired and complex to set up, many frameworks and key success factors have been created over time. Although many of them are different, we can still find similarities and best practices. The purpose of this study was to answer the following question: *"what are the key strategic success factors that enable smart cities to accelerate and ensure effective implementation?".*

In the next few lines, we will therefore answer this question using the information gathered in our case analysis and in the scientific literature that we have covered. Moreover, we have decided to rank these 17 key strategic success factors that we have found according to the scales established by the SMART framework *(figure 6)*, as they all have a specific importance over time.

3.8.2.1 Macro strategic level (strategy and multidisciplinary steps):

- The expression and definition of the smart city is a much-debated topic in the scientific community, governments, global corporations, and is often confusing. It is necessary for the city to put in place its definition, with the aim of bringing together all the actors and directing them towards what needs to be accomplished.

- Successful activities will usually be embedded in a comprehensive vision of the city. Conflicts of interest need to be discussed among stakeholders and the vision needs to be shared. The vision happens through the re-evaluation of the role of the city.

- Cities need to focus on their own problems and define their actions fields. The integration of an integrated and multi-stakeholder approach will make it possible to find common and cross-sectoral solutions.

- A mixed strategy between top-down and bottom-up is key. It is important and necessary that the city is able to have a vision and that they are able to give ownership to actors (top-down) but also that they are able to start from pilot projects on the field and learn from these projects to take the approach upwards and shape the vision (bottom-up). We believe that the vision also arises from the field and not just from the governance.

- Understanding the needs and requirements of end customers remains a fundamental key success factor. There is no doubt that such considerations should be integrated from the very beginning of the development of a smart city and, therefore, in the overall smart city methodology.

- The diversity of stakeholders (citizens, third party providers) is vital and must be involved both in strategies and implementation. Citizens are the end users, so the city must succeed in including them in the process.

- Governance must have a critical vision of its infrastructures and assets and put in place an urban development plan to fill the gaps and shape the city according to its vision.

- Project creation should not be overwhelmed by innovations, partners, and administration because it hinders the ability of a public enterprise to progress and innovate. Although the

process of a smart city enabling the launch of a project is quite complex, sometimes it is getting too complex (as in Brussels).

- The city must have a concrete action plan that will allow their initiatives to be implemented. The use of frameworks as a strategic guide is recommended, and more specifically the combination of Letaifa (SMART framework) and Zygiaris (Smart City Reference Model).

3.8.2.1 Mezzo strategic level (appropriation step) :

- Promoting knowledge sharing of smarts projects through events or platforms, will enable to build competences and involve the citizens. In addition, exploit and include as much as possible the ideas coming from citizens.

- Have support from private companies will provide fundamental mastery, money and technological capabilities. Minimal funding is required and the commitment of “EU Smart Cities Programs” can help to kick start the project, by allocating money.

- Educating citizens and providing them with knowledge about the current problems of the city, either through courses in schools or through events. It is through the dissemination of knowledge that people will be attracted to solve the problems of the city.

- Organizational transparency of projects is seen as a crucial key success factor, as it provides reliability in the achievement of objectives, openness of data, policy coordination and leadership.

3.8.2.2 Micro strategic level (roadman and technology steps):

- Focus first on a smaller area of the city and continue development around it. This helps to mobilize funds and to be sure to achieve a result without getting lost. However, this could create a gap between population segments or locations.

- Maximise the potential of data and TIC to provide new or improved services, optimise infrastructures and promote collaboration between different stakeholders

- Keeping in mind that the main goal is the sustainable transition and not the innovation. Innovation should remain a tool to resolve challenges. However, we believe that the support of subsidies for innovative entrepreneurs will allow them to get more involved and to create adapted solutions.

- The creation of innovative technologies to achieve sustainable goals are advocated to be created at the small level (regional or neighbourhood level) to better address specific local problems.

Through this research thesis, we were able to identify 17 key strategic success factors, including 9 in the macro-strategic level, 4 in the mezzo-strategic level and 4 in the micro-strategic level. It is important to note that through the division of these according to time scale, that there are more key success factors in the first scale (macro) than in the others (mezzo and micro).

Therefore, smart city planners need to devote most of their attention to the strategy and multidisciplinarity stages, as they help to define a vision, create leadership, bring together actors and resources, which will be replicated in the next stages. Therefore, if these steps are not well established and coordinated from the outset, it can lead to the malfunctioning of others and the whole process as a result. For example, if governance has not created a strong vision and clear objectives to be achieved, this will be translated at the final stage by creating technological innovations, which do not meet the needs of the citizens.

CHAPTER 4: CONCLUSION

The concept of the smart city is still a fairly recent concept and raises many issues. We have noticed that many scientific researchers, governments and other companies specializing in the subject still do not agree on one and only definition of the smart city. We can understand this inconsistency in definitions because the smart city is a theme that each city must deal with and give its own definition to establish its vision around it.

However, to successfully carry out our work, we have based ourselves on the definition given by the Smart City Institute, which is as follows: *« A smart city is an ecosystem of stakeholders engaged in a process of sustainable transition in a given territory using new technologies as a facilitator to achieve these sustainable objectives: economic development, social wellbeing and respect for the environment. (Smart City Institute, 2017) ».* Through this definition, we could understand that the main characteristic of smart city was the sustainable transition by using technology as a driver, to solve economic, social and environmental challenges.

Due to the fact that little research has been conducted on whether there are more effective frameworks, strategies or key success factors to achieve a smart city, we decided to analyze the following issue *« What are the strategic success factors that enable smart cities to accelerate and ensure effective implementation? ».*

To answer this research question as objectively as possible, we first carried out a review of the scientific literature, which enabled us to learn more about the concept of smart cities, its background and its development within the European Union. Following this, we discussed the different stages of setting up a smart city, which deals with the strategic aspect and proved to be relevant to our study. We extracted the five most popular strategic frameworks from the scientific literature, compared and evaluated them. We then made a selection and retained the two that seemed most appropriate, cross-sectorial and complete: the SMART framework (Letaifa, 2015) and the Smart City Reference Model (Zygiaris, 2012).

Then, to continue and address a more practical aspect, we have applied them to the cities of Brussels and Amsterdam, and we have come to some conclusions. The research results revealed

that Brussels and Amsterdam have two very different strategies and therefore, achieving different results:

- Amsterdam has opted for a mix of top-down and bottom-up strategy, which enabled a rapid launch of multiple projects in different action fields while maintaining a strong, common, and ambitious vision. Moreover, it has been able to adapt to its territory and to include its own urgent challenges it its smart plan which are mainly the reduction of CO2 emissions and the production of sustainable energy.

- Brussels has opted for a top-down approach, with a maximal focus on government/political actors with the aim of achieving formal objectives. Its's situation is controversial and difficult to judge, because most of the projects that have been launched, have not been implemented, expect few small projects with a minimal impact. One of its great advances has been the implementation of its DESI (Digital Economy & Society Index) key performance indicators, allowing it to judge its digital performance and competitiveness.

In terms of frameworks, we have overserved:

- Firstly, that the SMART framework (Letaifa,2015) provides a good strategic guide to follow the different steps at different levels (macro, mezzo, mezzo) and that it is the most comprehensive and cross-sectorial framework.

- Secondly, that the Smart City Reference Model (Zygiaris, 2012), with the help of these KPIs, gives different key ideas of what to include in each layer (city, green city, interconnection, instrumentation, open integration, application and innovation) in order to become a smart city. Moreover, it is a framework that can be used both at the strategic level, as well as in the evaluation phase to judge/compare one or more cities on their smart inclusion.

- Thirdly, the SMART framework and the Smart City Reference Model are two complementary frameworks and reworked together, they could provide a strategic guide for the establishment of a smart city methodology.

Regarding the key strategic success factors that enable smart cities to accelerate and ensure effective implementation, we were able to identify 17 of them through the case study we conducted and the literature we covered. We have classified them into 3 scales (macro, mezzo, micro) according to the SMART model of Letaifa, ranging from a larger scale to a smaller scale. Here is a summary of the most important, but if you want to have a more global idea, these are detailed in section 3.8.2: key strategic success factors of smart cities.

- **Macro strategic level:** a clear definition of the smart city, a comprehensive vision of the city, a multi-stakeholder approach, a mix between top-down and bottom-up strategy, understanding the citizens as they are the end-users.

- **Mezzo strategic level:** promoting knowledge sharing, educating citizens and providing them knowledge about the current problems of the city, minimum investment fund and organizational transparency.

- **Micro strategic level:** focusing first on a small area, maximizing the potential of data and ICT, keeping in mind that the goal is the sustainable transition and not the innovation.

Despite the fact that we have used sources from the scientific literature and that it ensures a high degree of reliability, this exploration, like any research, nevertheless has certain limitations.

Firstly, we would like to highlight the fact that we have only made an indirect observation and that consequently, we didn't have a field approach. In-depth visits of Brussels and Amsterdam were planned to test their smart applications, however due to the covid-19 pandemic, these have not been carried out.

Secondly, we only used case studies of two European cities characterized by a strong proximity and some similar characteristics, therefore our assessment on the strategic implications cannot be extend beyond these cities. We cannot guarantee that our key success factors will fit to all cities and ensure effective implementation, but they do provide a solid foundation and a wide range of factors to keep in mind. For future research, we will advise the use of more case-studies but always in keeping a geographical focus on a particular region.

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