INVESTIGATING ACTORS AND PERCEPTIONS IN THE CONCEPT OF SMART CITY: THE CASE OF HAMBURG

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ABSTRACT

INVESTIGATING ACTORS AND PERCEPTIONS IN THE CONCEPT OF SMART CITY: THE CASE OF HAMBURG

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The technology generates a quiet revolution across the fields of science and engineering, not to mention urban and computational studies. Day by day, authorities and corporations launch various Smart City projects and strategies. Whether it sounds terrifying or not, anyone has a digital footprint in the physical and virtual environment through the Internet of Things devices and smart appliances which emerge nearly anywhere in cities, including software applications which we voluntarily welcome on our smartphones or computers. Smart cities, therefore, are proclaimed as both inevitable and the future. This thesis combines theoretical and empirical research on the digital-oriented understanding of the physical environment and data-driven urban practices in academics and practices. The study reviews scholarly and grey literature to provide state-of-the-art knowledge in the subject, evaluates development and deployment of Smart City services in the City of Hamburg by analyses and semi-structured in-depth interviews to provide recommendations both to the concept and the City, captures the interrelations of different actors by actor-network theory to reflect their emphasis on social, political and spatial fields. The analyses result in the furcated division in the identification of smart cities. Numerous actors contribute and supplement to this fundamental dichotomy resulting cities as well as individuals to suffer. Additionally, engineers and data scientists detained this very urban domain in

academia due to the neglect and lack of knowledge of planning- and design-related disciplines. Moreover, the City exhibits various yet disorganised strategies, projects, initiatives and institutions for its Smart City vision. Conclusively, the analyses and recommendations serve to recapture the unique role of urban planners and architects in guiding the future of cities.

Keywords: Smart City, Urban Technology, Smart City of Hamburg, Urban Governance

ÖZ

AKILLI KENT KAVRAMINDA AKTÖRLER VE ALGININ İNCELENMESİ: HAMBURG ÖRNEĞİ

Yılmaz, Mert Can
Yüksek Lisans, Kentsel Tasarım
Tez Danışmanı: Prof. Dr. Müge Akkar Ercan

Eylül 2019, 134 sayfa

Bilim ve mühendislik alanlarına ek olarak teknoloji, kent ve hesaplama alanlarında da sessiz bir devrim gerçekleştiriyor. Yöneticiler ve şirketler gün geçtikçe farklı Akıllı Şehir projeleri ve stratejileri kurguluyor. Ürkütücü de olsa şehir içerisinde kolaylıkla karşılaşabileceğimiz Nesnelerin İnterneti aygıtları ve akıllı gereçler ayrıca telefonlarımızdan veya bilgisayarlarımızdan gönüllü olarak kabul ettiğimiz yazılım uygulamaları sayesinde herkesin fiziksel ve sanal ortamında dijital izi oluşmaktadır. Dolayısıyla akıllı şehirler kaçınılmaz ve gelecek olarak tasvir ediliyor. Bu tez, teorik ve ampirik araştırmalar üzerinden fiziksel çevrenin dijital anlayışını ve veriye dayalı kentsel uygulamaları akademi ve pratik örnekler üzerinden bir araya getiriyor. Bu çalışma, konu hakkında güncel bilgileri sağlamak üzere bilimsel ve gri literatürü tarıyor; kavrama ve Hamburg şehrine dair öneriler sunmak için şehirdeki Akıllı Kent hizmetlerinin gelişimini ve yayılmasını analizler ve yarı yapılandırılmış derinlemesine görüşmeler ile inceliyor; sosyal, politik ve mekansal alanlarda aktörlerin önemini vurgulamak için aktör-ağ teorisi ile farklı aktörlerin karşılıklı ilişkilerini gösteriyor. Analizler akıllı kent tanımlarındaki farklı görüşleri ortaya koyuyor. Aktörlerin temel fikir anlaşmazlıkları da şehirler ve bireyler üzerinde baskıya katkı sağlıyor. Ek olarak, planlama ve tasarım odaklı disiplinlerin ihmali ve bilgi eksikliğinden dolayı mühendisler ve veri bilimcileri akademideki kent ile iç içe olan bu alanda daha fazla

söz sahibi olarak yerlerini koruyor. Hamburg, şehrin Smart City vizyonu için çeşitli fakat bir o kadar da düzensiz stratejiler, projeler, girişimler ve kurumlar oluşturuyor. Sonuç olarak analizler ve öneriler, kent plancılarının ve tasarımcıların kentlerin geleceği üzerindeki önemli rolünü vurguluyor.

Anahtar Kelimeler: Akıllı Şehir, Kentsel Teknoloji, Hamburg Akıllı Şehir, Kentsel Yönetişim

to people working for a better future…

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Writing this thesis was an extensive and lengthy exercise regarding its interlocking subjects. City and technology relation of which the thesis depicts is an advancing, emerging and challenging matter. The main thrust of the research has germinated in one of the seminars of Urban Design Studio in Middle East Technical University, which subsequently constricted to the concept of Smart City. I owe a tremendous debt of tribute to the many people helping me over this process; withal, I must first express my gratitude to my supervisor Prof. Dr Müge Akkar Ercan for her invaluable commitment, continuous encouragement, guidance, advice and criticism throughout this challenging process. Without her encouraging comments and suggestions and her sympathy, this work would not have reached its grade of quality. I would also like to firmly acknowledge valuable criticism and kind interests of the examining committee members, namely Prof. Dr Adnan Barlas from Middle East Technical University and Prof. Dr Ela Vesile Öcalir from Gazi University. Furthermore, the descriptive richness of this work would have been inconceivable without participation, willingness and constructive insight of the interviewees in Hamburg. Last but not least, I owe a great deal to the kindness and helpfulness of a large number of my friends, especially to my peers from the bachelor's in City and Regional Planning and master's in Urban Design, as they witnessed this thesis stole much of my time than initially intended. I must additionally offer my special appreciation to Ecem Kutlay, Ebru Şevik, Eren Efeoğlu and Onur Tümtürk helping me overcome the bureaucratic issues, along with massive support. Finally, I am very much beholden to my family, and especially to my aunt Şükran Yılmaz, which this work could never have been accomplished without the immeasurable moral and material support of her. All in all, this research-oriented study has not only helped me to strengthen my knowledge in urban studies, planning and design, along with innovative technologies but also trained me in researching and academic writing, on top of building self-discipline.

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INTRODUCTION

1.1. Statement of the Problem

The cities of the ancient world were predominantly concentrated in the urbanised central territory, where it holds the potential and power commercially, culturally, and politically, which often lies in the historical or geographic core. The core had to be sustained by much larger rural populations. Despite a few major cities and urbanised societies, in which a high proportion of the population lives, cities were developed only in the late nineteenth and early twentieth centuries with the automation and machinery.

The situation drastically changed in recent history beginning with industrialisation and invention of the Internet. The process led to what urban studies call as urban-pull, and unplanned urbanisation as well as controlled one, rushing in the entire world. The industrial countries found directions to exploit the situation by scaling their economies and promoting further innovations, which compensated the downfalls of the crisis with strategic planning methods and visions. Agricultural oriented countries, on the other hand, faced with uncontrollable migration, and consequently unplanned urbanisation have created insufficient infrastructure and eventually unhealthy living environment in cities.

Pull and push factors of urbanisation influence the physical environment, eventually creating conflicts and disputes. Uncontrollable population growth and expanding urban sprawl creates severe damage to the life-quality of urban residents. There is a paradox in the world and especially cities, where they are presently facing the most pressing struggles in history, while several major cities and regions grow and expand.

Projections show the rise in the number and population of metropolises, where these heavily urbanised zones are dense regarding land use and conjointly demanding to govern due to their social fabric and diverse economic networks (Kraas, 2007). This is a phenomenon, which has been accelerated by globalisation, whereas it also affects the global environment (Goudie, 2018). A drastic increase in urban population highlights the issue of climate change, particularly ecological concerns. We are witnessing unusual climate events every year. On the other hand, we are also leading the transition to renewables to satisfy the growing demand for energy due to our current lifestyle and contemporary cities. These climate-responsive solutions have not substantial impacts on the global spectrum.

Contrary to the prevailing thoughts, these current problems are not inevitable facts of our future. Innovations are wrapping up cities. In a recent decade, there has been an intensive process of replacing the old analogue equipment with digital ones. Technological development in Information and Communications Technologies are spanning, where people enjoy personalised experiences with digital devices and their adoption to everyday life.

City administrations and companies are trying to adapt and create solutions to the recent issues and upcoming challenges of future cities with the help of technology; nonetheless, they are failing. Technology is not a silver-bullet answer to current urban problems. Moreover, it also creates ambiguity. Barnett (1989) points out that urban design and planning instruments must change due to the change of towns, suburbs, and residents. What was right about cities as recently as ten years ago is true no longer, and the process of the evolution goes on.

In this sense, we need to understand the current urban conditions, the relation and need of city actors, the position of technology whether it is a focal point or a mean to imagine a better economic and social life experiences for inhabitants. Therefore, urban methods of designing and governing should undergo adaptations and transformation to address the future challenges of cities.

1.1.1. Research Problem

The history of industrialisation is loaded with evidence of the application of scientific and technical knowledge. Cities are thus the fountain of scientific and technological awareness which produces innovations intended for modernisation and development of cities as well as communities. As cities are nodes of new ideas, the history of scientific and technological innovation, and that of civilisation is inseparable from the history of cities. Towns and cities have consistently been at the centre of most civilisations and techno-economic revolutions: from the ancient Mesopotamian, Nile Valley and Indus civilisations; through the classical Greek and Roman civilisations; to the Renaissance and Industrial Revolution (UN Habitat, 1994). It is thus evident that technology plays an increasingly critical and essential role in human life. It has permeated into every aspect of our lives, along with existing relations before digital progress. It has reshaped our approach to life, the way we think, act, socialise, communicate, travel, work, organise, and live.

Technology evolved gradually in its early period; subsequently, another discovery was found every following day. Before ‘essential’ devices which occupy our everyday life nowadays, there were considerable challenges as well as unique innovations. Performing necessary arithmetic calculations had been a large-scale problem where a room-sized computer was needed. Moreover, storage was another obvious obstacle, which was carried by several devices up until now as in floppy disks, CD-ROMs, and flash drive. We now can own personal computers which size as big as our hand or even smaller. Besides, we can store thousands of files and data on these computers as well as in cloud-based systems. Apart from storing data, we can share and access everything online thanks to wireless networks, and especially to the Internet.

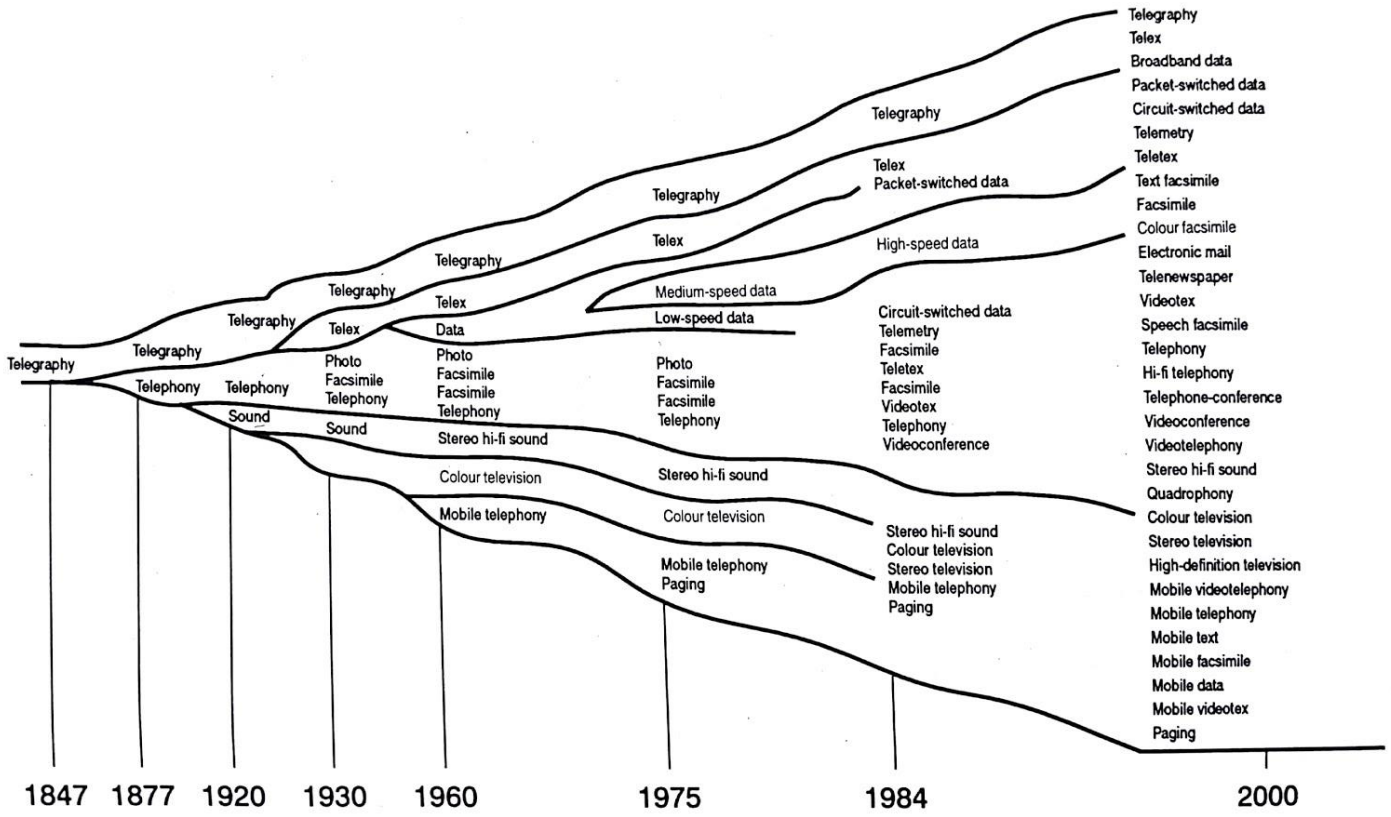

Figure 1.1. *The expanding range of telecommunications services: prospects for the year 2000 (Retrieved from Telecommunications and the City, Graham & Marvin, 1996, p. 16)*

Along with beneficial hardware that is making our daily life more pleasant, the industry generated thousands of worthy software. For instance, there is an indefinite number of search engines online to sort through the massive amount of data. The means of communication has diversified by the Internet, such as the rise of social media and video streaming channels. The phone which was invented to communicate along a line is now smart and connected. It is a personal portal to the Internet and the whole world with it.

With this accelerating pace of innovations, digital devices are and will be part of our everyday life. As we no longer think that having electricity charging a mobile phone or ordering online is an extraordinary action, the Internet and digital devices will be similar in the future, the backbone of our life.

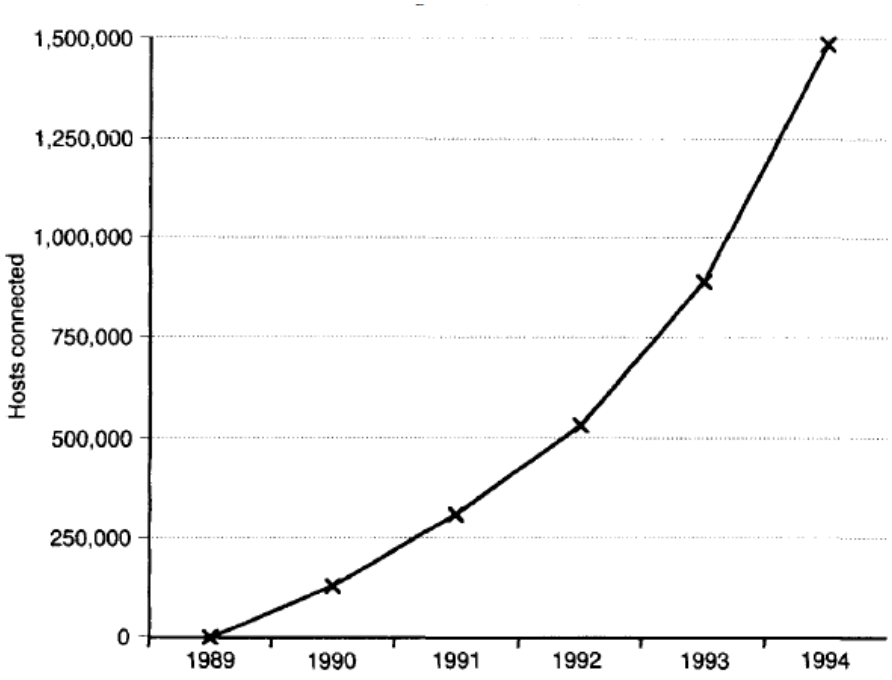

Figure 1.2. The exponential growth of the Internet 1989–1994 (Ogden, 1994)

As a result of this relentless technological breakthrough, which has begun with computer micro-miniaturisation by increasing storage capacity to communicate more information, a vast number of nowadays objects we own, and use are becoming museum artefacts. We all are living in a period of change, a tremendous revolution. The rapid pace of technologic development and digital systems paved the way of a quiet revolution, which fundamentally changes society. The so-called age of digital has created new forms to develop knowledge and transmit information. It has reorganised how a city, community and space are governed, managed, formed. Life is changing faster than ever and getting increasingly complicated.

Considering the development of technology, hence, the physical reality is experiencing a modest revolution where prevailing planning instruments and design approaches are not adaptive but limited. Nevertheless, these achievements and adaptation are insufficient. It is an urgent time yet uncertain one. We only comprehend a fragment of how the urban environment advances. We need to react fast, take effective decisions. We should not embellish existing processes but rebuild them from scratch.

In response to these above-mentioned but highly speculative and predictive events, this study focuses on the employment of technology in the urban environment, uttered as the concept of Smart City in the academics and business; the key enabling digital and connected appliances; their strategies and programmes; the relation and behaviours of urban actors from a critical perspective to unfold the idea to create an alternative spatial and organisational pattern for contemporary and future cities.

The thesis adopts and utilises several strategies to support the purposed statement by applying the knowledge and current debate in academics and business; observing cogent evidence from a case of Hamburg as well as numerous examples from the world; detecting expert opinions and judgments; finally exploiting personal observations and experiences.

1.1.2. Background and Justification

The visionary science fiction author William Gibson discloses that the future is already here; it is just not evenly distributed. If there is one truth, cities of the future will be very different compared to present-day cities in which we now live. Scholars and authorities express that cities will have a central position on this broader debate where technology is revolutionising its tools, and it transforms spatial, political and socio-economic patterns in an urban environment.

Humans, traditionally, produced tools to fulfil an appropriate need, yet nowadays it is the tool that is causing new needs, uncovering new, formerly unseen realities for which we must find new explications and tools (Branchi, Fernández-Valdivielso & Matías, 2015). It forms a new way to interact with their environment on a local, regional and global scale with the changing and expanding borders, partly real, partly virtual. As a result, they demand a new tool to ascertain what the most appropriate technology is to fit each particular problem that arises.

Martin Jacques, a journalist from The Guardian newspaper, argued on his visit to Kuala Lumpur in 1997 that modern planning is not about roads and estates; it is about an intelligent network linking our offices and homes (as cited in Aurigi, 2016). Although he highlights the importance of digital connection, which is crucial to mention, we need to fathom that a city has and should have complex fabric consisting of numerous components interacting with each other. Notably, the vital constituent in a city is the association between those components and their assembling; in other words, it is the influence on the social, political and economic aspects impacting on its inhabitants.

The urban environment can resort to the latest technologies, e.g. the Internet of Things (IoT) and Information and Communication Technologies (ICT), to help us increase efficiency, productivity and sustainability to unburden current and future urban problems. Population growth and migration tendencies interact and impinge

environmental concerns, mobility and safety issues as well as urban planning struggles. A brand-new urban revolution eventuates in virtue of technological revolution (Soja, 2001), in which we mislay sight of an unarguable purpose for technology, where technology is ripening into an end in itself. As the Internet and new forms of communication interfaces continue to grow and mature, the foundation unveils for smart visions in which tens of thousands of connected devices and sensors refurbish how we live and work.

Urban initiatives and policies are becoming more accessible to residents through the use of electronic devices, e.g., smartphones and computers. Mitchell (2000) debates that sensors and remote monitoring are likely to change service systems, and spread them wheresoever the network reaches, however the power of place will still predominate. The value of Geographic Information Systems (GIS) and remotely sensed data blended with topographical maps and population census data had manifested the capability inherent in the new appliances (Aguda et al., 2013).

The vast majority of smart developments designed by urban planners have focussed more on goods, tools and devices instead of individuals, who are the ultimate beneficiaries of these services. Smart cities manifest all over the world. Notwithstanding numerous cases of this urban labelling phenomenon in the world, we have a meagre portion of information about so-called smart cities, particularly concerning what the label ideologically exposes as well as hides.

Hollands (2008) reveals the gap in the rhetorical aspects of smart cities due to the lack of a precise definition, not to mention an underlying conceited tendency. Supplementary to what Muñoz (2008) argues that proposals are dull and applied without historical and cultural accuracy, consciously contextualising, and thinking of growth and future. Moreover, there is no coherent literature exists on the subject; and non-urbanist specialists mainly retain the field (Graham & Marvin, 1996; Aurigi, 2005, Ishida, 2000; Townsend, 2013).

In Asia, the Middle East, Europe and the Americas; for instance, there are models of smart cities that have been constructed from the ground up, thereby putting the technology at the centre degree. On the other hand, the US and the EU cherish initiatives to be driven by private companies to push and implement their smart services platforms. Fareed Zakeria (2011) uttered the outdated worldview that everything in your society must be modernised, and everything must be smart on Smart City Forum organised by the IBM (Townsend, 2013, p. 107). The top-down, dominative, authoritarian approach is clearly a mistake as we can see from many problems occurring in our cities. This indicates the Internet war of academics over governments or the triumph of distributed innovation over centralised innovation. (Townsend, 2013, p. 110).

Alessandro Aurigi (2005) remarks that given the progressive rapid development of the information society, city planners and managers need to reconsider their level of comprehension and their degree of control of the influence of information technology on today's cities. The underlying questions of how different it will be and whether our conventional approaches are adaptive are unclear. Based on looking at conventional planning approaches, the field is utilising as in methods of retrieving data, processing data, planner's role, responsibilities, community involvement. Future urban space or metropolises will embrace a complex network of social relations and interactions. Residents' needs have considerably altered over the last decade, while urban planning techniques have remained the same since the 1970s (Wakely, Levy, & Yap, 2014). Subsequently, a relatively more user-centred urban planning methods are present. Revolutions and innovations reshape space and society. The change can be radically, or grassroots based on the nature of the trigger.

Developing the Smart City is not about loading it with new technology, nor it is a designed artefact by architects or engineers. Instead, it is about leveraging technology to empower the socio-economic spine of the city. It is improving the quality of life and meeting the actual needs of city actors, e.g. citizens, authorities, companies and academia. The ultimate intention is to determine and achieve the ever-growing number

of urban problems, in the direction of a more sustainable city and a better quality of living.

The problem lies in the approach of business; business tries to accomplish the intention without involving the ones that will avail the most from these innovations – its residents. This intention has been similar to other familiar concepts as in Smart City thought. Experts should be able to incorporate varying perspectives in their advocacy of smart developments to understand different approaches and to anticipate a common platform of communication (Hanzl et al., 2012). Hence, we need to look from a different angle. These are either irrelevant or inadequate, even for current challenges, it is evident that there is a need for alternative solutions.

As mentioned above, we are facing a brand-new revolution of digital systems. Emergence, adoption and distribution of technology in our everyday lives have perpetually brought off the development of a variety of movements in the urban future. Nonetheless, the encouraging, as well as the disappointing legacy of the previous urban movements such as Garden City, New Urbanism, Creative City, Global City over environmental, economic and social concerns, inquire the crucial question of whether there is an ultimate concept or a formula to create a perfect city.

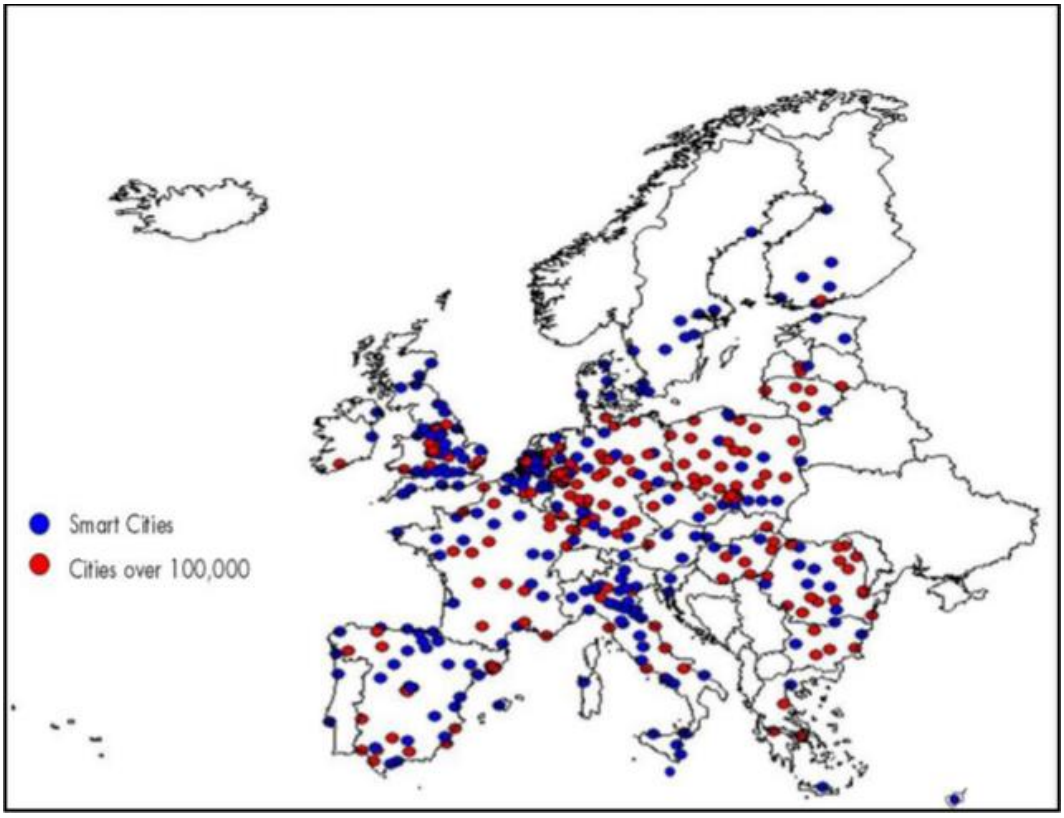

Figure 1.3. The number of Smart Cities in the EU (Manville et al., 2014)

1.1.3. Deficiencies in the Evidence

Society reflect possibilities for the future cities and provide a critical perspective about the present trend towards the creation of smart cities and the use of technology in the concept of the Smart City. A variety of studies have explored the technical standpoint of the smart city concept or how it functions with digital innovations; nonetheless, they did not get to the heart of how it is going to affect people and planning, design and management of the city.

There is recently a considerable amount of published works; however, there is a lack of holistic and comprehensive understanding of the phenomenon. Graham and Marvin (1996) and Aurigi (2005) articulate on their novel and timely books that there is no

coherent literature exists on the subject, and specialists from mainly non-urbanist fields retain the domain. Furthermore, not much has changed after these astonishing works are published. This relative neglect in urban studies leads to a problem that these specialists make very influential speculations on how urban developments should be, based on a variety of viewpoints, poor judgments and analysis. Predominantly, these ideas have been directly fuelled by interests in technological corporations, keen to foster positive public perceptions of new technologies as a motive for market growth (Slack & Fejes, 1987).

Mark Hinshaw was one of the pioneer architects to identify the misperception between the lack of judgment of employment of technology in the urban field. Planners encountering with the growing trend in the usage of smart and connected devices may presume that these will have limited or no effect on urbanism (Hinshaw, 1973). Hinshaw (1973) argues that any recognition of the association between urbanism and technology has relatively derived from the academic and professional world foreign to the fields most contiguously engaged in the urban study and its policy development. Nonetheless, most of the literature hail from these sources employing communication devices and information-generating hardware as sole means of eradicating the very urban problems which we are presently experiencing - with more and more technology.

Graham and Marvin (1996) say that the immaturity and neglect of urban studies mean that there has been a trend to approach the whole subject without trying to justify the theory or methodologies adopted. Thus, this study endeavours to describe several urban practices while also reviewing the literature and related documents; it also analyses the case of Hamburg to illustrate several projects to have a solid perspective how a city embraces the concept.

In the motivation to address these neglected and crucial areas, the study challenges what Warren (1989) describes as a candy store effect: the topic of technology and urban development by providing a license to engage in a range of phenomena. The

research avoids a result covering far too much with no logic or theory offered to explain the discussions, shreds of evidence presented, an analysis which lacks any academic base and an explicit methodology. This approach wards off the attention to marginal and tries to provoke the fundamental effects of technology-driven cities.

The literature and the professional field show that not much has changed after these above-mentioned astonishing works are published. Urban studies, as well as urban design, is profoundly relevant to understanding the concept. The significance of urban design lies in the role it plays in the overall transformation of cities. As economic, cultural and political changes have given new weight to cities, urban space is being reshaped to welcome the new urban conditions. In its broadest terms, urban design is the tool of this reshaping, hence its structural significance.

Therefore, this study intends to bring the topic back to the urban field and help to create a holistic understanding of the urban future. Thus, this research focuses on the employment of technology and digital devices where it unfolds the city to create an alternative spatial and organisational perspective and investigates human behaviours and future needs for a more liveable environment.

It should be noted that the research interest in this study occupies to gain perception in innovations and activities that combine to make cities and to see possible adoptions to the field of urban resilience for further explorations. This study is limited to several theories and concepts due to the enormous number of published works related to the phenomenon, namely Telecommunications and the City: Electronic spaces and urban places by Stephen Graham and Simon Marvin and Making the Digital City by Alessandra Aurigi.

1.1.4. Audience

The research investigates the integrity of urban planning and design with broader considerations of technologies in urban development and seeks to captivate specialists and non-specialists alike. This study may be constructive for researchers in the urban studies and other academics, for local initiatives practising and developing innovative city services, for corporates investing to the future urban environments, for people engaged in the technology bodies of local governments. Furthermore, it may interest individuals keen on the progressive and prominent domain of urban issues and technology.

1.1.5. Aims and Objectives of the Research

The upheaval from one paradigm to another in the urban issues manifest the augmented cycles of boom and bust, deepened socio-spatial segregation, uncontrollable environmental disasters, or decline of the public realm. Agencies encroach up the abandoned commodity of commoning and seize the future urban realm along with the current environment. The fields of urban studies, planning and design was a counter debate to the destruction of the urban environment and our collective future by campaigning for the intermediary and advocating for a socially integrative and environmentally responsible urban realm through its role, processes and strategies. Nonetheless, the academics conveys the impression that scientists and engineers occupied future studies, including its implications in the urban scene. Moreover, prevailing works and researches in urban planning predominantly describe innovative technology-adopted projects and applications in cities. Public and private authorities, on the other hand, chase after effective and efficient projects and strategies in terms of economic profits.

The field, all in all, seems to be populated by data as an analytic and quantitative input. 1 and 0 may work for the computational environment; however, a city is a complex phenomenon including technology, industry, nature, human relations and psychology; and the Smart City is no different. Consequently, urban-related studies should place importance on the concept of Smart City as technical fields such as engineering and informatics studies.

The thesis intends not only to inquire about the existence of urban technologies from several world examples and not to mention the case of Hamburg as an innovative city-state of Germany in terms of deploying smart and digital infrastructures but also to observe possible impacts of urban technologies and innovations while understanding the perspective of multiple actors on the concept to create a more interdisciplinary approach. Moreover, the study proposes on discovering the intersection between urbanisation and the ubiquitous digital technologies that will shape our world and how we will leave in it, giving a comprehensive illustration of the causes and impacts at the dawn of the digitalisation while giving guidance for decision-making processes and assessing the Hamburg strategy whether it is proceeding towards the desired direction. To this end, digital devices and their use and implications are to be exemplified in the urban context, where it is to reflect the notable difference or similarities between physical city to the digital world.

1.1.6. Limitations of the Research

The research process and the concept itself carries several limitations. It was often difficult to track down literature and obscure grey-material on the subject. The literature has parcelled out in several fields, e.g. urban studies, engineering, computer science and business. Each field has overlapping visions in conjunction with exclusive and distinguished aspects as well as its unique terminology. The subject embodies profound pessimism with utopian optimism; although, there is no respectable amount

of empirical study of how smart and connected devices relate to urban design and planning. Surprisingly, there is still no coherent material on the subject which brings different opinions of urban actors to the subject.

The concept in itself also limits urban management due to its limited range of users. Smart City exists with technology and not to mention people using smart devices. However, economic, political and cultural realities reflect that not everyone is benefiting from these remarkable discoveries but also denying and opposing to the technology-driven world.

The case of Hamburg is selected in order to understand and comprehend the concept in a real-time city and observe how practices work. Nevertheless, the case study resulted in difficulties due to the language in the public documents as well as for the interviews.

1.2. Research Methodology

This exploratory research investigates the complex and poorly understood set of relationships between digital technologies, planning and management of the city and society with a multitude of qualitative methods. Since the time of Comte, theoreticians have been searching for a method to employ the data of society which would yield as positive results as those attained in the realm of physical science (Chapin, 1974). The study tries to provide an urban perspective on how advanced technologies influence each and every facet of the environment, e.g. ecology, society, economy, governance, space and place. It represents an attempt to provide a comprehensive and synoptic approach to fill the gap left by the long-neglected territory of digitalisation in urban studies by reviewing literature and documents in order to create theoretical knowledge to understand the phenomenon and concept.

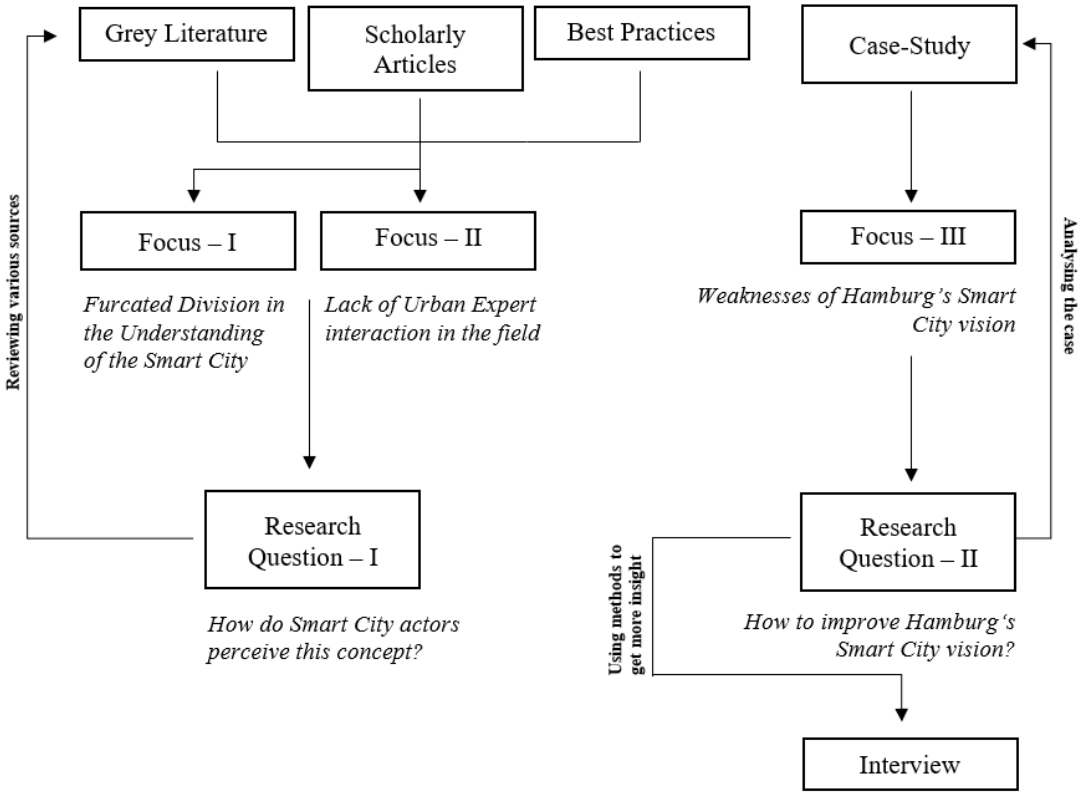

Figure 1.4. Research Flow (Yılmaz, 2019)

To understand how the interaction between technology, society, and space generates a novel urban assembly as the material basis of our lives at the dawn of the digital age, several theories and planning approaches, as well as latest urban trends, are reviewed in peer-to-peer journals and grey literature. For instance, smart and connected devices, the Information and Communications Technology, the Internet of Things, Big Data and its social background of data are reviewed to create knowledge for future cities. Additionally, different governance methods and planning techniques are investigated to understand and develop the actors, stakeholders, their relations and needs in cities. Due to the extremely rapid rate of change in technology and a highly imperfect and poorly understood territory in urban studies, the relationship of the phenomena and the city remain immature in an eclectic range of policies and research materials;

hence, the materials include also grey literature such as archives and internet articles because of the nature of the brand-new subject.

The thesis, furthermore, aims to stimulate more sophisticated debate and research on technology and the city. Nonetheless, it remains unable to provide answers to every question about this incipient field; inevitably, this thesis raises as many questions as it answers. The research emphasises and illustrates the complex relationships which exist between technology and cities by covering neglected subjects such as the urban environment, governance and urban utilities as well as the more familiar ground of socioeconomic development, transport and urban form. It debates between dystopian and utopian theorists and establishes a framework for considering the range of relationships between cities and digital technologies, linking these theories to debates about the social, economic, political and environmental development of cities within the case of Hamburg among representing other world examples and best practices. Hence, possible achievements and contributions to the research are visited by several examples and best practices to identify the current state. Real case scenarios illustrate practical experiences to create a generalised theory but also reflect possibilities and opportunities of digital technologies in the urban scene. The research also conducts several semi-structured interviews to have a sufficient and comprehensive evaluation about the case by a method of the in-depth interviewing in order to obtain more information and data about the smart implementations in Hamburg and viewpoints of different actors. The contact with the interviewees was made by both e-mail and in person. Also, the interview questions and their relation to the topics as mentioned earlier can be found in the appendix. Since experts have a very detailed specialised knowledge, interviews were conducted with a reasonably open framework which allows focused, conversational, two-way communication to understand the patterns and processes. Unsurprisingly, most interviewees voiced criticism and concerns about the projects in which they were involved. Finally, the methods were excellently suited to gain further background information on the respective example projects and, above all, to identify the specific perspectives and interests of the project participants.

Moreover, the study analyses the empirical data gathered from interviews and literature reviews in order to grasp the interrelation of various actors involved in the Smart City vision of the city of Hamburg.

Technology is a driver of change; however, there is no simple answer to how the future will shape the urban environment and society. It is the complex between cities and places that bring intense mobility by technology that now shapes urban life and urban development. Therefore, this thesis adopts a synthesised approach of several research methods to illustrate and describe these complex phenomena. This thesis ultimately reviews, classifies, and summarise the current state in the concept of Smart City while explaining projects, plans, designs or concepts within the theory and application in Hamburg. Therefore, this exploratory research seeks to understand the relationship between innovative technologies and the urban processes in which technologies emerge and evolve.

1.2.1. Research Questions

The latest dilemmas in the business and academic community have driven to the central research question in this thesis, i.e. the perception of Smart City actors and Hamburg's vision on Smart City. Considering the fact that a city is not a giant engine nor only a shelter, the concept should incorporate these four fields: analytics, computing, socio-economic insight as well as the governance. Data is a key to future cities as we are generating an enormous volume of data; thus, we need to analyse, understand and use what we mine from the city of things. Connected devices are a means to an end; therefore, we need to comprehend this computational world. A city is a mere physical being without its inhabitants. Social settings and economic factors are profoundly influencing the form and function of a city, where we need the knowledge of city experts, e.g. urban planners and designers, architects, engineers as well as political and legislative authorities. The pattern of the authorities is diverse

and employable based on our will, whether we want to awake in a collaborative tomorrow or an obscure dystopian future.

The hypothesis is that smart, digital or intelligent however this phenomenon is named, innovative urban technologies driving the city scene is going to help to the very urban problems we are currently facing in terms of society, ecology and economy. Thus, the research focuses on the issues and improvements within the concept of Smart City. Moreover, it interrogates the following questions:

- How do Smart City actors perceive the concept of Smart City?
    - Who are the Smart City actors and what are the relations?
    - How to look from an urbanist perspective to the relationship of technological advancement shaping the very city we live in?
    - Why and how do current issues and challenges lead to the Smart City concept?
    - How does this phenomenon shape urban management and governance?
- How effective is the City of Hamburg in respect to the debate of the Smart City discourse?
    - How can the smart vision of the City of Hamburg be enhanced?

1.3. Thesis Structure

The organisation of this thesis consists of 5 main chapters that each section addresses a different objective. Moreover, each sub-heading commences by stating several questions addressing appropriate topics described in these sections and finalised by a summary of the section and its relation to the following.

The first and current chapter is the introduction which presents the urban situation what we are currently facing and possible future scenarios, and later it is narrowed down the research focus of the thesis: The Smart City paradigm. Later, it defines the

problem within urban fields by addressing the very problem in the deployment of technology in cities. It also summarises and gives appropriate evidence from the literature while reasoning how it differed from others. Furthermore, the thesis structure patterns in a way that answers the research incrementally: Chapters 2 reviews the theoretical framework, Chapters 3 addresses the applied paradigm in the case of Hamburg, Chapter 4 draws the discussion from the theoretical and empirical evidence from previous chapters, and Chapter 5 concludes and summaries the thesis.

In more detail, Chapter 1 introduces the framework of the master thesis, explicitly stating the purpose and the research topic of Smart City. The intent of this study is to conduct scientific research on the development of cities deployed with new technologies and innovations provided by comprehensive theoretical and applied guidelines, and strategic recommendations about how Hamburg becomes more successful in the smart world. The central research question to be answered is 'How is and how should the development of smart city concept and be undertaken in the urban field? Besides, how effective is the city of Hamburg in the paradigm of Smart City? Chapter 2 tries to set a background knowledge in the literature by reviewing appropriate themes, notions, concepts. It illustrates the situation what cities are facing; how technology has evolved and what the relation between technology, society and city is; later it revisits the Smart City paradigm by stating the state-of-the-art with historical background and the reason why it emerged as well as the essential pillar of a city, decision patterns and power structures. Chapter 3 introduces the case study of the Free and Hanseatic City of Hamburg and conducts a qualitative analysis of the practices deployed in the city. Chapter 4 discusses the importance of the concept, dichotomic views from business and academics, the challenges and opportunities with growing smart city trends, as well as suggestions to the city of Hamburg. Finally, the Chapter 5 summarises and concludes the thesis, as well as drawing the previous issues illustrated in the thesis and tries to develop a typology for Smart City concept and formulates an idea around the effect of this paradigm.

CHAPTER 2

INTERRELATION BETWEEN THE CITY AND TECHNOLOGY

2.1. Understanding Urban Situations

Academics and professionals might have multiple controversies; however, both groups seek to the same questions: what constitutes a city; how can we increase urban quality; how do we apply the knowledge of theoreticians into real urban situations? Over the years, there have been disputes among urban researchers upon what incorporates urban quality and perception of cities such as classical and romantic views (Montgomery, 2007). For instance, Cullen (1961) emphasises on physicality as the rationalisation of urban design, e.g. design styles and the formation of buildings and open spaces, whereas Alexander (1979) and Lynch (1960) give importance to the psychology of place by mental maps as in the sense of place, all of which embodies safety, comfort, vibrancy, quietness, or threat.

Jane Jacobs (1961) explores urban situations from the basis of activities governed by set-conditions of physical features of the built environment, both producing and mirroring urban quality. Cook (1980) and Gehl (1989) debate that prosperous city is hinged on street life, and activities occur in and through buildings and spaces in numerous ways. Moreover, Mumford (1961) argues the choice of living between *necropolis* and *utopia* in his work, *the City in History: Its Origins, Its Transformations, and Its Prospects*. He questions the probability of developing a new city which will positively enrich and advance human development while liberating it from its inner contradictions. Moreover, he combines a comprehensive theory on functional and normative dimensions of urban life into urban design.

Buchanan (1988, p. 33) asserts the city as an essential for place-making and continues that “places are not just a specific space, but all the activities and events which made it possible”. This comment ultimately raises the notion of the city as not only bound up physical, psychological, social but also economic and cultural, as well as virtual. To manage, develop and design a better city, we primarily need to understand the urban situation with its dilemmas and sophisticated ecosystem.

2.1.1. Crisis of Cities

The world, as we all witness, is on strike. Who is to be blame of the guilt to produce the crisis of contemporary urban problems; is it city experts? The city and urban space what we understand now, as widely argued in academia, is disappearing with the advancement of technology and its effects on an urban sphere. Does it anticipate that it is dissolving and being replacing with a new identity? Where do we go? Are the connections what Sorkin (1992) emphasises as the link to make sense of forms under attack? An accelerated transformation is currently overtaking contemporary cities, earlier concepts, theories and methods about the development, planning and management of a city seem to be less and less useful.

A scholarly sociologist, Westrum (1991) envisages the connection of technology and society as a broad process of analysing cities as a range of competing and widely contradictory perspectives. On the contrary to critically delve into the competing approaches, the overwhelming majority of discussions on urban technology fail to justify or analyse the methods.

Urban challenges generate simultaneous causality, mainly between a mass migration, demographic changes, globalisation and urbanisation. Moreover, climate change is a cause and a consequence of these challenges in terms of economic, social, and political issues. Therefore, the relation between climate change, urbanisation, and technological innovations are visible (Bazrkar et al., 2015). Elizabeth Wilson (1995,

p.147) recounts the primary problem of cities in her book of *the Rhetoric of Urban Space*: the spreading giantism of a town is leading relentlessly to megalopolis and thenceforth to the necropolis. Lewis Mumford also acknowledged in his earlier works that this trend leads to the death of the city (Wilson, 1995, p.148).

2018 World Urbanisation Prospects report of the United Nations states that 55% of the world currently lives in urbanised areas, which is anticipated to rise to 68% by 2050. The urban population seems to be tripling while the global population is duplicating. The forecasts denote the boost of the global community, although urbanisation level and growth differ substantially by regions. The steady movement from rural to urban areas could count extra 2,5 billion urban inhabitants by 2050, with approaching 90% of this increase steering place in Asia and Africa (United Nations, 2018). We, nevertheless, should be cautious of the imprecise data on past projections and estimations due to the contradictory definition of what urban is. Despite the inaccurate numbers and trends in urbanisation, the pace of urbanisation creates challenges confronting the future of cities. Urbanisation has long been classified as one of the dominant human impacts on the micro-climate of urban areas and has been associated to massive and often disastrous changes into numerous hydroclimatic outcomes, e.g. temperature, humidity and precipitation.

Accelerated urbanisation, which strains necessary infrastructure, has long been classified as one of the dominant human impacts on the micro-climate of urban areas, and it is exacerbating the impact of environmental threats by massive and often disastrous changes into numerous hydroclimatic outcomes, e.g. temperature, humidity and precipitation (Wong et al., 2016). Urban sprawl and ever-growing population lessen agricultural lands, available water catchment areas while increasing demand for energy (Chee & Neo, 2018). The widening gap and inequality between different groups of urban inhabitants in and out the megacities of the future might destabilise society, upend any benefits of urban development and negatively affect liveability.

Physical and population density of cities combined with environmental risks have results for people, planet and economy. Making cities more resilient and innovative against these threats is one of the biggest challenges faced by city officials and lacks urgent attention (Davoudi, 2012). Employment of technology convey the impression of increasing in the development and running of cities of the future, boosting agricultural productivity, ensuring more efficient transmission of electricity, forming human-made wetlands for ecological balance, and alleviating traffic gridlocks.

One could claim that the urban environment is genuinely human ecosystem, and the evolution of humankind is city dwellers' phenomenon. It develops critical innovations and theories, leading to progress (Florida, Adler, & Mellander, 2017). Thus, cities are the essentials of our history. Nonetheless, we should additionally explore what awaits cities in the future. Considering accelerating technologies and innovations, future cities might offer immense opportunities to enhance inhabitant's everyday life (Nam & Pardo, 2011). However, good governance is imperative in order to not exclude urban poor, who cannot afford it or lack the capability required for its adoption. Care must be exercised to prevent the rise of a new form of social divide rooted in future cities, contrariwise equity, liveability and sustainability in cities of the future should be addressed.

Urban residents transform and interact with their environment through their consumption of food, energy, water, and land. Moreover, the contaminated environment consecutively affects the health and quality of life of the community. Melody (1986) declares that the foundation of developed economies closed the twentieth century by information gathering, processing, storing and transmitting over efficient communication networks. And, Sassen (2000) argues inaccurate rhetoric of academicians about that developments in telecommunications and the ascendance of information bring the end of the city, as it would convert to an obsolete economic entity without the need of the relevance of space and distance due to the growth of information and industry allowing firms and workers to remain connected. Since the beginning of the twentieth century, urban planning has shifted insufficiently, which

the need to plan came from the need to ensure the success of local industrial dynamics (O'Sullivan, 2018). However, Klosterman (2013) describes the dramatically evolving process of driving visions of planning in both hard infrastructures such as roads, buildings and bridges, including urban metabolisms such as the flows of goods and people. The agenda has formed from a linear process to a collaborative method, engaging the overabundance of diverse stakeholders to meet sustainability targets for development and consumption.

Mumford's argument towards megacities has extended to several average size contemporary cities around the world with the signs of crisis in identity and a sense of citizenship, including numerous additional social difficulties identified by unemployment, multicultural and multiracial circumstances, and a lack of communication. Although, the growth has radically created a gap between micro, macro and mezzo levels of habitats and dissolved the city limits, the issue is more than merely a function of urban size. The crisis is not plainly a matter of size; city is no longer a whole.

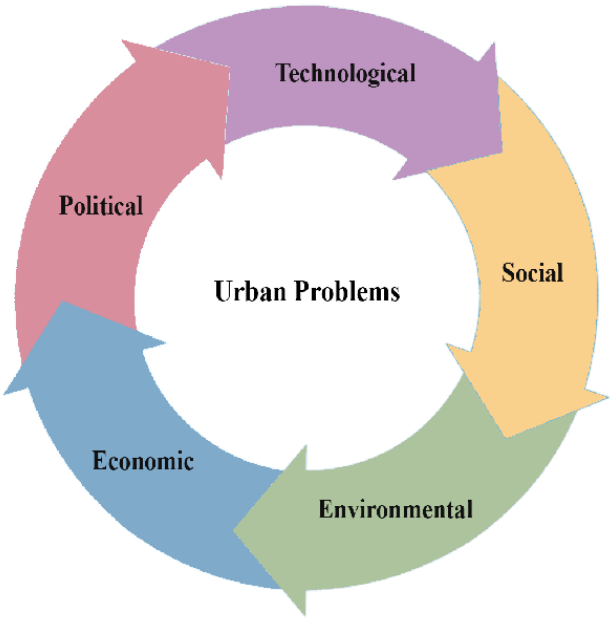

Figure 2.1. Problem Pillars in the City (Yılmaz, 2019)

Sorkin (1992) debates the idea of a contemporary city like a swarm of urban bit ejecting a physical view of the complete, sacrificing the thought of the city as the place of community and human connection. Nonetheless, it is challenging to find the right body to address and find solutions with, to very urban problems. For instance, urban issues can be categorised under five pillars and can be exemplified such as power wars for political affairs, climate change and urban population growth under the environmental problems, ageing population as one of leading factor in social matters, financial restructuring and globalisation for economic concerns, as well as the change in online retail and entertainment sectors with the technological changes (Figure 2.1). However, these seem to disturb our future.

2.1.2. Complexity of Cities

A city embodies a complex ecosystem in order to solve the current crisis and build a better environment for the future. What considered to be a city? An intricate fabric of routes, structures and green areas of slums and captivating commercial buildings are unquestionably not considered a city just because it embodies a large number of citizens. If it is not the commercial zones, what brings liveability into a city? What are the foremost elements of liveability that can draw people to one city rather than to another? Is a city merely a body of physical infrastructures? What can increase the productivity and efficiency of inhabitants? Does technological advancement and deployment of cyber networks change the social fabric and the reality of a city? These ad-hoc queries and strains are what Geddes recognised as the tension and intrinsic values to the very idea of imagining a city (Batty & Marshall, 2017).

A city is not a programmed architectural product; on the contrary, it is organic and evolving in relation to its environment, which is a tenable and fundamental contribution bequeathed by Pattrick Geddes on urban planning and design (Batty & Marshall, 2017). When we imagine a city of the future, we need to superimpose its

physical infrastructure, social patterns as well as the gospel truth of cyber networks and space.

Despite the tremendous theories, concepts and notions in urban theories, the practice reflects the opposite. People and exclusively the business consistently favour elements that have a direct relation to their day-to-day life quality: physical beauty, opportunities and places for socialising, and integrated public services (Gleye, 2015). The physical settings, e.g. streets, buildings, public spaces, communication and transport infrastructure, have always been focal points in most of the city development projects. By all means, the market anticipates the economic benefit where companies position themselves in contemplation of the growth. The prime goal of the private sectors which provide capital for infrastructure projects in pursuance of inhabitant's life-standard betterment prime goal is to earn more. Gleye (2015) remarks that this paradox creates bifurcated approaches on planning, e.g. city versus urban planning, design versus social-policy oriented planning, social versus physical. Moreover, Paul Davidoff debated in his article written in 1965 and titled as *Advocacy and Pluralism in Planning* that the historical concern of planning profession over the physical environment distorted its vision to perceive physical structures as servants to those who use them (Gleye, 2015). The dichotomous thought on how to establish the well-being of people is increasing and creating an immense gap with the distribution of digital devices and cyber networks in a city.

Social and economic changes in the information era, and the acceleration of the knowledge economy, not to mention increasing ecologic concerns, are guiding urban advocates to hunt for other options in urban infrastructure and services. Furthermore, rapid technology development in the area of cyber networks has a notable consequence on present urban infrastructure planning. Inasmuch as Mitchell (1999) envisioned computerised utopian ideas for urban future, i.e. *E-topia*, at the end of the 20th century, urban actors anticipate the effect on urban spaces as a consequence of the digital revolution. Urban and digital infrastructures have given significance in new constructions. For example, technological improvements and the benefits emanating

from the application of these technologies in urban development resulted in the rise of new forms of urban infrastructure such as long-distance communication, smart cards, driverless vehicles and intelligent control systems (Cohen & Nijkamp, 2002).

The physical city, as well as its cyber networks and digital infrastructure, has high importance when we imagine the future urban habitat. Contrary to the business approach, planning should also pay attention to the city as a socio-economic space, not only physical space. Architectural, technical and the social contexts of a future city are critical parameters to generate the idea of a better city, not to lean over one direction. We need a holistic understanding of the urban environment right now and also in the future.

2.2. Understanding Technological Experiences

2.2.1. Technological Determinism

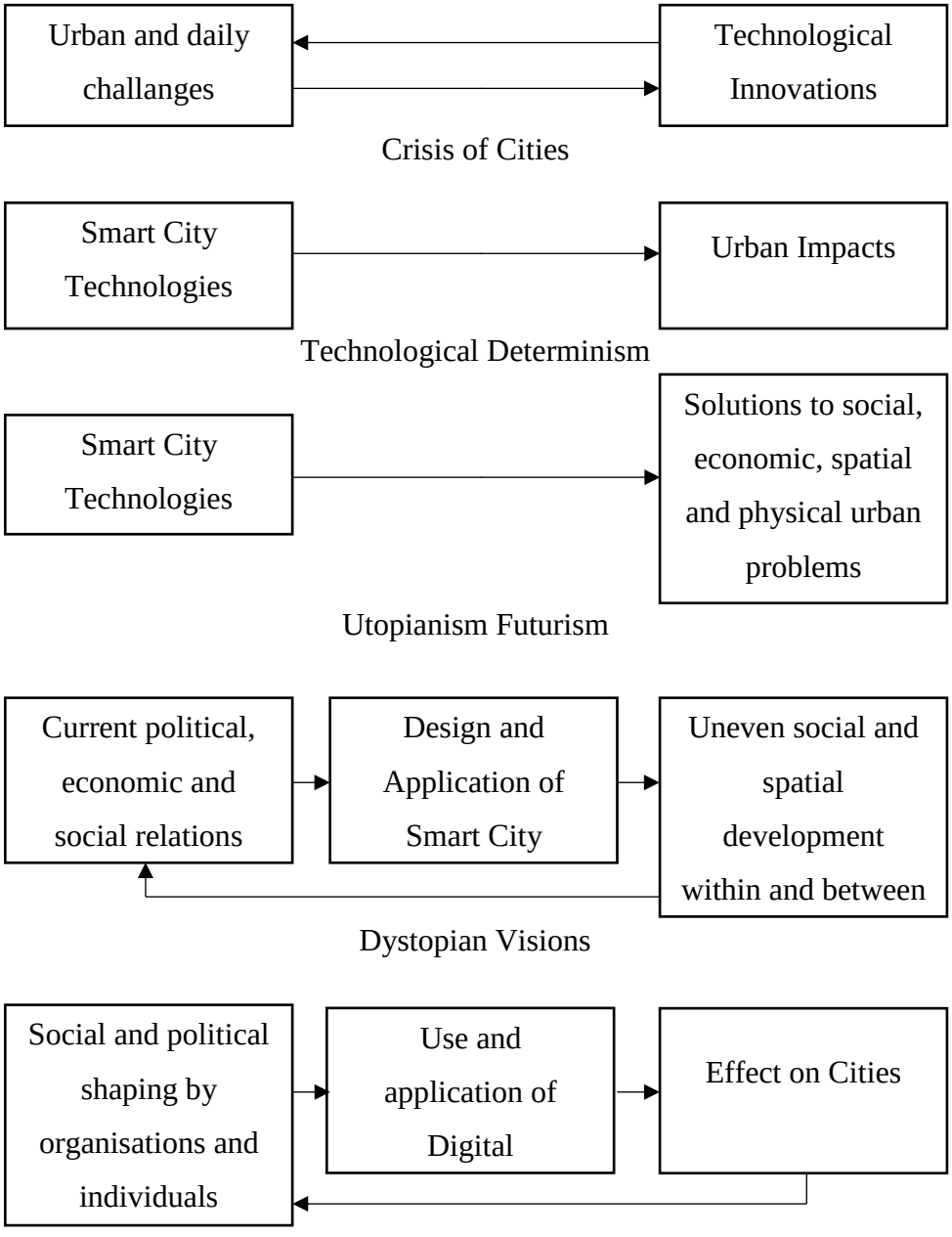

Figure 2.2. The relation between cities and technology (Yılmaz, 2019)

The technology generates a better, fairer and more efficient urban life. However, there is a necessity for further research due to a prevalent tendency regarding determinist attitudes in technology, originate from the techno-enthusiast and the techno-scared (Aurigi, 2005). We need to ask ourselves what the relationship between technology and society is; how technology position itself in the city. How do technological advancements serve people's well-being in cities? Is technology going to answer our problems, or is it going to raise them? There are specific approaches we need to avoid in technological deterministic-attitude while devising future. In the end, how should we correlate cyber-physical insights into planning?

Burnett and Marshall (2003, p. 9) express technological determinism as knots between the predominant communication technology and the key peculiarities of society. Although heavily criticised and accused of being a vague term, technological determinism has still need to be revisited with the awakening of new technologies like the Internet. Technological determinism is identified with its hard and soft approaches. Gunkel (2003, p. 510) states that hard determinism perceives technology the sufficient or essential state for social change, while soft determinism explains technology to be a key factor facilitating change.

Determinism is presumably the central deficiency of these view-points. They are either optimistic or pessimistic about new technologies and community; they still partake a position that makes them inspect the urban future; nevertheless, entirely indifferent about contemporary urban life. What happens now is seen as an insignificant series of events; something that will affect the future, but that cannot be altered, modified, or carried out differently (Aurigi, 2005).

When the new technological applications arouse in cities, it is advantageous to study not merely the system itself, but what produces the demand for it and the problems it is assumed to answer, the answers it is thought to produce. Pincher and Bijker (1987, p. 35) advise identifying the relevant social groups for a particular artefact. A striking

detail is what problem each group has witnessed in respect to that artefact so that numerous alternatives of solution can be identified.

The extensive amount of enthusiasm in the information era delivers inhabitants to seek how technology will influence society, environment, politics, and urban life. Nonetheless, the notion of pure technology is inconsistent. This approach is invalid by the fact that social, political, economic factors genuinely influence technology itself (Bijker & Law, 1992, p.3), which implies that we must compromise a mutual relationship between society, technology and the city.

The nature of space, time, distance and urban life are mutually under question. Everyday life seems volatile, accelerated, ambiguous, and more fragmented since the end of the last century. Accepted notions about this transformation are remarkable leaps in the ability and weight of urban technology. Contemporary cities appear to begin involving, at least in part, the application of new urban technological infrastructures and services to promptly leave behind physical and spatial barriers. For instance, Abler (1977) mentions that telecommunications mainly settle between space and time barriers, the essential requirement of human life. Technology unites widely separated points and places together with minimal delay, creating a real-time city (Graham & Marvin, 1996). However, it is again critical to remember that technology is a tool and a means to an end, not an end in itself.

2.2.2. Historic Periods

History of humankind exhibits the interrelationship of various subjects, namely time, space and intellectual capacity that induces a sense of past, present and future (Polak, 1973). Therefore, urbanisation, growth and the embedment of technical activities in the light of evolutionist theory have led to the march of civilisation (Oswalt, 1976; Boserup, 1981). Hence, society, economy and environment fit into sustainable urban development through the use of technology and innovations (Maclean, Cuthill, & Ross, 2014). Unlike other fields, the factors behind the occasion are pretty much notable in and for the city; thus, we need to ask several questions to comprehend more

than what happened and how we can use it. What are the historical periods, and technologies shape these periods? What remarks the beginning and the end? Has technology changed through time? How does the changing pace of technology and innovation impact on cities and society?

Grubler (2003) describes how technology has shaped the urban environment and eventually the society over the last century in his timely book, Technology and Global Change. The change has transferred us from agriculture to factories, and lately to the Internet, which impacts on a global level. Although technology is here to improve our life quality and eliminate the problems, it also has adverse side-effects, i.e. global warming, migration, and inequality.

The historical classification is not absolute and same in every culture and every region. Cantwell and Vertova (2004) proclaim the gospel truth that economically advanced countries tend to broaden their technological activities beyond many fields while developing countries tend to weigh into particular technology-niches. However, these differences should not withhold us investigating and categorising technological advancements through the historical periods.

Smihula (2010) divides the stages of human development to four distinctive levels: hunter-gatherer, early production economy and settled lifestyle, traditional agrarian society, and modern society. Despite the character and impact in every stage of the development, technology has been an accelerator to increase efficiency and solution for future problems. Moreover, Smihula considers the technological revolution in five stages, shown in Table 2.1., as agricultural, industrial, technical, scientific-technical, and information and telecommunication revolution, where each period lead by a significant sector. Besides, the modern society we are currently living in is characterised by a non-stop stream of technological and industrial innovations, economic growth, and classified by armed conflicts such as state and non-state conflicts, i.e. wars since the eighteenth century. On the other hand, UPSTO (The United States Patent and Trademark Office) also - roughly - divides the late nineteenth

century and twentieth century as: pre-war (1880 - 1914), inter-war (1915 - 1939), post-war (1940 - 1964), stability (1965 -1990) to classify divisions of innovations and technologies (Cantwell & Vertova, 2004). These centuries can also be identified by production and organisation cycles, e.g. Fordism and Post-Fordism, organised and disorganised capitalism, welfare and risk society.

Table 2.1. *Technological Revolution Stages (Adopted from Smihula, 2010)*

Technological Revolution	**Period**	**Length**	**Leading Sector**
Agricultural	1600-1740	180	Finance and trade
Industrial	1780-1840	100	Textile, iron, coal, railways
Technical	1880-1920	60	Chemistry and machinery
Scientific	1940-1970	45	Air, oil and nuclear industry
Information and Communication	1985-2000	30	ICT, informatics and the Internet
Digital	2000	-	IoT

Table 2.2. *Major Industry Innovations (Adopted from Smihula, 2010)*

Industrial Innovations	**Period**
Water-powered mechanisation	1780-1848
Steam powered mechanisation	1848-1895
Electrification	1895-1940
Motorisation of transport	1941-1973
Computerisation	1973 -

Technological progress and innovations, as well as socio-spatial setting, is an integral and constant part of such modern society and its economy. Table 2.2. reflects the significant industries in the eighteenth century, marking different stages of the development process and as well as indicating the industrial revolution to different stages. The invention of coal and steam engines (1780 - 1840) facilitated the first wave of the industrial revolution, following with railways and mass production (1840 - 1890) as the second industrial revolution. This originality expanded the urban area and increased production in cities, followed by the invention of electricity (1890 – 1940), which started the technical revolution shown in Table 2.1. Lastly, theoreticians suggested an additional stage as the age of electronics and microelectronics (1940 - 1980) beginning with the scientific-technological revolution leads to the current situation of digital innovation in the urban environment.

The information and communication revolution speculated the invasion of computers and informatics technology into the economy and daily urban life. Toffler (1980, pp. 5-11) remarks that this revolution embodies a transform in social structure as essential as the industrial revolution and the Neolithic revolution. Karvonen (2001, p. 28) considers that the invention of microelectronics also influenced economic growth and space-time relation. He reckons that it began with the first transistors built at the Bell Laboratories and continued by the production of integrated circuits printed on silicon chips, thumbnail size microprocessors to execute an entire computer function.

A Japanese author, Yoneji Masuda, who got inspired by Western futurologists, evaluated the information society as computopia in his book, *The Information Society as Post-Industrial Society* in 1981. His interpretation points the emancipatory potentials of voluntary groups and participatory democracy in the adoption of new values to create better-living conditions for people with the deployment of digital tools

to urban life. Digitalisation is a notable technological innovation for processing, handling and delivering information in the most effective way possible.

Due to the fast-changing situations and rapid innovations in the last decades, scholars are not convinced how to identify the information growth in the history. European Commission responds to the mass information flow by the rapid developments in information, and communications technologies are to name it as the Information Society (Karvonen, 2001, p.36). There is a dichotomy of definition: Castells (1996) defines it as the Information Age, Peter Druker (1994) and Nico Stehr (2002) suggests the term of Knowledge Society instead of Information Society, an American economist Fritz Machlup (1962) uses the expression of Knowledge Industry, the sociologist Daniel Bell (1973) and Alvin Toffler (1991) insist on post-industrial society referring to both knowledge and information, Gershuny and Miles (1983) emphasises on self-service society. The main reason behind this confusion in terms can be traced back to the 1940s when Claude Shannon and Warren Weaver (1949) started using the term information as a synonym for signal transmission. Moreover, the daily misusage of both terms as synonym flavours the delusion. The information has no relation to the contents of a message, i.e. knowledge (Karvonen, 2001, p. 49). Thus, nowadays, we cannot be sure whether the term Information indicates either electronic signal transmission or knowledge exchange. Bell (1982, pp. 505-506) defines knowledge "a set of prepared statements of facts or ideas, presenting a reasoned judgement or an experimental result, which is transmitted to others through some communication medium in some systematic form". Knowledge does not have a connection with communication as information. Thus, the precise definition can be said as "Information is the communication of knowledge" (Machlup, 1962, p. 15).

Despite the fact of how we define these periods, the pace of development is just accelerating. Scholars are unsure whether this acceleration leads to catastrophe or better society. One thing is clear that we are living amid a severe historical transition. The waves of innovation – technological revolutions follow each other in a logical sequence. One technological revolution creates the conditions for the next one

(Freeman, 2001, p. 221). It also appears that the periods between begins of technological revolutions (lengths of waves of technological innovation) are getting shorter as a result of the acceleration of technological progress and economic growth (Toffler, 1992, pp. 17-25). The social, political and economic effects will be significant, like the leap after every technological revolution (Šmihula, 2010).

2.2.3. Technological Innovations

Cities are the physical artefacts built up by industrial and technological improvement and are at the front line of a revolution with the dominant population, communication and business concentrations of our society. We may experience and use these urban technological devices. We need to ask ourselves what they are and how helpful they become. Besides, it is also essential to question what and how do urban actors employ urban digital devices to everyday life in cities; what are the uses of the digital in everyday life; and how deep technology is embedded to our everyday life?

The development of contemporary cities has produced not only social and economic life but also much of the scientific and technological innovation of the modem period. Henri Lefebvre and Michel Foucault comment on the active dimension of social life rather than a passive formed by space and place in the urban context (Dierig, Lachmund, & Mendelsohn, 2003). Nevertheless, the main reason what might be missing in the process of the deployment and utilisation of scientific and technological inventions is to be a mean for creating a better, effective and efficient daily life. For instance, the invention computer is to programme electronic machines what are executing mathematical computations and logical operations, particularly one that can process, store and retrieve massive amounts of information. In short, computer or other key technologies help us to execute complicated commands faster and to use our time efficiently. While doing so, the urban environment must curl in the latest advancements in technology into its blueprints, which includes those in Information

and Communications Technologies (ICT), the Internet of Things (IoT), Artificial Intelligence (AI), machine-to-machine communication, Radio Frequency Identification (RFID), context-aware computing, wearables, ubiquitous computing, Big Data analytics, and many more smart and innovative key technologies.

Information and Communications Technologies

The development of electronics and computers, as well as information transfer, paved the way of the term Information Technology. The military and industry sectors were the dominant sources of research and development for the expansion of automation to substitute human resources by machine power. Later, the term evolved and became widespread with the inclusion of electronic communication field due to the technological innovations and increasing communication needs. The Information and Communications Technology (ICT), or sometimes referred by Telecommunications, is solely the combination of information processing, computing and communications technologies. The ICT is transforming daily procedures: learning and working mechanisms, as well as education, health care, and governance structures. It utilises already existing and established infrastructures to help individuals, corporations, and institutions.

Progressive technological and regulatory change has been a persistent characteristic in several fields; the earlier separate areas of information, telecommunications, computing and media technologies are gathering around a core group of digital technologies (Graham & Marvin, 1996). Moreover, the ICT world has been in constant turmoil since the late 1970s, and telecommunications-based technologies are apparent in the urban field, mentioned with grand metaphors creating shocks, waves, or revolution in the urban environment (Gokalp, 1988). Furthermore, academics and businesses use two-pathed and simple models for understanding urban and social changes. Thus, technological determinism is still a standard view in the sense of a

linear and straightforward cause and effect relation in urban technologies. Notwithstanding, it is clear that telecommunications have an increasing role in city management, design and administration due to growing information flows (Graham & Marvin, 1996). Scholars define this period and society with different terms: information society (Lyon, 1988); post-industrial society (Bell, 1973); information revolution (Williams, 1983); third-wave (Toffler, 1981).

Table 2.3. *Alternative perspectives on the ICT (Adopted from Atzori, Iera, & Morabito, 2010)*

Metaphor	**Function**	**Aim**
ICT as a tool	Support for workers in the work process	Increase quality and rapidity, improve capability to cope with complexity
Automation Technology	Elimination of human labour	Cost savings
Control Device	Monitoring and steering the work process	Avoid defects, adaption to environmental changes
Feedback Mechanism	Support learning process	Innovation
Organisation Technology	Integration of tasks, functions and processes	Organisational flexibility, transparency
Network Technology	Creation of technical connections among people and with machines	Rapid exchange of information and knowledge

Telecommunications altered its perception from slow-moving and insignificant sector to a growing and vital need in capitalist societies. Business Week (1994) remarks in an article that the telecommunications industry is becoming a leading sector in the world. Importantly, ICT is a technology providing different information types, e.g. voice, data, sounds, images and video signals to be processed and transmitted in the

form and a series of zeros and ones (Graham & Marvin, 1996). Many cities have constructed and are continuing to increase their communication and service infrastructures, which will develop and benefit to its inhabitants and businesses.

Progress in both switching and transmission have enabled the expansion of four new telecommunications infrastructures, which are also influential for cities. Wireless and mobile communication systems connect phones and computers to networks via radio signals and satellite connections. These systems are arranged in cells to create coverage of a building, city, or region. Wireless networks, the fastest growing area of the telecommunications industry, allow phone and data communication to operate most flexibly. Spector (1993, p. 403) asserts that the 1990s has been declared as a decade of wireless communication. Furthermore, the annual growth rates of mobile phones worldwide are expanding as technology advances, networks spread wider and wider, costs reduced, and competition among new private mobile operators increased (Financial Times, 1994). Public network services are to build to residential consumers as broadband cable networks.

The cable is the basis for distributing a much larger number of television channels traditionally accessed through terrestrial radio-based TV transmission; however, these networks are increasingly sophisticated and capable with optical fibre bodies and new digital switching technologies that complement or replace the coaxial copper cable of previous systems (Graham & Marvin, 1996).

Internet of Things

Machine to machine communication has been around as a vision for a very long time. In the 1830s, the machines have been communicating directly since the telegraph developed, and the first radio audio transmission defined as radio-telegraph developed on June 3, 1900 (Ibarra-Esquer et al., 2017).

One of the first examples of the machine to machine communication was a Coca Cola machine in the early 1980s at Carnegie Melon University (Ibarra-Esquer et al., 2017). Computer programmers unite to the cooling device over the Internet and check to see if there is a drink and if it is cold before carrier. Machines communicating with each other over the Internet is named the Internet of Things. Also, the notion has evolved since it appeared in the late 1990s. However, the Internet of Things as a concept was not officially named until 1999 (Ibarra-Esquer et al., 2017).

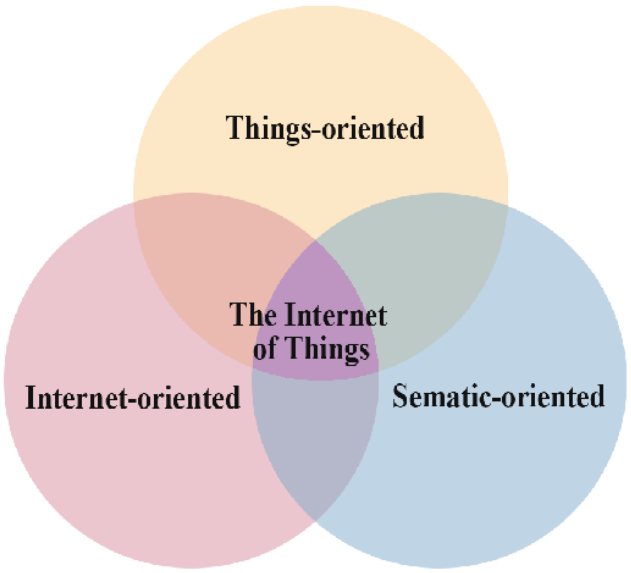

Figure 2.3. Three main visions of the Internet of Things (Adopted from Atzori, Iera, & Morabito, 2010)

It is a novel paradigm shift in the IT ecosystem to control, inform, and facilitate information accumulation efficiently. It changes devices, making them indistinguishable in the fabric of everyday life. Large corporation drove the idea as their need grew in order to benefit significantly from the foresight and predictability for mainly economic reasons. The reason was to generate more efficient and speed-up

processes, to reduce error and prevent theft, and to incorporate sophisticated and resilient systems through the IoT (Ferguson, 2002).

As similar to several concepts in the computational field, there is no unique or standard definition of the Internet of Things; besides, the term is also changing based on the sector or academia used. Madakam, Ramaswamy and Tripathi (2015) include the terms of Web of Things, Internet of Objects, Embedded Intelligence, Connected Devices and Technology Omnipotent, Omniscient and Omnipresent. They also supplement the term based on signifying one element of the concept such as cyber-physical systems, pervasive computing, ubiquitous computing or calm technology, machine-to-machine interaction, human-computer interaction, and ambient intelligence.

Kevin Ashton, the Executive Director and digital innovation expert at Auto-ID Labs at MIT, first developed the term Internet of Things in 1999 and linked the use of Radio Frequency Identification (RFID) in Procter & Gamble's supply chain to the Internet (Ibarra-Esquer et al., 2017). However, academics are unsure of the interpretation of the Internet of Things. Sarma et al. (2001) distinguish the term as an ecosystem where electronic or non-electronic every device is connected. Miorandi, Sicari, De Pellegrini and Chlamtac (2012) describe it as an extension of the existing Internet and the Web's physical realm. Another team of scholars foresees the evolution of the Internet to some form of access to everyday physical objects (Mayordomo et al., 2011). Aggarwal and Las Das (2012) refer to it as a global network that allows communication between human-to-human, human-to-things and things-to-things. One of the most comprehensive descriptions is an open and comprehensive network of smart objects that is resilient to change in the environment and situations, is capable of automatically organising, sharing information, data and resources (Madakam et al., 2015). In short, the Internet of Things consists of real-world living and non-living everyday devices connecting to the Internet, which includes almost everything from mobile phones to building maintenance to aircraft jet engines, servers, computers, sensors and actuators creating intelligent virtual objects to unify everything under a shared infrastructure.

There is also a similar concept to the Internet of Things, the Internet of Computers (IoC) in an ecosystem of Internet-connected devices. The IoC functions as means for accessing those in the IoT for configuration, modification, and data storage, processing and visualisation (Ibarra-Esquer et al., 2017).

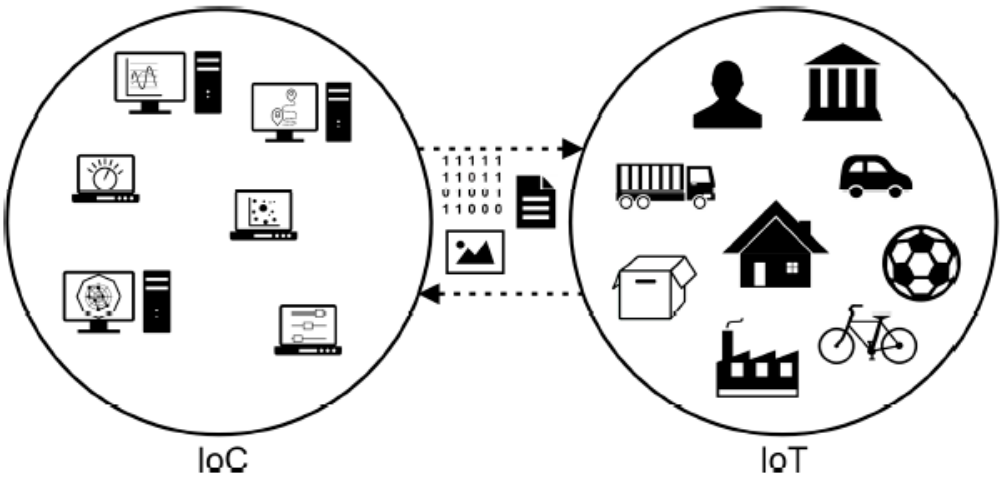

Figure 2.4. Interaction between the IoC and the IoT devices (Ibarra-Esquer et al., 2017)

The connection is possible through a universal global neural network in the cloud, which connects various physical items. It is an ideal service for household appliances and smart machines interacting and communicating with other machines, infrastructures, and environments. For instance, the so-called smart residence is an example to the IoT, when the air conditioner is switched on, the system can automatically close down the windows; or when the gas furnace is switched on, the windows are closed. Sharma and Tiwari (2016) say that 9 billion devices are interconnected and are expected to reach 24 billion by 2020. One of the most popular and universal tools of the IoT is a mobile phone, connectable to the Internet, which is at the disposal of almost everyone information. As of 2013, the Internet of Things has become a system that uses a range of technologies, from the Internet to wireless

communications and systems embedded in microelectromechanical systems (MEMS) (Ibarra-Esquer et al., 2017). Traditional automation areas including automation of buildings and homes, wireless sensor networks, GPS, control systems and others, support the IoT.

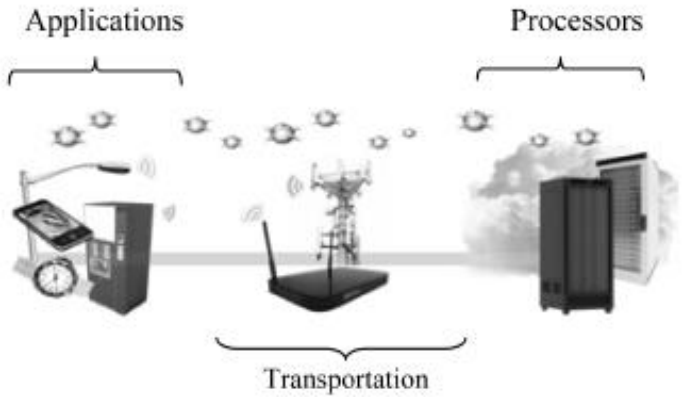

Figure 2.5. The IoT work-flow (Ibarra-Esquer et al., 2017)

There are several fields where the IoT can be beneficial in the urban environment for people, organisations, as well as governments (Sharma & Tiwari, 2016). Firstly, safety and emergency are the main areas for environmental access control, liquid detection in the buildings, checking the radiation levels, explosive and hazardous gases. Smart houses are the second deployment in the city where the system can remotely monitor and manage our household appliances in order to reduce energy and water consumption. This practice may benefit the economy and reduce environmental issues. Thirdly, the medical sector might profit significantly from the usage of the IoT. It helps elderly and disabled people living independently in terms of monitoring and controlling conditions, as well as patient supervision in hospitals. The smart city phenomenon is the primary outcome of the implementation of the IoT, to engage in data effectively and efficiently for quarters and neighbourhoods, as well as monitoring of parking spaces, vibrations, material conditions of constructions in the city. Highways, roads and bridges might get assistance from the Internet for warning messages and deviations based on climatic conditions and unexpected events such as

accidents or traffic jams. Another sector that might profit is agriculture; creating smart agriculture where it is possible to monitor the condition of the crops, check micro-climate conditions, reduce water consumption. Last but not least, the industrial sector will advance thanks to the IoT devices increases; they will improve sector performance and productivity.

The prerequisites for the IoT are dynamic resource demand, real-time needs, the exponential growth of demand, availability of applications, data protection and user privacy, efficient power consumptions of applications, execution of the applications near to end-users, and access to an open and interoperable cloud system (Ibarra-Esquer et al., 2017). Moreover, he suggests three components for the seamless Internet of Things: hardware composed of sensors, actuators, IP cameras, CCTV and embedded communication; middleware on-demand storage and computing tools for data analytics with cloud and Big Data, and presentation easy to understand visualisation and interpretation tools that can be designed for the different applications.

The Internet

The demands on research and development in scientific and military fields led to the invention of the Internet in order to connect computers, to increase and improve computer research efficiency through information exchange, and to create an added value of knowledge (Beranek & Newman, 1981). It began as a vision of a global computer network and named as the Defence Advanced Research Projects Agency (DARPA) in late 1962. Followed by 1969, the Internet began its usage as an early-element of the IoT. Moreover, 58.8% of the world's total population currently uses the Internet, and this number is increasing day by day, increasing the chance of better connection and service for city-dwellers (Internet World Stats., 2019).

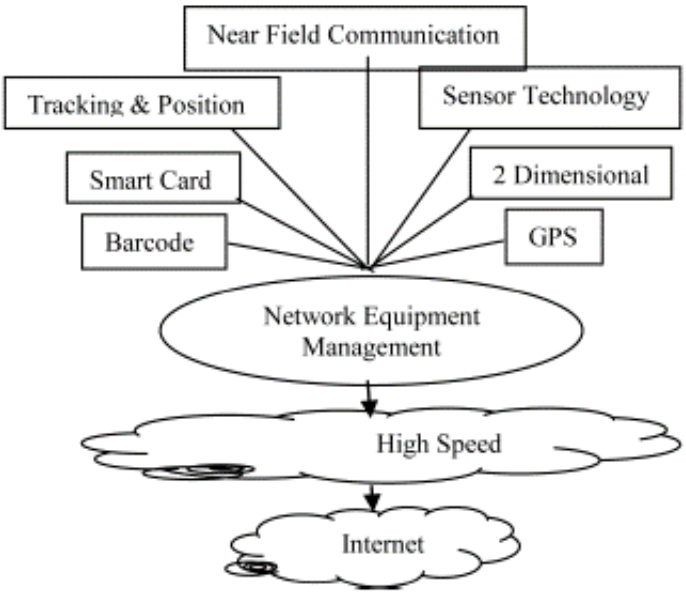

Figure 2.5. The Internet (Ibarra-Esquer et al., 2017)

Nunberg (2012) describes the Internet as a global system of interconnected computer networks using the standard Internet Protocol Suite (TCP/ IP) to serve billions of users worldwide. He depicts as a network of millions of private, public, academic, business and governmental networks uniting with a wide range of electronic, broadcast and optical network technologies, from local to global.

Later in early 1993, the Department of Defence established a stable and highly functional system of 24 satellites creating the Global Positioning Satellites (GPS) (Madakam et al., 2015). While the Internet is a communication platform of the IoT devices, satellites and landlines provide the backbone of the system for the communication.

Internet is not the invention for distant communication. Wireless Fidelity (Wi-Fi) is a networking technology enabling computers and other devices to interact over a wireless signal, which was founded by NCR Corporation in Nieuwege in the Netherland in 1991. Vic Hayes named as the father of Wireless Fidelity. Later, the

high-speed Wireless Local Area Network (WLAN) was developed for connection of millions of houses, offices and public locations such as hotels, cafes, and airports. Nowadays, entire cities are creating services as Wi-Fi corridors through wireless access points (Wireless AP).

Ericson Mobile Communication company began a project named Bluetooth in 1994 with an inexpensive, short-range radio technology which eliminates the need for proprietary cabling between devices. It further developed the creation of the Personal Area Networks (PAN), and Piconet, a set of Bluetooth devices sharing a common channel for communication. Lately, Near Field Communication (NFC) has become popular in mobile devices complementary to Bluetooth, creating a set of short-range wireless technology at a distance of 4 cm. It is more comfortable and more convenient for consumers for transactions, digital exchange content, and connect electronic devices with a touch.

Mobile Broadband is a wireless data-communication technology employing lower frequency radio spectrum; consequently, the users can access the Internet through mobile or desktop devices. There are several generations; the G stands for the generation of mobile technology; the figure displays its timeline and technology innovations.

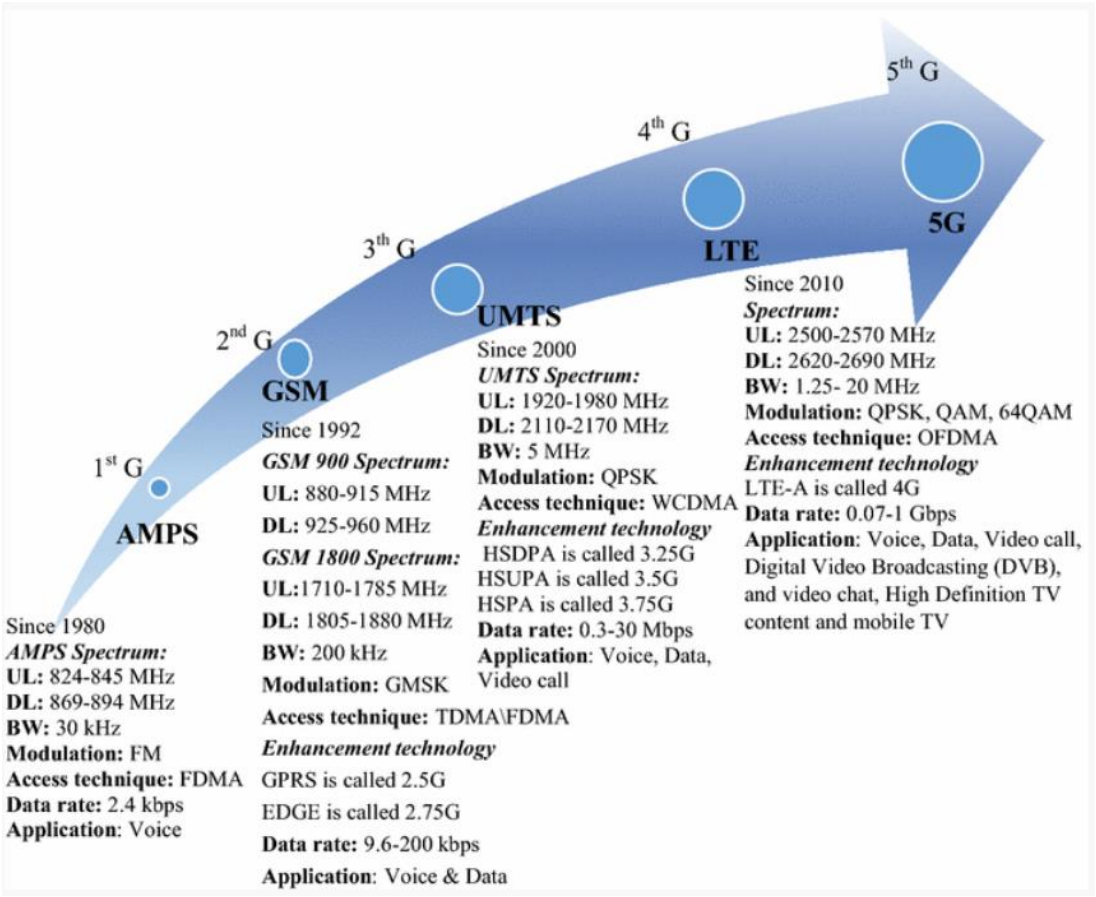

Figure 2.6. Major milestones in mobile generations (Alsharif & Nordin, 2017)

Every following generation of wireless technology increases the data volume, velocity, variety and veracity. Therefore, it creates various data sets, improves the existing technology of voice and visual networks. For instance, the 4G provides approximately three times greater speed than current LTE networks, and it also covers carrier aggregation, increased multiple-input multiple-output (MIMO) and orthogonal frequency division multiplex (OFDM) to acquire more data, coordinated multipoint, relay station, and heterogeneous network (Hashem et al., 2016). The MIMO utilises multiple antennas at the transmitter and receiver, and the OFDM, as a transmission technique, uses closely-spaced carriers modulated with low data rates; both enable

high data rates and permits multiple users to share a common channel (Hashem et al., 2016).

LTE-Advanced is bridging the gap between the 4G and 5G by introducing high bandwidth and lead to machine-to-machine communication, the IoT (Abdalla & Venkatesan, 2012). Ahmad (2015) proclaims that deployment of the 5G networks, improved technology for collecting more than one hundred billion devices and supports a bandwidth of up to 10 Gbit/sec with relatively low latency, will increase and result in fast and resilient access to the Internet and support for smart city realisation. However, such technology prevails in its infancy and is currently experiencing a series of pilot projects. It eventually will enhance experiences, personalise services, create a dynamic platform and digital solutions for people. It will give the capacity to seamlessly connect people and machines through sensors and mobile devices, share rich content amongst users. Therefore, the 5G and future wireless technologies will allow us to harness the potential of an unlimited ever-expanding Internet of Things.

Internet Protocol (IP)

Internet Protocol (IP), developed in the 1970s, is the primary network protocol used on the Internet. The IP is the primary interactions protocol in the Internet protocol suite for transmitting datagrams across network boundaries. The two versions of Internet Protocol (IP) are in use: IPv4 and IPv6, where each version sets an IP address uniquely (Alsharif & Nordin, 2017).

The Web

The World Wide Web was invented in 1989 by British scientist Tim Berners-Lee. He wrote his first web browser in 1990 while working for CERN in Switzerland. The

Internet is an extensive network combining millions of computers around the world, and computers on this network can communicate with any other computer as long as they are connected to the Internet. However, the Web or World Wide Web (WWW) is a means to obtain information over the Internet. It might be classified as a platform built on the Internet to reach information where documents, images, and many other web sources identified by URLs (Uniform Resource Finder). This area is connected with hypertext links and can be accessed over the Internet.

Table 2.4. *Web Taxonomy (Ibarra-Esquer et al., 2017)*

Category	Description
Near Web	It refers to the version of the Web that is closer to us, which is accessed using a computer by means of interfaces like keyboards and mice. It is defined by information and provides a notion of mobility through wireless networks.
Here Web	The version of the Web that can be accessed anytime and from any place using a device that is always with a person, becoming part of his or her identity.
Far Web	This Web refers to accessing contents through broadband networks. Such contents usually infer an innovation in entertainment.
Weird Web	The Web that is accessed with natural user interfaces. Its style of use defines it as the most pervasive of the first four Webs.
B2B	In this version of the Web, business computers talk to each other about business processes. It was initially identified as "e-commerce Web".
D2D	The device-to-device Web refers to devices communicating to share information to manage, control and monitor processes. It was initially identified as "pervasive Web".

Sensors and Smart Meters

The Internet of things offers seamless communication on a platform for sensor and actuator devices in a smart ecosystem enabling timely information and sharing between platforms (Gubbi et al., 2013). Sensors are sophisticated devices by mid-1990s, used to detect and respond to electrical or optical signals. A sensor is a physical parameter, converting the information of temperature, blood pressure, humidity and velocity into an electrically measurable signal. There are various types of sensors: accelerometer, biosensors, image sensors, motion detectors, temperature sensors,

touch sensor, advance sensor technologies such as bar-code identification, and transponders embedded in the car keys. Furthermore, a wireless network (WSN) composed of spatially allocated self-competent devices such as low-power integrated circuits and wireless communication technology are using sensors to monitor physical and environmental situations (Arampatzis, Lygeros, & Manesis, 2005).

A smart meter, as a part of wireless sensor networks and a component of a smart grid, is an Internet-enabled device that measures the energy, gas and water consumption in a building or house. Traditional counters deployed at houses and offices only measure total consumption, whereas smart meters further record and gives an estimation of how much resource is to be consumed, and create a two-way communication, coordination and control. Energy companies use smart meters to monitor consumer use and adjust prices by day and season — a smart meter functions as an input router between the utility network and the monitored building.

The pace of innovation displays that these technologies and many more which are not mentioned in this section are just a glimpse to the future. Even though it has been more than a few decades of evolution for the ICT, the IoT and other critical technologies for smart cities, it is still considered to be in its early stages. Graham and Marvin (1996) structure these technologies as the powerhouses of communication, information, and knowledge whose traffic overflows across global networks, which the most comprehensive mechanical and automated systems ever devised by people. Moreover, the transformation from an industrial and manufacturing society to one dominated by information and services create the path for the commodification of information, what we observe nowadays in cities. As we move towards an informative society based on the rapid transmission of messages, signs and knowledge with global networks, the relations between communities seems to be minimal and alter to a different form. Therefore, many theoreticians have argued that these shifts are part of a more comprehensive technological and economic revolution which seems to undertake the advanced innovative societies and within which both the development of technology and urban development hold central value (Miles & Robins, 1992).

2.3. Revisiting Smart City Phenomenon

Since the foundation of cities, technology has always generated a social, economic and political atmosphere in the urban environment, and innovations are the principal source for the betterment of our habitat. The innovations in media, communications and information technologies, as well as the invention of the Internet, have begun shaping our day-to-day life. However, we need to research better to understand how so-called smart technologies will shape and change cities. Cities are assembled and endured for human association. According to scholars Taewoo Nam and Theresa A. Pardo (2011), we need to discuss traditional institutions and human factors in urban dynamics in order to conceptualise Smart City leveraged by new technologies.

'Space of places'	'Space of flows' (Castells, 1989)
Physical presence	'Telepresence' (CEC, 1992)
Physical mediation	'Telemediation' (Richardson, 1994b)
Geography	'Telegeography' (Staple, 1992)
Distance	Speed and time (Mulgan, 1991)
Closure	Openness and exposure (Virilio, 1987)
Locality	Globality (Knight and Gappert, 1989)
'Modern' space	Post-modern 'hyperspace' (Jameson, 1984)
	'Data spaces' (Murdock, 1993)
	'Electronic spaces' (Robins and Hepworth, 1988)
	'Cyberspace' (Gibson, 1984)
	'Netscape' (Hemrick, 1992)
	'Networld' (Harasim, 1993)

Figure 2.7. New conceptual approaches for the telecommunications-based city: old and new characterisations of urban space and development (Retrieved from Telecommunications and the City, Graham & Marvin, 1996)

Furthermore, this section tries to address to following questions: what constitutes the Smart City, is it utopic or realistic and also still relevant? Does it generate liveable, workable and sustainable urban environment, what else does it offer to inhabitants, could it be regarded as an identifiable new trend of urban development as it seems to be taking for granted in academics? An urban environment is never static but evolves, adapting form and functions as seen by developments. Thus, we need to take a look at its dimensions, technical solutions, human offerings, and relation to other institutions to understand the impact of the Smart City paradigm.

2.3.1. Familiar Urban Paradigms

History has attested that the social, economic and spatial formation of society, as well as science and technology, produces cities and utopian visions of the ideal environment. Angelidou (2015) emphases on the negative effect of the physical structures on the rapid transition; however, she supplements that it cannot prevent the forthcoming. One idea feed another; a place attracts the vision and the imagination; thus, we need to acknowledge the background story of the very notion before we grasp the idea and adopt it in our physical environment. Hence, we need to ask ourself what earlier concepts influenced the paradigm of smart city vision? Were they just utopic or realistic and reflecting the social transformation of their period?

A British-Canadian historian Martin Kitchen expresses that the market and urban theorists stress the transformation of urban infrastructure, governance, economic and social structure with the adoption of the Information and Communications Technology (ICT) as with the Internet of Things being the developed-innovations of the Industrial Revolution (2014). Scholars and theorists have named this transformation and the urban concept of "Smart City" in various designations based on what they signify in their ultimate vision such as Wired City (Dutton et al., 1987); Cyber City (Graham &

Marvin, 1999), Digital City (Ishida & Isbister, 2000), Intelligent City (Komninos, 2002); or Sentient City (Shepard, 2011).

Table 2.5. *The familiar concepts to smart city (Adopted from Cocchia, 2014)*

Concept	**Definition**	**Reference**
Wired City	*"… literally to laying down of cable and connectivity not itself necessary smart"*	Hollands
Virtual City	*Concentrating "on digital representation and manifestation of cities"*	Schuler
Ubiquitous City	*"further extension of digital city concept, a city or region with ubiquitous information technology"*	Anthopoulos et al.
Intelligent City	*"territories with high-capacity capability for learning and innovation, which is built-in the creativity of their population, their institution of knowledge creation, and their digital infrastructure for communication and knowledge management"*	Komninos
Information City	*"digital environments collecting official and unofficial information from local communities and delivering it to the public via a web portal"*	Anthopoulos et al.
Digital City	*"a comprehensive, web-based representation, or reproduction, of several aspects or functions of a specific real city, open to non-experts", and having "several dimensions cologne social cultural political ideology, and also theoretical"*	Couclelis
Smart Community	*"a geographical area ranging in size from neighbourhood to a multi-country region whose residence, organisations, and governing institutions are using information technology to transform their region in significant ways. Corporation among government, industry, educators, and the citizenry, instead of individual groups acting in isolation, is preferred"*	California Institute
Knowledge City	*aiming "at a knowledge-based development, by encouraging the continuous creation, sharing, evaluation, renewal and update of knowledge. This can be achieved through the continuous interaction between its citizens themselves and at the same time between them and other cities' citizens. The citizens' knowledge-sharing culture as well as the city's appropriate design, IT networks and infrastructure support these interactions"*	Ergazakis

Table 2.5. *The familiar concepts to smart city (Adopted from Cocchia, 2014) (Continuation)*

Creative City	*having "overwhelming impact on the economies of their countries and compete with one another directly for trade and investment" based on technology, talent and tolerance*	Florida
Learning City	*learning in this concept "covers both individual and institutional learning. Individual learning refers to the acquisition of knowledge, skills and understanding by individual people, whether formally or informally. It often refers to the lifelong learning, not just initial schooling and training. By learning, individuals gain through improved wages and employment opportunities, while society benefits by having a more flexible and technological up-to-date workforce"*	OECD
Sustainable City	*using "technology to reduce CO2 emissions, to produce efficient energy, to improve the building efficiency. Its main aim is to become a green city"*	Batagan
Green City	*following "the green growth which is the new paradigm that promotes economic development while reducing greenhouse gas emissions and pollution, minimising waste and inefficient use of natural resources and maintaining biodiversity"*	OECD

In the early industrial revolution, Ebenezer Howard embellished a healthy and functional city vision to restore the acute problems of the period in his book the Garden Cities of Tomorrow (Hall, 2000). Later, Tony Garnier illustrates the ideal industrial city what he called Une Cité Industrielle aspired by the functionalist aspect of the modernity; exhibited in 1904 (Hall, 2000). The Futurist movement around 1909 and 1916 generated the thoughts related to speed, machinery, industry, cars and aeroplanes due to the innovations of automobile production, the use of hydroelectric power, air navigation, the film sector, and photography (Angelidou, 2015). For instance, an Italian architect and prominent member of the Futurist group Antonio Sant'Elia envisioned the city as an efficient and speedily machine in his work, Città Nuova (New City) shown in Figure X. The mass production of the industrial revolution also has had substantial effects on the social and physical environment in Germany between 1919 and 1932, which still influence architectural practices. The Bauhaus movement foresees the machine and modern technology as positive elements for urban development; thus, it seeks the industrial and function-oriented vision.

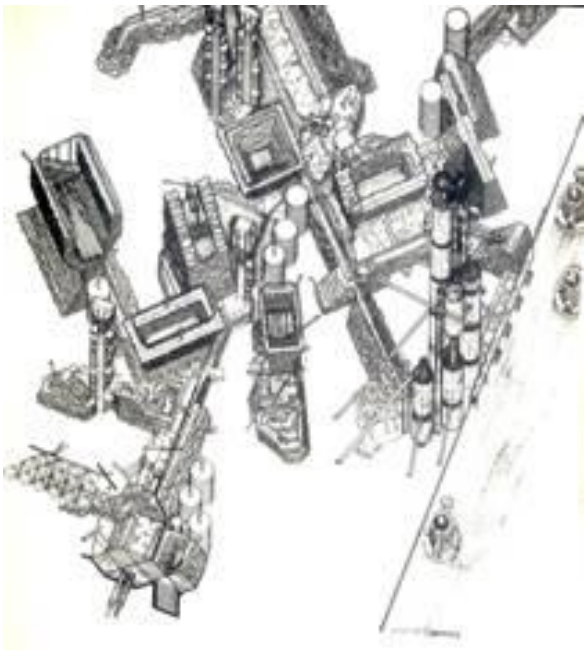

Figure 2.8. Plug-in city by Cook, 1964 (Essential-architecture, n.d.)

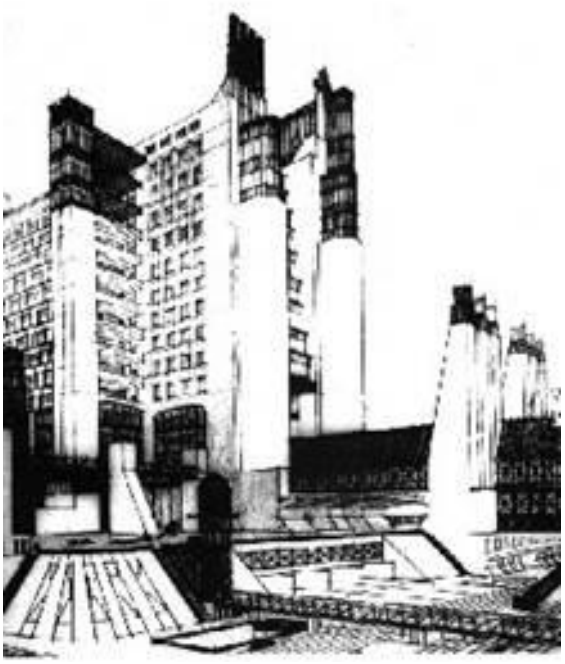

Figure 2.9. Citta Nuova by Sant'Elia, 1914 (Essential-architecture, n.d.)

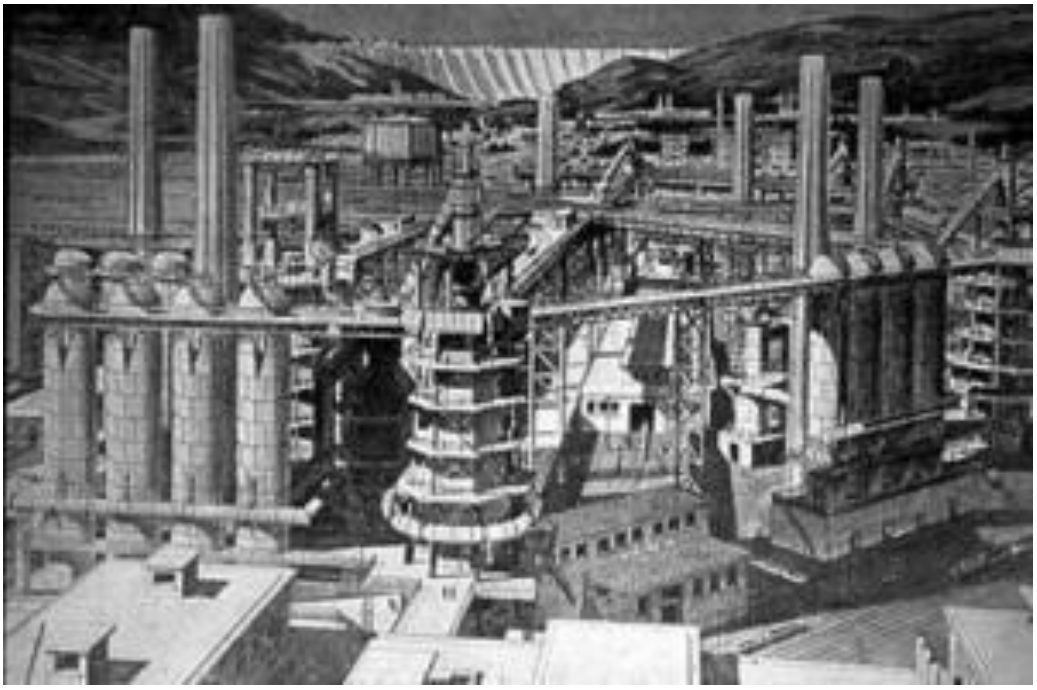

Figure 2.10. Cite Industrielle by Garnier, 1908 (Essential-architecture, n.d.)

Figure 2.11. Walking city by Herron & Harvey, 1963 (Essential-architecture, n.d.)

Angelidou (2015) remarks embracing the technological achievements of the period in architects and urbanists visions for the built environment in the works of Le Corbusier, Archigram and other designers. She narrates examples of which a well-known leading modernist architect Le Corbusier exhibited Maison Citrohan after the French Citroën automaker, Plan Voisin after the French aircraft manufacturing company, and Ville Contemporaine (Contemporary City) to house a population of three million (2015). Moreover, planners introduced a cure to the problems of its period such as congestion and overpopulation in cities with the New Towns movement in the United Kingdom, which expanded later to the rest of the world (Atkinson, 1998; Hall, 2002). Besides, Peter Cook from an avant-garde architectural group of Archigram illustrated an urban megastructure Plug-in-City, and Ron Herron laid out a technologically advanced city, Walking City in 1964 (Angelidou, 2015). Moreover, Angelidou gives another avant-garde and speculative design from a post-war generation Greek architect Takis Zenetos, Electronic Urbanism, which proposes diverse levels and places for different urban functions using telecommunications technologies.

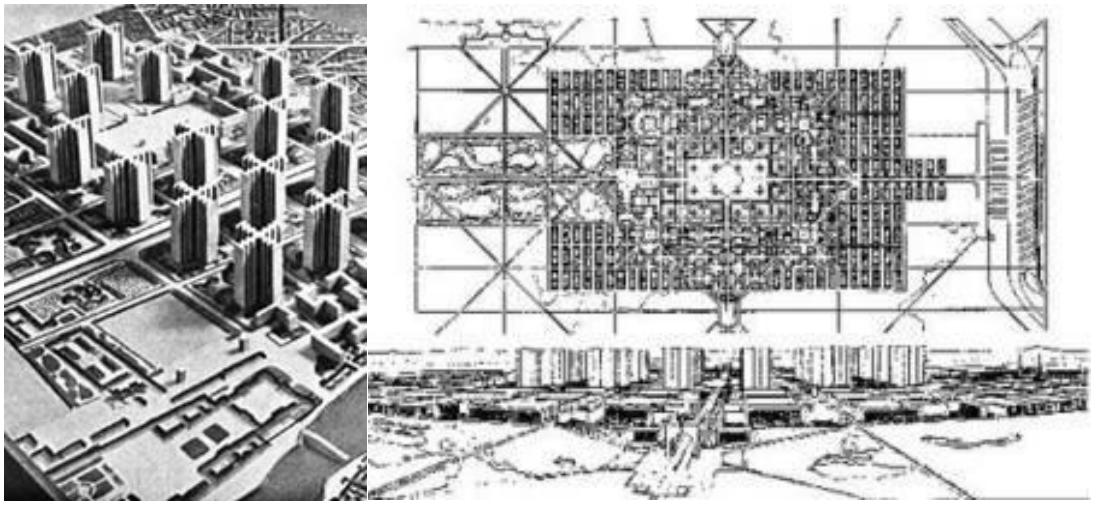

Figure 2.12. Le Corbusier's Plan Voisin (left), 1925 and Ville Contemporaine, 1934 (Essential-architecture, n.d.)

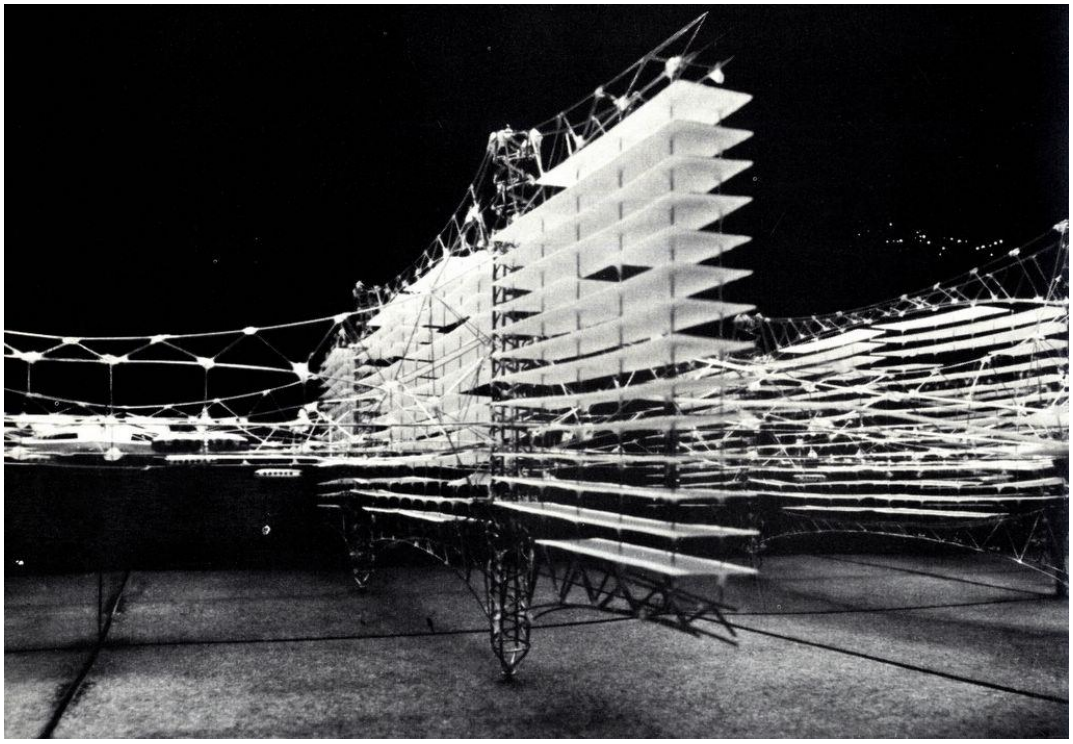

Figure 2.13. Model of Zenetos's Electronic Urbanism (Zenetos, 1969)

Data was believed to be the key for efficient urban systems; a cultural theorist Shannon Mattern expresses the importance of data analysis in the modern urban planning, referring as Cities-as-Machine. During the first two decades, data became a prime source for technocratic planning (Williams, 2015). For instance, the 1916 Zoning Regulation in Manhattan was one of the first progress stories of this data usage in urban planning. However, the decline in the modernist urban approaches provoked urban activists and practitioners to leave the idea of quantitative data is everything. A prominent civic activist Jane Jacobs and urban sociologist Herbert Gans along with other actors guided this transformation in the late 60s; they affirmed the essentiality of human-centred narratives for conjecturing the economic and social necessities of cities (Hall, 1989; Gratz, 2011). Jacobs (1961) was opposed to using only data-driven proofs for building highways and eventually destroying all the neighbourhoods because of the lack of adequate information given to inhabitants. She believed that communities were not aware of the outcome of their choices at the beginning; thus, she campaigned for the involvement of the public in the decision-making process (Williams, 2015).

The Situationist movement and the field of psychogeography claimed that urban environment should use not only land use and census information but also the experiments of citizens (Cosgrove, 2005; Wollen, 1999). An American urban planner Kevin Lynch was improving the similar idea on his findings where he gathered these conceptions on a perceptual form of an urban environment. Williams (2015) explains that cognitive mapping was pointing essential places based on a person's experiences in a city by drawing a mental map. These visions and approaches in urban planning were reactions to designing with only quantitative data and utilising only technological innovations for further improvements.

In a particular way, each of these concepts shares a focus on the effects of embracing innovations for an entrepreneurial and regulatory outcome for urban daily life. Moreover, these experiences reflect that designing with mere technology or data is a complete failure because of the dynamic structure of cities. However, we need to

acknowledge that the future should embrace industry and its technological achievements, as well as understanding the behaviour and needs of inhabitants.

2.3.2. History

Communications technologies and the Internet have become a sort of fashion and even convention to associate with a territory, space, place, or even an entire city. Consequently, urban advocates and developers constructed visions for a specific section of a city or a complete urban area in order to solve the contemporary problems and to address future needs. Scholars and the business name this phenomenon differently, e.g. Digital City, Cybercity, Cyber Zone, Virtual Square, Telecity, and many more which spatial metaphors accurately attached to technological terminology that it became natural to discuss digital solutions and the Internet services for the city (Aurigi, 2005). The central portion of each is a position in the physical field that puts the application into a social context.

In 1996, Graham and Marvin began speculating the indication of the latest inventions to the daily urban life in their timely book Telecommunications and the City; furthermore, several scholars such as Mitchell (2003) and Castells (1996) began contributing this new field of knowledge from varying perspectives (Albino, Berardi, & Dangelico, 2015). For instance, social media guru Clay Shirky identified the kinship between the virtual and physical world through the Web as "situated software" and noted that the connection is critical for prosperous works (Townsend, 2013, p. 233).

The 'invisible city' (Batty, 1990)
The 'informational city' (Castells, 1989)
The ‘weak metropolis’ (The Dematteis, 1988)
The ‘wired city’ (Dutton et al., 1987)
The ‘telecity’ (Fathy, 1991)
The 'city in the electronic age '(Harris, 1987)
The' information city'(Hepworth, 1987)
The' knowledge-based city’ (Knight, 1989)
The intelligent city' (Latterasse, 1992)
The virtual city (Martin, 1978)
‘Electronic communities' (Poster, 1990)
‘Communities without boundaries' (Pool, 1980)
‘Electronic cottage’ (Toffler, 1981)
The city as ‘Electronic spaces’ (Robins and Hepworth, 1988)
The 'overexposed city' (Virilio, 1987)
The ‘Flexicity' (Hillman, 1993)
The 'Virtual Community' (Rheingold, 1994)
The 'non-place urban realm' (Webber, 1964)
‘Teletopia' (Piorunski, 1991)
‘Cyberville' (Von Schuber, 1994)

Figure 2.14. Metaphorical characteristics of the contemporary city (Retrieved from Telecommunications and the City, Graham & Marvin, 1996)

Smart City and Digital City terms are frequently used ideas in both scientific literature and technical reports. Nevertheless, the paradigm of the Smart City first adopted in 1994 (Dameri, & Cocchia, 2013); however, the academia hardly embraced the term, or there were a couple of articles related to the concept. In 2010, they began to progress sharply following the European Union began to use "smart" to characterise sustainable schemes and actions in urban areas (Al-Hader et al., 2008). These concepts further developed with the involvement of the EU SETIS (Strategic Energy Technologies Information System of the European Union), a body working to achieve sustainable goals through the lens of technological advancements such as reducing greenhouse gas emissions by up to 40% by 2020. The term smart distinguishes a family of smart electronic devices (Hollands, 2008). Moreover, politicians, governments and

companies are applying these concepts to refer to the ideal city meeting the needs of its citizens in a favourable, efficient and effective ways (Hollands, 2008). On the other hand, large technology companies such as IBM use the term as information and communications technology to distinguish, analyse and combine analytical information from core systems in working cities (Water, Li, & Fu, 2011).

Nevertheless, urban developers should be careful with technological concepts while designing an entire city for the upcoming innovation. Townsend (2013, p. 101) annotates the obvious and intended conclusion of Futurama; new cities must be designed not just to accommodate the automobile but to exploit its full potential for personal mobility and freedom.

2.3.3. Urban Digitalisation

One of the most important technologies used to support smart city strategies is telecommunications, as well as the Internet and digital devices. Hence, the term of Digital City as the most repetitive has regularly used as a synonym for Smart City along with other phases. Dameri (2013) questions whether these two concepts and share the same ideology, strategies, and technologies. Kryssanov, Okabe, Kakusho and Minoh (2001) also disclose the confusion in the reflection of technology-driven cities as being divided and open to debate in the literature. Common ground is mostly found in the technological applications in the public services and its reflection to the city strategies.

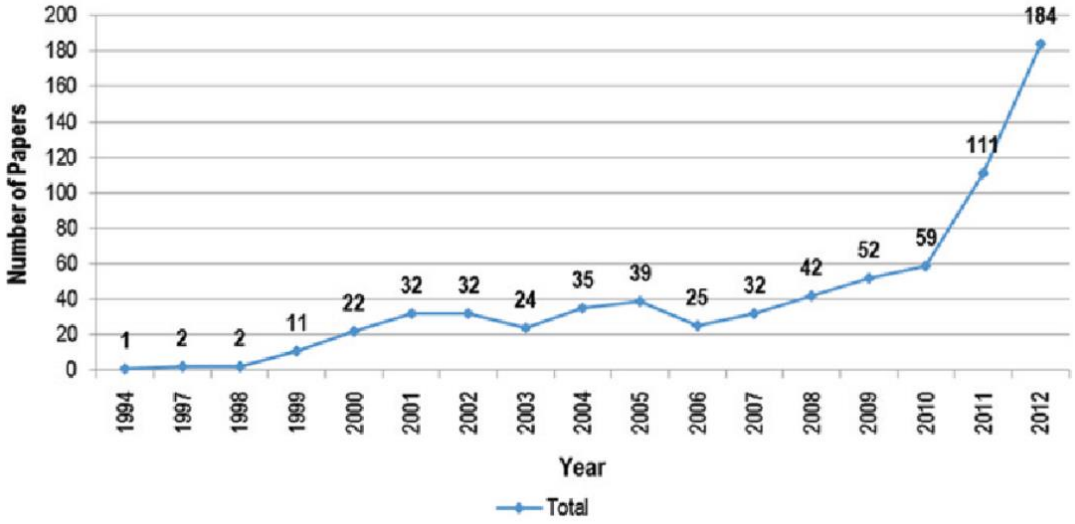

Figure 2.15. Time analysis: number of papers about smart city and digital city (Cocchia, 2014).

Shifting the analogue practices to computers and the help of network systems in an urban ecosystem for communication, governance, decision-making, or efficient public services is a matter of today's world as well for the future. The concept identified in the field of computer science and several others as Digital City to stress the digitalisation of public services and other urban practices. Notwithstanding, Table displays that scholars defined it slightly different than each other, highlighting the necessary aspect based on their fields or city needs as they envisaged. For instance, Gumpert and Drucker (2001, p. 27) define it as "a conception of urban space that emphasises the electronic transmission of public information and instruction". Ishida (1999, p. 7) also mentions the intersection of urban information technology creating public spaces for inhabitants. Moreover, he highlights on local initiatives working on digital technologies and telematic, where more than 100 organisations began working since 1994.

Other scholars emphasise on technology investments in the city, especially the Internet of Things (Anthopoulos et al., 2012), and communications and information technologies from various resources to provide services aimed at facilitating social

and spatial aspects in virtual and physical environment (Kryssanov et al., 2001, p. 56). Some emphasise only on the connection in terms of communication via broadband networks and other service-oriented innovations to meet the needs of governments and their employees, citizens and businesses (Yovanof & Hazapis, 2009).

The Smart City concept, on the other hand, is more challenging to delimit (Dameri, 2013); combining several other paradigms such as sustainable technologies too. Unlike Smart and Digital Cities, other concepts also share similar aspects. For instance, the notion of Intelligent City emerges at the crossing of the knowledge society, creativity and digital services (Moser, 2001). Creativity is an indispensable endowment in the Smart City vision where human infrastructures such as occupation, knowledge, networks, voluntary works, nightlife economy and social infrastructure such as intellectual and social capital blends for creating competitive city. Learning is another aspect improving the competitiveness of Learning City in the global knowledge economy while Knowledge City is purposefully designed to encourage the nurturing of knowledge. Virtual City emphasises on digitalised public services in the cyberspace, whereas the Information City refers to the data collected by local communities and the environment delivered to the public via cyberspace (Nam & Pardo, 2011). A Ubiquitous City or U-City is an extension of the Digital City in terms of ubiquitous computing accessible to the urban elements (Anthopoulos & Fitsilis, 2010).

A city is a complex ecosystem consisting numerous components interacting with each other such as business, government, local organisations, and people while these components are created by and from others such as learning, knowledge, creativity as well as infrastructures. Thereby, a city is a self-organising system which is re-producing the fabric of itself (Mino, 1999, p. 58).

2.3.4. Smart City: The-state-of-the-art

Apart from different terms with similar aims, each body and field working for the city and with the Smart City concept define it differently based on their motives and background such as “a city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens” (Giffinger et al., 2007); “a city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens” (Hall, 2000); “a city connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city” (Harrison et al., 2010); “a city combining ICT and Web 2.0 technology with other organisational, design and planning efforts to de-materialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability” (Toppeta, 2010); “a city that is focusing on the use of Smart Computing technologies to make the critical infrastructure components and services of a city—which include city administration, education, healthcare, public safety, real estate, transportation, and utilities—more intelligent, interconnected, and efficient” (Washburn et al., 2010); and finally, “smart cities represent a conceptual urban development model based on the utilisation of human, collective, and technological capital for the enhancement of development and prosperity in urban agglomerations” (Angelidou, 2014).

Table 2.6 summaries a few definitions from the most cited scholars in the subject to give background in differences. However, a standard and clear definition are still lacking not only in the academics but also in the empirical applications of the concept, i.e. smart environment; moreover, business uses the term as an urban labelling while

it mainly hides the ideology behind the vision (Hollands, 2008). For instance, the business uses the term Smart instead of Intelligent to reflect their user-friendly and user-oriented services. Eventually, it becomes a fuzzy word due to its inconsistent definition and other uses as in sustainability, sustainable development, urban greenery and intelligent.

Table 2.6. *Most cited definitions of smart city* (Cocchia, 2014)

Definition	**Reference**
"a city well performing built on the smart combination of endowments and activities of self-decisive, independent and aware citizens"	Giffinger et al., 2007
"a community that has made a conscious effort to use information technology to transform life and work within its region in significant and fundamental rather than incremental ways"	California Institute
"a city to be smart when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life with a wise management of natural resources, through participatory governance"	Caragliu et al., 2009
"the use of information and communications technology to sense, analyse and integrate the key information of core systems in running cities	IBM
"the product of Digital City combined with the Internet of Things"	Su et al., 2012
"citizens, objects, utilities connect in a seamless manner using ubiquitous technologies, so as to significantly enhance the living experience in 21st century urban environment"	Northstream
"a city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, pater, even major buildings, can better optimise its resource, plan its preventive maintenance activities, and monitor security aspects while maximising services to citizens"	Hall, 2000
"the urban centre of the future, made safe, secure environmentally green, and efficient because all structures – whether for power, water, transportation, etc. are designed, constructed, and maintained making use of advanced, integrated materials, sensors, electronics, and networks which are interfaced with computerised systems comprised of databases, tracking, and decision-making algorithms"	Hall et al., 2000
"combining technologies as diverse as water recycling, advanced energy grids and mobile communications in order to reduce environmental impact and to offer its citizens better lives"	EU SETIS, 2012

Table 2.6. *Most cited definitions of smart city* (Cocchia, 2014) (Continuation)

"a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development"	Dameri
"capitalising on the opportunities presented by ICT in promoting its prosperity and influence"	Odendaal, 2003
"actively embracing new technologies to be more open society where technology makes easier for people to have their say, gain access to services and to stay in touch with what is happening around them, simply and cheaply"	Partridge, 2009
"one that takes advantages of the opportunities offered by ICT in increasing local prosperity and competitiveness – an approach that implies integrated urban development involving multi-actor, multi-sector and multi-level perspectives"	Paskaleva, 2009
"using ICT to make the critical infrastructure components and services of a city – administration, education, healthcare, public safety, real estate, transportation, and utilities – more aware, interactive, and efficient"	Belissent et al., 2010
"representing an extraordinary rich ecosystem to promote the generation of massive deployments of city-scale applications and services for a large number of activity sectors"	Hernandez-Munoz et al., 2011
"using a smart system characterised by the interaction between infrastructure, capital, behaviours and cultures, achieved through their integration"	Alkandari et al., 2012
"representing a community of average technology size, interconnected and sustainable, comfortable, attractive and secure"	Lazarioiu & Roscia, 2012
"empowering people through using technology for contributing to urban change and realising their ambitions… providing the conditions and resources for change… an urban laboratory, an urban innovation ecosystem, a living lab, an agent of change"	Schaffers et al., 2012

2.3.5. The Smart Ecosystem

The notion of the Smart City as well as its complementary visions, e,g, Digital City, Ubiquitous City, and Intelligent City is using several conceptual differences of the understanding of the paradigm as reflected in the previous sections, cities utilising smart and digital solutions embedded in their infrastructure have been developed all over the world. On the other hand, its aim can be generalised in a few forms:

- to enhance the quality of life, taking into account the social, economic, cultural and political processes that take place within the city.
- to improve the environmental quality
- to deliver better services to the citizens
- to enhance democratic participation
- to create a helpful tool for advanced communication and social interaction
- to represent the real city, town, or village on the Internet
- to organise the digital information of the corresponding cities
- to offer residents different kinds of information
- to catch up with the global economic dynamics
- to revitalise the local or regional economic structure
- to provide a public information space for people living in and visiting them (Hall, 2000; Van den Besselaar, Melis, & Beckers, 1999; Tanabe, van den Besselaar, & Ishida, 2003, p. 2; Ishida, Ishiguro, & Nakanishi, 2001, p.246).

The Smart City is representation of a real city or town with its social, economic, and political structures either it offers advanced information, communication and social interaction infrastructure or it delivers digital and virtual services to construct sustainable and economic development in the physical or virtual realm, it uses innovative technologies and farsighted strategies to achieve such aims (Schuler, 2001, p. 71).

Actors

The issue of classification and definition is a deliberate subject in the Smart City paradigm; on the other hand, what actors involved in this phenomenon is another critical issue to discuss. A city is a complex organism due to the relationship and combination of its actors. According to Law and Hassard (2005), an idea or an urban item take its form and function by interaction with surroundings and other related entities. Scholars identify this relation in causality and agency, where it deals with various actors. For instance, non-human actors include technologies, machines, tools, goods and services which acquire an identity of their own. Thus, we need to analyse actors or actants included in and excluded from the process. Moreover, are these actors addressing the needs of inhabitants? What is the inter-relation among these actors?

According to Cosgrave and Tryfonas (2012), universities, research institutions and hi-tech companies are one of the central players in this model because of their strong support in the development of innovations, technologies, and opinions. They are producing ideas, projects, initiatives and ultimately products and services by using their competencies to plan and implement smart solutions to prolong urban life quality for the people.

The Smart City envisions a connected ecosystem where the market, institutions, governments and people share and exchange information with and by themselves with the help of technology, engineering and scientific innovations (Dameri, 2013). Hence, technology and its tools are the principal drivers to envisage the concept.

Information and Communications Technologies and the Internet of Things, as well as other smart and connected technologies, drive this paradigm. Nevertheless, there is no city without its people. This portion is either lacking or not having central importance in this discussion. Social aspects, as with the physical enhancements, are essential in the adoption of the Smart City vision. Unlike investors and developers where the goal seems to be making more money, many scholars underline the influence of the social,

economic, institutional or human perspectives within these developments. This situation is the dichotomy between different actors and their motivation, which generates branched and unfamiliar cities using smart technologies and aiming to create a better lifestyle for its residents.

Despite academia's role in emphasising importance and engagement of urban residents, inadequacy lies at the questions of whom we are letting in and what role to involve them in the development of cities. City dwellers and citizens are not the only people in the urban environment; there are also visitors, tourists, people who are working in a particular city but living in another, migrants, immigrants and refugees. It is a subject to be careful upon due to the title of people in cities because the retrieved and generated data, the lifeblood of smart solutions should be evaluated thoroughly to create smart strategies for problems and urban developments.

As urban residents are an important actors in Smart City strategies, the neoliberal mentality and the market-led technological solutions led large companies to become a key player in several projects. Thus, it is reasonably no wonder that some of the strongest advocates for smart city development are big businesses such as IBM, CISCO, Microsoft, Intel, Siemens (Kitchen, 2014). For instance, IBM developed campaigns of Smart Cities and Smart Planet programmes to promote the use of technology and data to analyse the problems of cities in 2008 (IBM, 2015). Also, Cisco pushed its Smart and Connected Communities program to utilise data analysis and web-based programs to connect cities through technology (Swabey, 2012). They encourage people and pressure city governments for the adoption of their brand-new technologies and services while pursuing privatisation and deregulation. IBM's and other big companies' vision of the Smart City characterised in three pillars instrumented, interconnected, and intelligent (Harrison et al., 2010) with the ultimate goal to enable more efficient capital accumulation. Instrumentation implies to deliver data from both physical and virtual sensors and other smart technologies, where multiple processes, systems, organisations, industries, or value chains interconnects such data (Nam & Pardo, 2011). Townsend (2013, p. 236), however, argues that

creative ideas about smart technologies are expanding not quite the way IBM envisions, it is happening from city-to-city, peer-to-peer, driven by local communities and NGOs to cross-fertilise innovations.

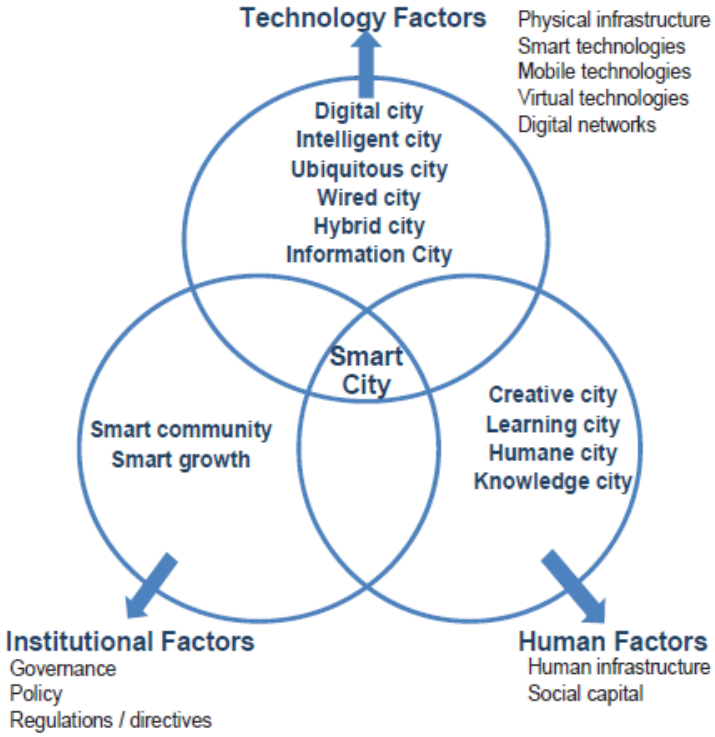

Figure 2.16. Fundamental Actors of Smart City (Nam & Pardo., 2011)

There is a distinctive characteristic between the Smart City, Smart City initiatives, and Smart City projects; each developed by actors from the public, private and civic backgrounds (Manville et al., 2014). Unlike branded Smart Cities or smart developments organised by big corporations, local initiatives also take actions for the improvement of urban life for residents. Various actors collaborate for the Smart City initiatives, where each formulates a novel form of a Smart City vision. Each initiative tackles a different aim and promotes one or a couple of characteristics of the Smart City while developing concrete smart city applications. Any Smart City project

includes several actors as well as multiple digital technologies where individuals conjointly can demonstrate their involvement. Manville et al. (2014) describe an exemplary Smart City with the superimposition of these different networks of various actors and actants.

Ecosystem

Application	Specific Use	IoT	Possible Communication Technologies	Advantages	Limitations
Smart Healthcare	Health monitoring,	Sensors, smart wearable devices	Bluetooth and ZigBee	—Early diagnose the disease	—Lack of precision
Smart Transportation	Efficient route management	Smart Cars, Cameras, RFID cards	RFID, 3G, and 4G	—Automatic traffic management —Efficient route management —Less congestion	—Network disconnectivity can cause serious accidents
Smart Governance	To make smart policies with the aim of managing the citizens	Smartphones, cameras, sensors	WiFi, LTE, LTE-A, WiMax, Bluetooth, LoRaWAN,	—Awareness in terms of citizens needs —Clear policy	—Collection and analysis of data seem difficult task
Smart Grid	To manage the power supply	Smart meters and Smart readers	WiFi, Zigbee, Z-Wave	—Efficient power supply —Future needs estimation	—Costly —Hard to manage

Figure 2.17. Different applications in the smart city ecosystem (Hashem et al., 2016)

The engagement of different actors and the presence of various aims in the Smart City persuade a sustainable and enriching quality of life for residents. Several scholars and market-led companies characterise the smart environment in several functional areas. Giffinger et al. (2007) identify six characteristics: living, economy, governance, mobility, environment and people, whereas a research and consulting firm Frost and Sullivan, characterise a Smart City which demonstrates at least five out of the eight criteria in a project: governance, energy, building, mobility, infrastructure, technology, healthcare and citizen (Madakam & Ramaswamy, 2008). However, several authors dealing with this concept and indeed companies indicate their smart environment differently or with some specific sectors due to the case features they are analysing in the former situation and based on the necessity to promote their services in the latter condition. However, Smart City can work with five functional areas:

living, energy, mobility, services, and first and foremost governance. Technology is a driver in each field while citizens are actor needs to be included in the agenda while designing each area.

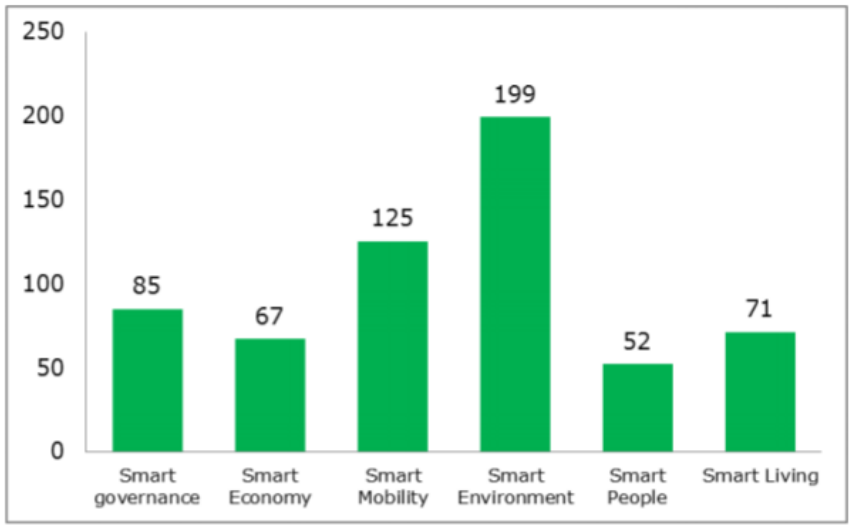

Figure 2.18. The number of Smart Cities in the EU presenting the six Smart City characteristics (Hashem et al., 2016)

Smart Living is a focus area concentrating on the quality of life of people in which different levels from micro to macro spatial levels such as a shelter as a house, building, or a communal environment as public space, or neighbourhoods, cities and regions, or the network of these components. The patterns collected from the massive amounts of traffic and pedestrian data, on the other hand, can enhance mobility schemes from the point of lessening traffic congestion by implementing alternative routes and reducing the number of accidents by examining accident data, including the cause (Ju et al., 2013). Mobility data can also provide many benefits such as optimise the movements, reducing the environmental impact and increasing safety as well as improving user experience, among many others by the help of ICT, sensors, and the IoT. Berrone and Enric (2016) invoke another example honoured as the second

smartest city according to Cities in Motion Index (CIMI). The populated city began delivering smart services with exceptional and intelligent mobility management, wireless connection (Silva, Khan, & Han, 2018). In terms of smart mobility management, San Fransico municipal transportation agency replaced single-occupant vehicles with a programme called shared, electric, connected, and automated vehicles (SECAV) to extend the mobility system and reduce energy consumption (Silva, Khan, & Han, 2018), while also establishing infrastructure for the operational performance of buildings and centralised waste management.

Masdar City, for instance, is a planned development aiming at using the latest technology to increase the life quality in urban space while delivering more beneficial services to its citizens and improving the environmental quality and to be the first zero-carbon city in the world (Hall, 2000). Santander city is another example to the City project in a city-scale, implemented as a part of SmartSantander programme and supported by the European Commission (Sotres et al., 2017). It aimed to be the most comprehensive test base for research experiments on IoT deployment (Silva, Khan, & Han, 2018). Moreover, Nice is another well-known European Smart City promoted to be a contactless urban ecosystem for mobility systems, as well as in public spaces such as galleries and shops thanks to NFC technology to execute transactions (Anttiroiko, Valkama, & Bailey, 2014). Later, Nice and Cisco collaborated to provide possible benefits of IoT in service areas of waste management, mobility and services such as security and lighting (Mitchell et al., 2018).

Smart City, fundamentally, holds another vital area in the smart ecosystem: smart governance. The local and national government holds transparent governance, public services as well as public participation in decision making thanks to the advanced smart technologies. Kyoto was a leading example of social information infrastructure for the everyday life of urban residents for the 21st century. Barcelona is another preeminent example, despite its downfall in 2008, aiming to employ ICT and IoT infrastructures in business and governance sectors to enhance accessibility, transparency, and public service efficiency in the industrial and touristic spotlight in

Europe (de Barcelona, 2012; Leon, 2008). Barcelona expanded smart infrastructures to intensify in economics, mobility, science and technology as well as housing and urban life quality (Bakıcı, Almirall, & Wareham, 2013). Both the municipality and the University of Padova had a joint venture in implementing a Wireless Sensor Network to generate open data for public administration tasks (Perera et al., 2014; Zanella et al., 2014). The ethics advisory committee of Darmstadt hosted a collaborative discussion on cybersecurity, privacy and smart technologies between citizens, universities, businesses and public authorities for the city future (Ransom, 2019). The deployment was for a decisive role in tackling urban problems and upgrading to existing infrastructure while creating new partnerships to represent residents efficiently.

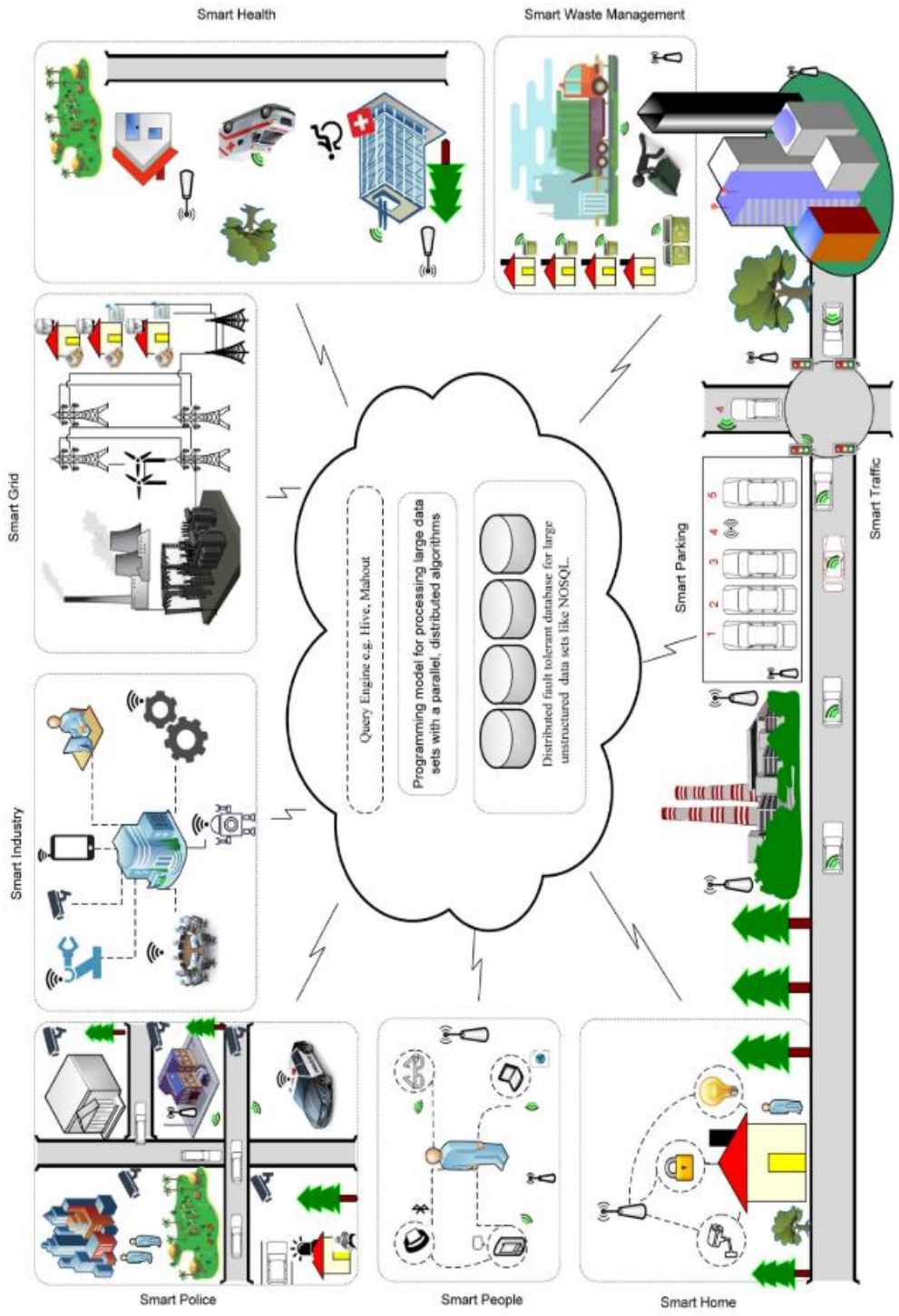

Figure 2.19. Landscape of smart city and big data technologies (Hashem et al., 2016)

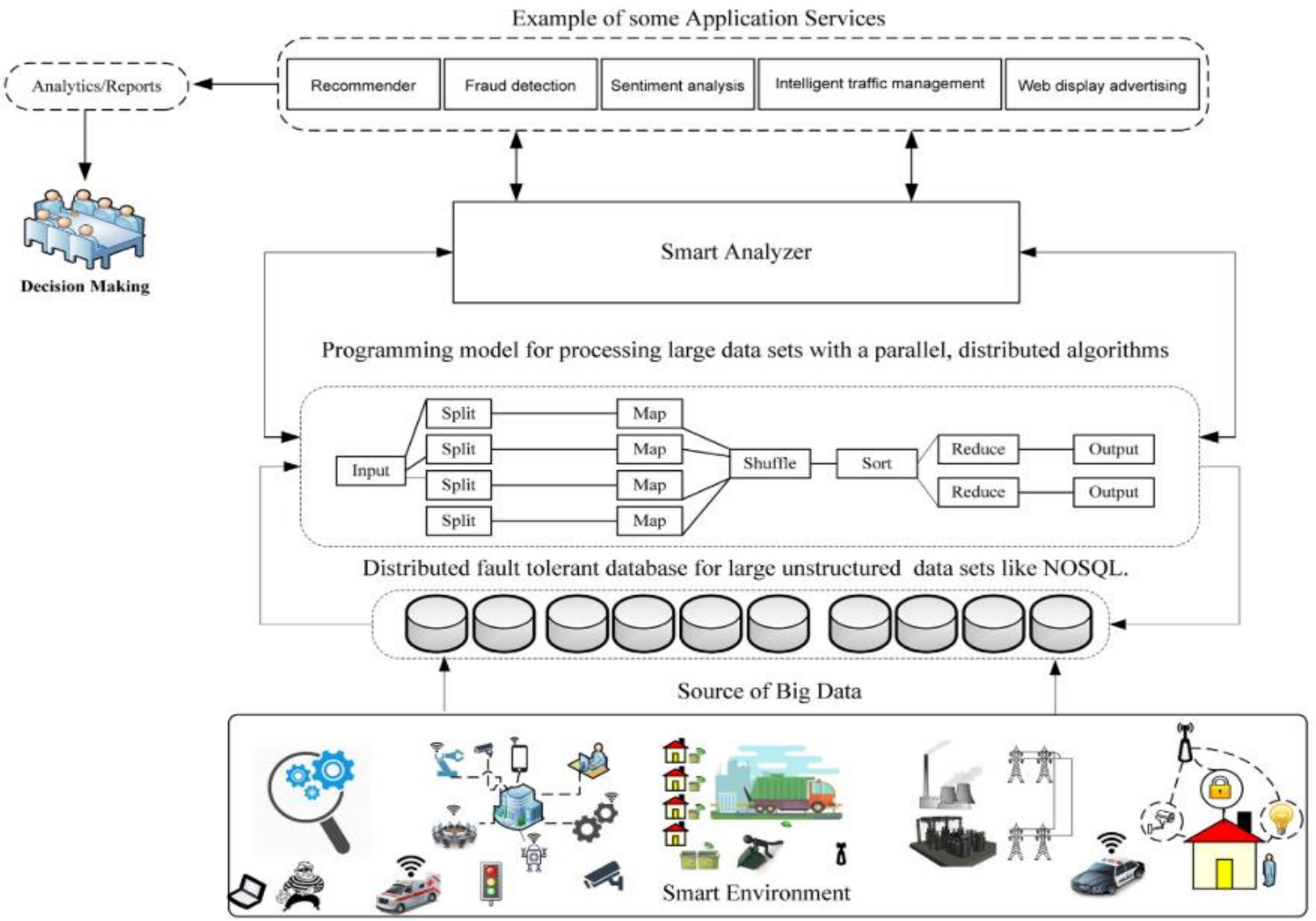

Figure 2.20. Construction of big data technologies for smart city (Hashem et al., 2016)

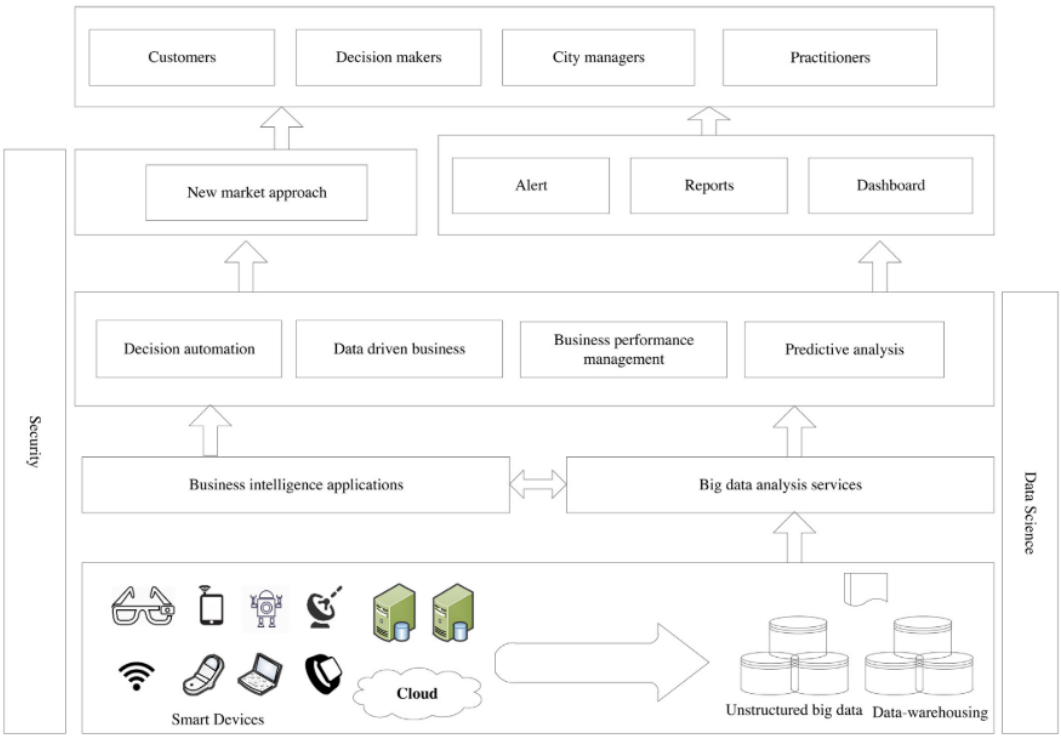

Figure 2.21. Business model for big data and smart city (Hashem et al., 2016)

Despite pursuing unrealistic developments, actors from residents, communities, public and private organisations, universities and institutions with different agendas and motivations deal with five areas in the Smart City ecosystem namely living, energy, mobility, services, and governance to enhance urban life quality, assure local food supplies, and transitioning to renewable energy for residents by programmes such as smart and connected car network, better data management systems, smart grids, and smart security systems by various smart technologies. Nonetheless, these fields are just the application areas, and smart technologies are only mean to solve the problems of cities. People are a pivotal actor in this process who also needs to be smart. For this, qualifications, education level, the quality of social interaction, plurality, and open-mindedness are essential criteria in the public life where local and national governments should encourage individuals to improve themselves for smart manners (Giffinger et al., 2007). Moreover, the economy is another factor governments and

residents should take into account because an investment is needed for the development.

CHAPTER 3

SMART CITY OF HAMBURG

3.1. Introduction

Today there are over a hundred Smart City projects in Europe and the world, where the scale and degree of technology utilisation differ from one to another. Subsequently to the theoretical background and illustrative examples in the previous chapter, this thesis analyses and criticises the City of Hamburg. This chapter examines the Smart City vision, projects and implementations in the Free and Hanseatic City of Hamburg associated with the discourses and agendas of various actors. It also asks the following questions: how does the City of Hamburg perceive Smart City vision; how smart is it; what technologies deployed in; what types of initiatives could be identified, and how has its digital-urban space been shaped; what agencies in Hamburg are promoting the smart city phenomenon?

Hamburg has a peculiar status in terms of the political system in the Federal Republic of Germany that it maintains noteworthy autonomies as a city-state due to its location and economic background dating back to the Middle Ages. Trade relations, networks and economical manners have always driven the urban development of Hamburg, where the city adopted modernist, utopian and futurist notions in the physical progress. Hamburg has a distinctive difference from other cities as a city-state where the local government have played a pioneering role while adopting technologic developments to the urban environment and everyday life and including its residents in the process. Another reason for the selection of this particular case is that Hamburg offers various smart implementations by different actors, namely big companies, universities, public and private institutions, non-governmental organisations, as well as communities.

Moreover, the city constitutes one of the most recent examples of contemporary approaches in urban design.

The chapter begins with a glance at the urban transformation of Hamburg. Later, it offers practices in housing and technical infrastructure policies, as well as public and private urban services with the social and governmental structures in order to describe what technologies the city has implemented with jurisdictional competencies of Hamburg. This section, moreover, embraces several methods to reflect the relations and the network of various urban actors, semi-structured in-depth interviews with experts from the municipality, private and individual initiatives working for the digital future of Hamburg, personal observations, as well as literature research and document analysis to obtain comprehensive perspectives in urban practices.

3.2. History

Hamburg is the second-largest city with 1.8 million inhabitants and 4.3 million in the metropolitan region and one of three city-states in North of the Federal Republic of Germany, consisting of seven administrative boroughs and 104 districts (Hamburg, n.d.). The special status of being the city-state grants Hamburg with numerous political and juridical rights, which the state policies operate as urban policies (Vogelpohl & Buchholz, 2017). Charlemagne's victory over the Saxons conceived a diocese in a castle called Hammaburg descended from a nearby village called Hamm in 831 by Emperor Ludwig der Fromme, which developed to be the merchant town of medieval Europe (Klessmann, 2002, p.18). Merchants, artisans and fishers began to dwell around the outskirts of the castle and three rivers of Hamburg, i.e. the Elbe, the Alster, and the Bille (Krieger, 2006, p. 12). According to Klessmann (2002, p. 23), the German King Otto I. authorised that religious and secular powers mutually governed the city of Hamburg.

Figure 3.1. Plan of Hamburg around 1900 (Krieger, 2006)

The ruling elites enlarged the land in 1188 by developing a new town in pursue of the economic benefits and constructing a new harbour on the Elbe replacing the former one in the Alster (Krieger, 2006, p. 21). The German Emperor succeeding granted the New Town with exclusive rights such as free commercial exchange and no tariffs for the local traders (Klessmann, 2002, p. 26). Later, the rulers expanded the scope of these exclusive rights from economic features to governance. Hamburg began administering itself with a city government comprised of the thirty most wealthy traders and artisans by 1215 and also consulted with the parliament of the citizenry in order to get the opinion of people (Krieger, 2002, p. 25). Hamburg, furthermore, had an economic network between not only merchants but also with Northern European towns - the Hanse (the Hanseatic League) including Lübeck, Amsterdam, Antwerp and London, which was founded in the 13th century (Klessmann, 2010, p.45).

Evidently, the city owed its prosperity to the port development and its activities as being the member of the precious Hanseatic League.

Later, Hamburg operated as a third-largest port and became the world's largest transatlantic shipping hub with the Hamburg-America Line (Stefanovics, 2016). However, several consecutive political and innovative events such as the Second World War, joining the European Union of Germany, the German reunification in 1990, industrialisation, and the discoveries in scientific and technologic fields, e.g. computers, the Internet, telecommunication industry and many more, led to depredation in the spatial and economic domains. For instance, the neglected and undesirable port industry with the growing technologies caused the Free and Hanseatic City of Hamburg to redevelop the port area as a new housing development, the HafenCity Hamburg, intending to restore the identity of Hamburg as a maritime city, project an innovative vision, arouse investments and stimulate property-led interests. The HafenCity Hamburg envisaged as a high-end waterfront urban renewal identified as one of the largest and most ambitious projects in Europe (Vogelpohl & Buchholz, 2017). The regeneration project predicted to increase Hamburg's surface and the housing stock by 40% in 20 years, to attract roughly three million guests annually, to create 20000 new employment opportunities in the service sector (Sepe, 2013); a public-private partnership company, HafenCity Hamburg GmbH, formed to accelerate the process and coordinate the development. The fundamental principles of the project denote to secure the quality of water, waterfronts and the environment as the existing urban fabric, to set mixed-use as a priority development strategy, to give a character with Hamburg's historical identity, a public access to inhabitants, and transparent and efficient decision process with public-private partnerships and public participation methods (Vogelpohl & Buchholz, 2017).

3.3. Smart City Discourse in Hamburg

Local and national governments invest large sums of capital in urban development projects with the aim of not only developing the urban environment and public services but also shaping the perceptions of the city towards the desired image and bringing investments (Zenker & Beckmann, 2013). The Senate of the Free and Hanseatic City of Hamburg, moreover, firmly pushed the city to adopt several aspiring visions such as Growing City, Smart City and Green City, and sustainable long-term development strategies to regain its position in the international arena and steer on smart growth both in terms of demographic and economic development.

However, apart from their number, who exactly were the users, and who are initiatives targeting? Would these people participate and debate anyway? Do smart initiatives of Hamburg pursue clear strategies for the economic development and regeneration of the city? What was the attitude towards business and economy in general?

The City of Hamburg delves into the digitalised realm insofar as their residents benefit from public services, including public participation and efficient city infrastructures. Nonetheless, the city conveys the impression of undefined decision-making processes, which utters participation as citizen engagement, cooperation and brainstorming. Senator Horch of Hamburg summarises the process and describe the role of the city in the public debate of digitalisation that "Hamburg is a city of an incubator for trends, where develops innovations and technologies for the future". He emphasises on the significant role of the city as a business location, for which Hamburg dwell into the path into a smart city because the city must face challenges of a growing population, including possible economic, environmental and social outcomes.

Hamburg is economically one of the most durable and most liveable cities in Europe, where technical innovations, the networking of economy and science as well as the compatibility of economy and ecology play a prominent role in the future development of the Hanseatic City. Whereas, the population in Hamburg increases as in the other

major world metropolises, which appears in an exclusive social responsibility for these metropolises. The strategies on smart, digital, networked, green notions improve resident's quality of life through intelligent, innovative infrastructures, eventuating to make mobility more efficient, conserve resources and reduce negative environmental consequences. Telecommunications, the Internet of Things, sensor and other smart technologies will continue to gain importance in the future.

The City of Hamburg and an American multinational technology corporation Cisco collaborated on a strategy for the city at the beginning of 2014 and concluded a Smart City Memorandum of Understanding (MoU) at the City Hall of the Hanseatic City, which was the follow-up of the Smart City Summit in 2013. Local government, research institutes, as well as local and international initiatives, came together to define the first Smart City programme. The MoU has anticipated the creation of pilot projects focusing on mobility, economy, energy, urban environment and public services, including the port and HafenCity urban development.

A large number of technology associates have consented to cooperate in the first pilot projects. The mayor Olaf Scholz concluded at the end of the summit that "The term Smart City can hide everything today... It is a continuation of what [The City of] Hamburg has always praised: the combination of technological and social progress... Different partners are currently laying the foundations for the Smart City of the future, for a city that uses technology to conserve resources and be closer to its citizens" (Department of Economy, Transport and Innovation, n.d.).

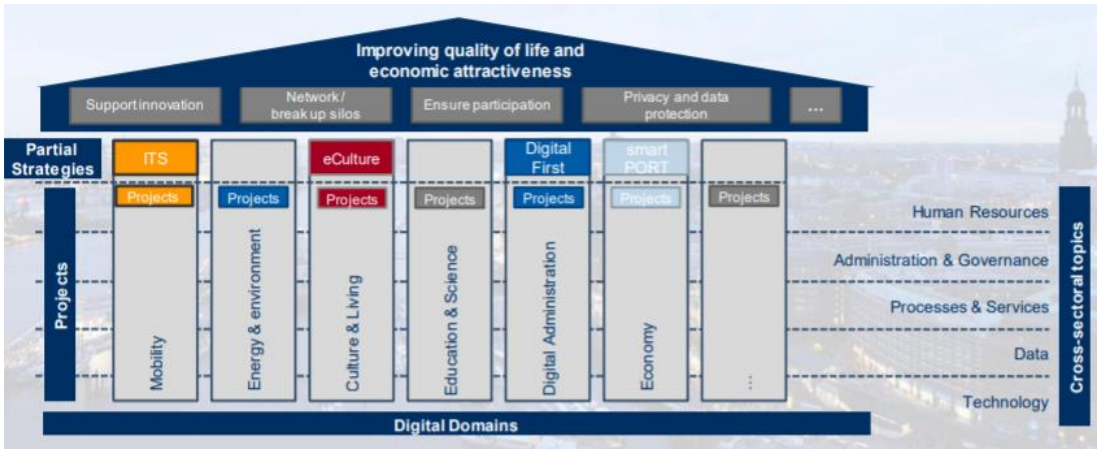

Figure 3.2. Digital Domains and Smart City Strategy of Hamburg (Jacob & Wieckmann, 2018)

The Smart City strategy approved by the Senate on January 2015 aims:

- to develop the city into a laboratory of digital modernity
- to digitise the city and public services
- to create a balance between centralised and decentralised projects and initiatives

where various stakeholders cooperate, e.g. administrations, technical experts, public authorities, companies, research and education institutes, as well as Hamburg residents (Jacob & Wieckmann, 2018). State Secretary Council, the Department for IT & Digitisation in Senate Chancellery (founded in 2018), the Digital City Co-Ordination Office (founded in 2015) and City Science Lab (founded in 2015) which is a joint venture between HafenCity University Hamburg & The Massachusetts Institute of Technology collaborate and work to establish integrative strategies and innovations supporting the local government and corporations for the future of Hamburg (Jacob & Wieckmann, 2018).

3.3.1. Smart City Actors

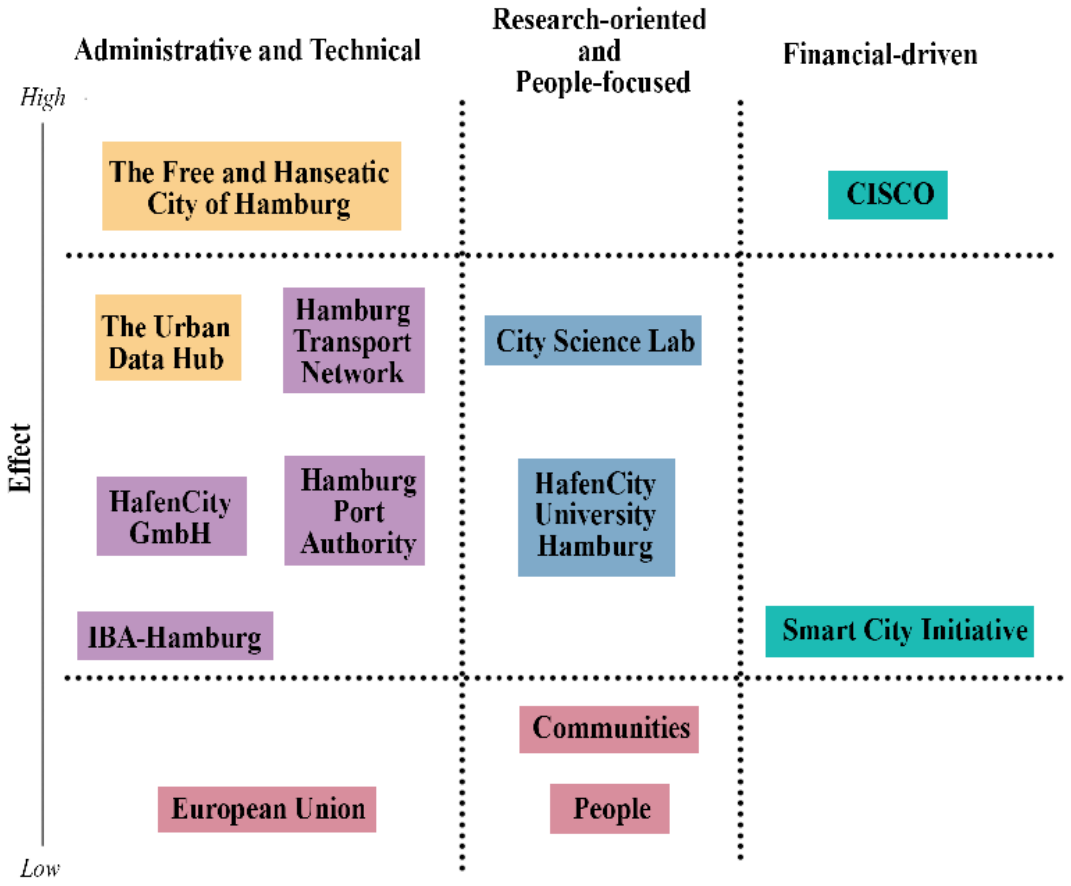

Figure 3.3. The Structure of Urban Data Platform and its Applications (Yılmaz, 2019)

As a second largest city of Germany, Hamburg involves several major financial and social actors, playing essential roles in the futurist vision of the city. Thus, the City of Hamburg was studied based on empirical research through conducting semi-structured in-depth interviews with different actors involved in various phases of Smart City projects in Hamburg, where the interview questions can be found in the appendix. The empirical data is analysed to describe the network of actors involved in smart city development and their roles. The Digital City Strategy has the involvement of multiple relevant and fundamental stakeholder groups, including Hamburg's citizens,

businesses, administrative departments and civil society **(**Interviewee-I). Each actor has a different focus with high-low impact levels on the on this development, namely administrative, technical, research-oriented, financial-driven, including people and communities (Figure 3.3).

3.3.2. Smart Implementations

As demonstrated in Chapter 2, the Smart City works with five functional areas: living, energy, mobility, services, and governance to improve the quality of life in the city and increase the economic attractiveness. The Senate Hamburg and other actors have established projects on each pillar; some includes a variety of areas as well as focusing on one sector.

Energy

Energy is one of the major concerns of current cities and the basis of modern urban life; thus, Hamburg works on several implementations in order to establish cost-efficient solutions for both the city and residents. The development of a district heating network operating at low temperatures in the Schleusengraben canal in the east of Hamburg ensures efficient and sustainable heat supply to the neighbourhoods. This type of district heating network enables the economical use of industrial waste heat and the long-term storage of heat in central ice storage. These improvements are possible with technologic innovations, which are laid under the smart strategy scheme of Hamburg.

Mobility

The Free and Hanseatic City of Hamburg implements around 60 projects in the area of mobility, which includes autonomous bus services, intelligent parking or site coordination. This is due to the Intelligent Transport Systems, which stands for the increasing digitisation and networking of vehicles with highlighting environmental and infrastructural aspects. In this way, urban transport as a whole can be made safer, more efficient and more environmentally friendly, and the comfort for citizens increased. The city develops serveral services and pilot projects for mobility:

- HVV Application
- Smart Parking
- Video and thermal cameras for traffic detection
- ProjectHEAT (Hamburg Electric Autonomous Transportation)

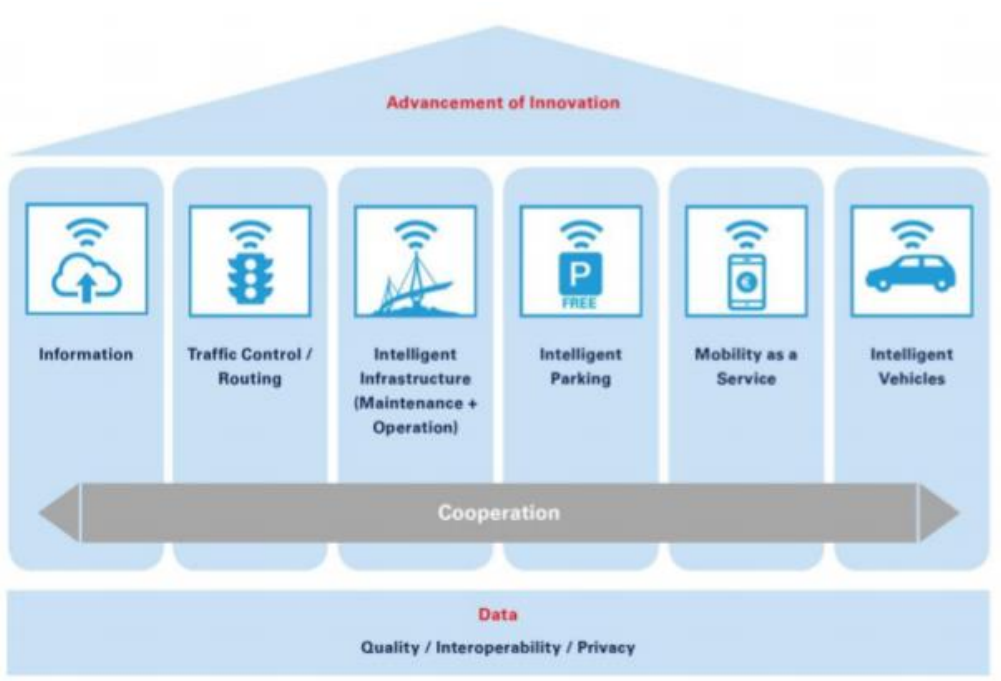

Figure 3.4. Hamburg's Digital Mobility Schemes (Jacob & Wieckmann, 2018).

The aims include:

- ¬ to create economic strength
- ¬ to protect nature
- ¬ to produce liveable and connected public spaces
- ¬ to secure and diverse mobility and public transport options
- ¬ to create real-time and forecast traffic data
- ¬ to establish smart services such as online parking detection, shared mobility services

Public Services

To ensure the sustainable goals of the city, the Senate established organisations such as the Hamburg Port Authority and IT bodies under the municipality and promoted educational projects such as Hamburg Open Online University and smartPORT as well as other public services which are illustrated in other pillars. Sustainability plays an essential role in the port of Hamburg is the proximity of the port areas to the city, and the sensitivity of the Elbe river ecosystem requires particular attention to sustainability issues in the development of the port. Hence, the Free and Hanseatic City of Hamburg founded Hamburg Port Authority to manage the port to promote energy management by coordinating all aspects of energy management, from energy efficiency and reduction of the carbon footprint of the port to waste management and sustainable development by encouraging the use of renewables sustainable energy resources within companies or community, to derive solutions for carbon management and to raise the profile of energy conservation (Merk & Hesse, 2012).

Governance

The digitalisation of public administration is another pier of the smart strategy for Hamburg. The Senate passed *the Online Access Act*, which requires all administrations to offer their services online by 2022 (Jacob & Wieckmann, 2018). This project assumes efficient service for citizens and companies. Moreover, additional program *the Digital First* helps public authorities to develop and deliver their services in a user-friendly way. For this reason, four guidelines set the direction: to communicate with companies and residents digitally, act proactively, reduce data entry and automate procedures. *Smarticipate* is another project to use Open Data for real-time feedback, proposal to evaluate immediately and to inform residents about the quality of the development proposal. In each of the three subject areas of the project, the citizens of the project area have the opportunity to participate in the individual projects and planning processes. Thus, the city can be developed cooperatively, taking into account the ideas of the citizens.

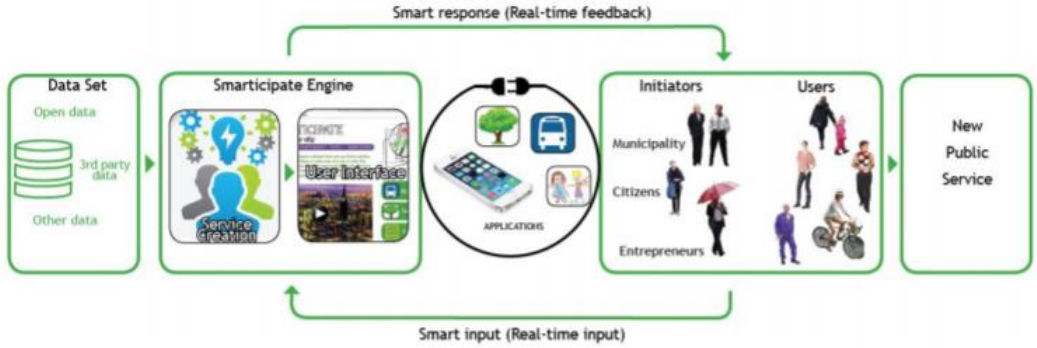

Figure 3.5. The Sytem of Smarticipate (Schubbe, 2017)

The State Agency for Geographic Information and Surveying and the HafenCity University Hamburg develop a joint competence centre for urban data management, the *Urban Data Hub Hamburg*. Its core objective is the linking of urban data from

areas such as transport, environment, social affairs or economics on an online accessible data platform, which enables an evaluation in real-time. Besides, the Hub identifies further development needs and develops innovative digital services for civil society, from business to science and administration. The Hub connects existing and future IT systems and services, not only the knowledge of each other but exchange data, and it uses interactive processes for logical and analytical analysis to prepare or assist in decisions. The responsibilities of this centre include data consultancy for public institutions and stakeholders in Hamburg, decision-making assistance, the development of advanced data governance for Hamburg by providing data platform and knowledge. The further goals of the centre include providing services such as city dashboards, a building permission procedure reflected in an online platform, as well as navigation for cyclists and several other sources for disposal of residents, visitors and investors.

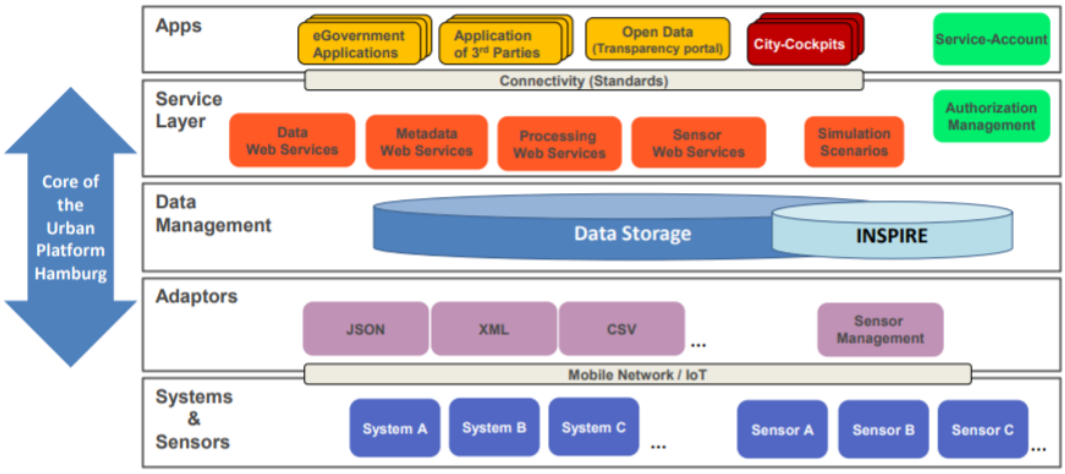

Figure 3.6. The Structure of Urban Data Platform and its Applications (Schubbe, 2017)

Living

Digital technologies and services provide sustainable and economical solutions for the living environment in different urban levels from a housing unit to the neighbourhood, district or the whole city. *mySMARTLife* is a project funded by the EU program Horizon 2020, in which Hamburg is to be pilot city next to Nantes and Helsinki. The goal is to develop a holistic Smart City model that can be transferred to other cities. The focus is on the elaboration of concepts for the areas: energy, mobility, digital communication and interaction with the citizens. An urban data platform described above enables transparent communication and provides information such as geodata or databases in the fields of energy, mobility and digital infrastructure for everyone in the city. As part of *mySMARTLife*, this platform will be supplemented by additional digital functions based on new requirements from the district of Bergedorf in Hamburg, which is selected as a pilot area to observe the necessities of the platform and give spatial manners. Additionally, traffic is one of the most significant causes of CO2 emissions in cities. The mySMARTLife project has set itself the goal of reducing these emissions through an exemplary expansion of electromobility. These include, for example, car-sharing concepts and the acquisition of electric buses for public transport.

To conclude, the future opportunities the city offers by the networking of people, processes, data and objects will not only bring cities and municipalities forward in their development but also offer residents more comfort and thereupon quality of life. The responsibility is to steer these developments in the right direction by appropriate framework conditions so that opportunities proceed, and challenges overcome. The prerequisite for promoting the transition to adopt smart solutions in a city is an appropriate climate for innovation and the close cooperation between industry, science, administration and people. In this regard, Hamburg creates corresponding structures and acts as an enabler. Moreover, the regular exchange with other cities and countries on a national and international level is relentlessly giving

new impulses and best practices. Paul Mikolajczyk, the speaker of the management of the beesmartcity company, rationalise the reason for Hamburg adopting the Smart City concept is "reacting to the external challenges with the Smart City, such as demographic change or growing population. The city presents new applicable approaches with its solutions in traffic systems and digital administration" (Schubbe, 2017). Additionally, Senator for Economic Affairs Frank Horch utters that Hamburg is an innovation metropolis, in which the city consistently continues on the smart path and prepares itself for the future (Schubbe, 2017).

Cities, furthermore, are currently in a competition as companies. "They are looking for ways to create jobs, increase growth and profitability, become more efficient and, above all, improve the quality of life of their citizens", says Michael Ganser, Senior Vice President of Cisco (Department of Economy, Transport and Innovation, n.d.). Thus, Hamburg is taking a step forward in this competition, furthering to become a city-brand with the concept of smartness. Besides, the first mayor of Hamburg sums the discussion up "we have to find out what we want in everyday discourse, then we can use the potential of technological progress for the good of the community". However, smart technologies deployed and the aims, strategies, projects make it clear that the understanding of Smart City idea of the City of Hamburg is distinct than what the literature proposes. Hamburg sees the potential of digital technologies and applies them for mainly economic benefits between the government and corporations who are going to invest in the city, which can be determined as Corporate Smart City ideology.

3.4. Smart View of Hamburg

Cities, to conclude, are in a competition like companies, seeking ways to create jobs, increase growth and profitability, becoming more efficient and, above all, improve the quality of life of their citizens (Interviewee-I). As an innovative metropolis (Interviewee-II), Hamburg envisions the Smart City as a strategy and potential of technological progress offered by the Internet of Everything for the good of the community, citizen comfort, life quality and to promote innovation (Interviewee-I). Data has a central place in this Smart City debate in each project or implementation in any city (Interviewee-II); preparing ourselves for the future offered by the networking of people, processes, data and objects. While the importance of data is emphasised, the precautions for IT security and data protection in Hamburg is lacking (Interviewee-VI). Transparency is a crucial frame for people and communities; nonetheless, transparent communication and information has set to be not for everyone. One of the interview partners questions the ownership of the data generated, which is actually the citizen's data. As an international company, CISCO has a different legal frame, and its motive seems to be solely financial profit (Interviewee-II). The problem appears to be two factors here, one from a technical standpoint that one company developing the urban infrastructure might be vulnerable to malware and cyber-attacks; on the other hand, the monopoly over the data and technological leverage in a city might not be beneficial for its citizens. Eventually, Smart City is for participation and increasing information channels of citizens or other inhabitants (Interviewee-IV). The prerequisite for improving the transition to the Smart City is an appropriate climate for innovation and the close cooperation between industry, science and administration. In this regard, Hamburg creates corresponding structures and acts as an enabler, creating strategies and instruments (Interviewee-III). The developed tools and applications should ultimately be open to all interested citizens, the public sector and those who want to adapt and improve (Interviewee-V). Conclusively, Hamburg ventures around the digital transformation for the well-being of citizens, while

touching to the topics of sustainability, ecology and greenness for future needs and problems of the city such as developing smart house projects in terms of energy efficiency, car sharing for effective mobility systems, using digital methods in the development and participation phases or solely informative tools for citizens' easy access (Interviewee-III). The lacking factors are the collaboration of various actors and top-down decision processes (Interviewee-VI), inadequate involvement of civil society and becoming the early phases of this transformation (Interviewee-II). A smart city is a mean for continuous adaption and better service provisions while putting every community in a safer journey of smarter and demand-oriented cities.

CHAPTER 4

CHALLENGES IN THE SMART CITY CONCEPT

This chapter tries to discuss the findings from existing literature, highlight the missing points in the Smart City concept while giving recommendations to improve it, as well as provide ideas and strategies for the case of Hamburg where digital infrastructure and practices knit the city, develop resource-efficient and sufficient infrastructures and provide fast, safe and cost-effective services for the interest of residents, visitors and others.

The dilemma in the Smart City discourse is that this vision is not going to solve every current or anticipated problem of cities. Smart strategies and implementations provide occasional solutions to the issues of human development; nevertheless, they do not get to the core of the problem. Jacobs (1961) outlines the reason behind this difficulty since the role of engineered solutions in cities is subordinate to individual and social issues in the sense that service provision and management provides the means to support socioeconomic life but does not determine it. In other words, the city is a complex system where technology, nature, institutions, relationships and especially human interaction take place. Therefore, we should not look at the vision of Smart City as a data hub going to eradicate famine and prevent the doomsday. It is only a concept for the urban realm; we are not reinventing the world; we learn and understand how technology is beneficial in cities and creating prosperous urban daily life for the people.

This section, furthermore, addresses several concerns in the Smart City discourse, namely the dichotomy in the literature about identification and definition of the concept, adoption of the term to business as a branding and obscure word, the agenda behind big corporations and governments, technical issues of digitalisation such as

fragmentation of standards, storage and analysis of the data generated and collected, privacy and security concerns of individuals and communities, incompetent decision-making process where local governments represent as public participation or civic engagement. In other words, the section reinforces the urban planners' role in the concept and reconfigure the definition

The main reason for the confusion around the scientific status of the Smart City research rests with the lack of intellectual exchange among those researching the interrelation among technology and the city. The tendency Smart City researchers have to be subjective and follow personal trajectories in isolation from other researchers, where the divisions generate struggles in the scientific community that communities have in finding any common ground between everyday life and the knowledge Smart City research produces disagreements in the ways of conceptualising and defining the paradigm, which emerges as one of the main terms of reference for telecommunication and digital-related urban innovations. This situation leaves smart-city research fragmented and divided along two main development paths and, in a position, whereby the future development of this new, promising, but divided area of research at risk (Mora, Bolici, & Deakin, 2017).

There are several challenges which can be summed into four categories, namely disputes in the decision-making and governance methods, ownership related issues such as privacy and security concerns, technical obstacles such as data storage issues and fragmentation of connected devices, and most importantly different ideologies and understanding for the Smart City vision such as the corporate vision.

4.1. Decision-making Processes

Technology and any invention encompass both the good and the ill; however, users or other key actors who decide what purpose they will use the tool for. Contrary to popular belief, Townsend (2013, p. 110) argues that the Internet will bring the

distributed age of innovation to central innovation. On the other hand, technology giants such as Cisco, IBM, Siemens make decisions about technology, industry and management without any input from the broader civic community and citizens; this is contradictory to how cities work and how they develop, from bottom-up (Townsend, 2013, p. 110). Design and operating costs seem challenging to design, implement and manage realistic Smart City strategies based on heterogeneity between devices, massive data collection and analysis (Silva, Khan and Khan, 2018). Townsend (2013, p. 111) represents the problem as a dilemma. The concept is not a solution for our urgent urban issues such as global warming, health, education, transportation, business. Eliminating one of these problems with one click is undoubtedly not realistic nor beneficial from a holistic perspective. Besides, the process takes time, including the right decisions and participation, and we can develop our future cities wisely (Townsend, 2013, p. 111). Moreover, if we want smart cities to have places of meaning, representation, politics, communication and experience, we should design them together with communities, not for themselves. This will be an essential step towards creating and running standard virtual and digital space formats that support diversity and participation, i.e. participation and transparency (Besselaar, Melis and Beckers, 1999, p.43).

4.2. Ownership, Privacy and Security Concerns

Ownership of physical materials and knowing who owns and operates digital cities is critical, suggesting that they can determine correlations with the type of property (Aurigi, 2005). Besides, the private sector has more impact on the Internet and especially on the Worldwide Network; however, this does not mean the implementation of the city of Orwellian “Big Brother” or the panopticon, a central system that controls our lives in the future (Aurigi, 2005). Increased concerns about the rise of surveillance in societies and acceptance of data policies are prominent issues due to the ability of individuals to follow up and monitor. This level of

monitoring is guided by an increasing control culture that seeks security, regularity and risk management (Kitchen, 2014).

4.3. Technical Problems

The digital aspect of the Smart City includes disconcerting problems, and there is no such thing. Townsend (2013, p. 258) argues that any system errors might have chain-reaction consequences, leading to an unclear situation who fixes or who administers it. However, the current implementations might create more resilient and democratic designs of the future. On the other hand, another problem is the foundation we try to build upon. Existing infrastructure, systems and decision-making and management procedures are far behind the innovations and theories (Townsend, 2013, p. 276). For instance, the computational issue of fragmentation of various connected devices may occur. The governments, policy-makers, experts should investigate if we plan to build smart cities. Moreover, unwittingly we forget that the virtual and digital has a physical body, a material flesh. The Internet is not only happening in the cyber world. It has devices, infrastructure, communication networks of wires and cables, where the data is flowing across these wires and stored in places. Thus, we need to design or plan the storage places for the digital face of our cities.

4.4. Corporate Vision

A city is a social and physical entity for people; On the other hand, it is also seen as a commodity, marketing area and branding place, which exists for the promotion and financial flows (Ward, 1998). The increasing competition between cities, attracting investors, companies, new citizens, qualified and talented workforce and tourists has exceptional value in business, as well as governance. Urban flagship projects, visions

and strategies are not only developed by the city, but they are promoted to attract local and international investors while strengthening the city brand (Zenker & Beckmann, 2013).

While the Internet has triggered global businesses, it also enables us to create productive information spaces for everyday life. Even though the economy has become global, daily life becomes more local (Ishida, 1999, p.7). For corporations such as IBM, Cisco Systems, and Siemens AG, the technological component is the crucial component to their conceptions of smart cities. Their approach has recently been critiqued by authors such as Adam Greenfield who argues in Against the Smart City (2013) that corporate-designed cities such as Songdo (Korea), Masdar City (UAE), or PlanIT Valley (Portugal) avoid actual knowledge about how cities function and represent "empty" spaces that disregard the value of complexity, unplanned scenarios, and the mixed uses of urban spaces. There are authors, however, who have shown that technology can be used in cities to empower citizens to adapt their techniques to their needs rather than to adjust their lives to technological exigencies (Albino, Berardi, & Dangelico, 2015).

The debate on the smart city has become more about technical architecture, where IBM says that smart city is nothing else, and then everything follows (Townsend, 2013, p. 248). This is an unreliable representation of how a city works disregarding the very central actor of the city, human.

CHAPTER 5

CONCLUSION

5.1. Smart City: Beyond the City Application

This collection of chapters establishes the claim that the rapid development of technology is advantageous for the urban environment, public services, as well as society and economy. Schuler (2001) and Grübler notice that the world is becoming increasingly urbanised and digitised, current problems forcing urban actors to take immediate and smart actions due to climate change, financial restructuring, online retail and entertainment and ageing population. Arnold Grübler marks that we are no longer able to proceed without technology, and it is clear that there is no turning back due to the unforeseen events we caused in society and the environment. On the other hand, there are technological changes that work in the right direction. At the same time, digital technologies are shortening the globe, connecting people and institutions with mass information every day (Schuler, 2001, p.71). Hence, the idea of the Smart City naturally becomes notable with smart technologies and connected infrastructures where we have quickly adopted in our everyday life. Therefore, this thesis researched the interrelation between technology, city and society and reflected possibilities for our shared future from the literature, examples and urbanistic perceptions. It describes predominant discussions about what we are currently facing, and problems and deficiencies in literature, as well as the purpose and methods in the first chapter. The second chapter tries to set a background knowledge for the under-recognised subject in the urban field by reviewing the literature with familiar concepts, historical periods in technology, critical technologies for the future urban domain, as well as giving state-of-the-art discussions in the Smart City concept and world examples. Later, empirical research of Hamburg case reflects the applications and implementations

how a real case scenario works by document analysis and interviews with experts. Finally, the discussion provides dichotomic views from business and academics, challenges and opportunities of the smart future, as well as recommendations to the Hamburg case.

Townsend (2013, p. 111) argues that we are incapable of building a smart city the way we built the Internet. However, it is clear from what we now know about the best ways to build cities and create new technologies that we need to start the search for ways to do it. Smart City is not a concept to cure every single urban problem. We need to look at the reasons, causes, effects, impacts why we are talking about new technologies in the city. Because a city is a social place rather than a merely physical entity, it affects the everyday life of inhabitants and change the society in many forms and set our future - whether we believe it or not.

As Greenfield (2013) and Townsend (2013) argue, without such critical interrogations, the smart cities of the future will likely reflect narrow corporate and state visions, rather than the desires of the broader society. Thus, urban actors from various background should collaborate and work on how this trend might be beneficial and influential for people and the environment. To the contrary of avoiding the forthcoming, city experts should evoke practices and viewpoints; the good and bad hail from the way it is chosen to use.

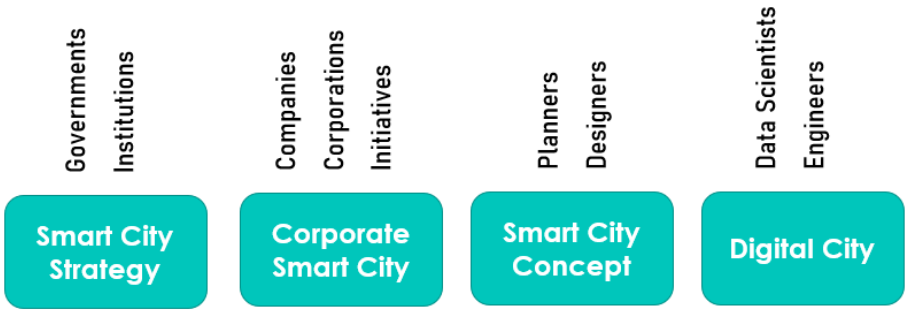

Figure 5.1. Different Perceptions of Smart City Actors (Yılmaz, 2019)

Hamburg, as well as other Smart Cities or contemporary cities, consists of multiple stakeholders. These can be grouped in several categories, for the purpose of this thesis and based on the analysis of the case and literature review, Smart City embodies four different perceptions. These are based on the motive and background of the actor. For instance, the case study shows that the City of Hamburg sees the digitalisation of the city infrastructure and services as a strategy than a holistic concept for the city (Interviewee – III). The problem with city strategies is that they are defined with the current issues, obstacles or opportunities of cities. Therefore, they can be modified, postponed or scrapped entirely. Nonetheless, the Smart City concept should not be framed as a current trend because it alters the whole structure of the city, services, as well as administrative procedures.

Another perception is the corporate ideology, the main driver of companies, large corporations, small bottom-up initiatives is the financial point because of the expectations of the investments. However, the city is not a mere economic entity, there are political, social and environmental concerns. The lack here is the regulations and policies of the local governments, or the low interest of inhabitants also play a crucial part in this situation (Interviewee – VI). Therefore, Smart City is understood as branding while improving the services for corporations. Thus, they develop for the sake of money, not the well-being of the inhabitants.

The literature reflects that bifurcated understanding of the concept, where it is dominated by data analysts, engineers or other technical fields (Cocchia, 2014). The responsibility of urban designers and planners is neither to embrace this new logic uncritically nor to hunker down in dogged resistance to it. It is, instead, to understand the opportunities that this new logic presents for reweaving the urban fabric, and thus to find new ways to pursue the ancient goals of equity, sustainability, and delight. (Mitchell, 1999, p. 6). The different of the planners and technical fields is the vision or the understanding of the built environment. Thus, data analysts emphasise the importance of the role of data and quantitative sources, while engineers will seek for efficient and effective solutions to decrease the cost of infrastructure. On the other hand, a city is a complex and self-organising entity where inhabitants, communities and their complex relations reside.

To conclude, this thesis reviews the literature on the interrelations between technological innovations and urban issues, focusing on the Smart City concept as a contemporary and futurist phenomenon. It also presents several examples from the world, but concentrate on the case of Hamburg, where it analyses the city by observation, interviews, and document reviews. There are two main questions this thesis answers: the different perceptions of Smart City actors and the reality of Hamburg's Smart City vision. It identifies four Smart City perception, i.e. Smart City strategy on the eye of the governments, Corporate Smart City for companies or other financial-driven organisations, a futurist and utopian Smart City Concept for planners and design-oriented fields, and Digital City perception for engineers, mechanical professions and data analysists. Therefore, there is no precise definition of the Smart City, it can be modified based on the motive or where to focus on the urban environment. On the other hand, it should be admitted that it is not a trend nor a determined solution for our urban problems. According to the interviews and literature and document reviews, Hamburg sees Smart City as an opportunity for increasing the well-being of inhabitants; it transforms the current infrastructure with digital solutions. The problem with Hamburg's vision is being disorganised. There are

numerous researches, projects and initiatives in the city; on the other hand, there is no platform for communication and knowledge sharing. Thus, it is clear that the need for a common platform to bring different actors such as research institutions, university representatives, local government, civic societies, non-governmental organisations, large and small companies, as well as inhabitants.

5.2. Further Studies

In consideration of reviews, analyses and discussions mentioned in previous chapters, innovative and futurist technologies, concepts, trends and paradigms produce prosperity as well as several drawbacks. Assessing contemporary discussions on futurist urbanism and technology-related issues is a speculative subject due to the very idea of accelerating innovations in the last century, in which the trend appears to boost in the near future. Hence, there is a need for resilient strategies and visions for the urban environment. The discourse and discussions on the Smart City concept seem to be far behind this notion. Therefore, this thesis attempted to elaborate on the concept, definition, actors and their relations in the urban domain. Although the projects and implementations in Hamburg have influenced the course with persuasive perceptions, the socio-spatial hypotheses behind the spatial fabrications need to be thoroughly elaborated concerning the fundamental arguments on the future structures. In this regard, the concepts and theories fall deficient in developing a reliable and practical futurist notion in urbanism related to the social, political, economic and spatial dynamics.

Further studies, thereupon, may apply this work to a set of empirical Smart City applications to understand the smartness between the empirical definition and the concrete realisation of cities. Moreover, the definition, especially regarding the scope and boundaries of the smart city, will be used to support the development of a smart city evaluation tool, both to assess the effectiveness of public policies and private

initiatives aiming to implement the concept, and to drive the strategic definition of goals to be reached and benefits for people to be delivered. Also, further research may examine the knowledge gained and discussed in this thesis from the perspective of different stakeholders involved in the Smart City implementation such as corporate idea and associate the concept with substantial urban paradigms such as sustainability and resilience. Ultimately, we should bear in mind that discussions on technology and city relation would not be prominent and striking without any ideas for changing the social structure and decision mechanisms.

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APPENDICES

A. Interview – I

Questions for Interviewee – I from the Hamburg Senate

I was tracing online articles when Hamburg was branded as Smart or Digital City and encountered “Projekte der Digitalen Stadt” on February 2018 article at hamburg.de website the office was formed on January 2018. Then, there are news articles naming it as a Smart City Project and Digital First. Later, the Office for IT and Digitalisation was formed in the Senate.

- Was there any other administrative body dealing with digitalisation in Hamburg before the office was formed? What is the role and focus of this office?
- What and when are the first smart (or digital) strategy or project in Hamburg in terms of Smart City concept?
- Did the European Union fund the project under the Horizon 2020 programme?
- What opportunities does it bring in decision-making processes in regard to digitalisation to have a unique feature of both municipality and city-state (Stadtstaat) (i.e. Freie und Hansestadt Hamburg) create? Or does it create confusion either on administrative or citizen’s sides?

On Hamburg website, there are several projects tackling to urban issues e.g., Digitale Verwaltung, Intelligente Verkehrssysteme, smartPORT, Hamburg Open Online University, Intelligente Bildungsnetze, Smarte Geodaten, Smart Energy, eCulture.

- How are their status currently? Are there any further projects?
- Who are the participating agencies and institutions in process? Is there any relation of Smart City of Hamburg with its European counterparts?
- What are the challenges the city faced during the process?

There are also various public and private small-sized projects, initiatives, and start-ups in Hamburg.

- Is there a communication-network platform or a strategy to create one?
- How do you support start-ups? Do you give them expertise or information?

There is a small but significant difference in the academics between Smart City and Digital City. In short, Smart City encompasses the improvement of socio-economic well-being of inhabitants as well the physical city and participatory governance aspects and sees digital technology is a tool for this transformation, whereas Digital City emphases on the hi-tech usage in the city.

- What is the strategy of the City of Hamburg: a solely technologically advanced city, a branding name or more than these?
- How would you describe the characteristics of Hamburg's Smart City vision?

Another issue widely discussed in academics is the infrastructure network built and rarely operated by technology companies such as Cisco, IBM, Siemens.

- How does Hamburg cope with data management in respect to personal data privacy as well as malware and cyber-attacks on the system?

Architects, urban planners and policy-makers have already been supporting their urban development proposals for improvement of service quality with conventional data sources from administrative documents, technical expert views, neighbourhood meetings or surveys.

- Are there any additional strategies to use Information and Telecommunication networks and the Internet of Things efficiently to increase opportunities for public service and management quality?
- Is it possible to implement data from Information and Telecommunication networks and the Internet of Things to the urban planning and design process?
- How do you see this new digital approach and data analysis from connected devices change the perception of different stakeholders dealing with a city?

- Do you foresee a digital city of Hamburg where it abandons conventional paper-works or does the city plan more diverse options to include different methods in the process?

B. Interview – II

Questions for Interviewee – II from the Urban Data Hub

I was tracing online articles for the process of Hamburg being branded as Smart or Digital City. The IT and Digitalisation office under the Senate was formed on January 2018. Then, Hamburg.de website has article of forming "Projekte der Digitalen Stadt" on February 2018, and later Smart City Project and Digital First, and Urban Data Hub.

- ¬ When was the Urban Data Hub created? What is its role, focus and strategies? What is the relation with Urban Data Platform?
- ¬ What services do you offer besides consulting, Geo-Portal, Digital Participation System (DIPAS)?
- ¬ Are there any cooperative public or private bodies? Or Is the UD-Hub working as a separate unit?
- ¬ What opportunities does it bring in decision-making processes in regard to digitalisation to have a unique feature of both municipality and city-state (Stadtstaat) (i.e. Freie und Hansestadt Hamburg) create? Or does it create confusion either on administrative or citizen's sides?

On Hamburg website, there are several projects tackling to urban issues e.g., Digitale Verwaltung, Intelligente Verkehrssysteme, smartPORT, Hamburg Open Online University, Intelligente Bildungsnetze, Smarte Geodaten, Smart Energy, eCulture.

- ¬ Do they get the data from your services: Urban Data Platform, GeoPortal? Or do they have their own data management systems?
- ¬ What are the challenges you observe during the data management process?
- ¬ Who updates the Geo-Portal and how is the process?
- ¬ Would you categorise a typology of data processed in Urban Data Hub: real-time data, user-generated data, socio-economic data or behavioural data? And, is the system Open Data?

Another issue widely discussed in academics is the infrastructure network built and rarely operated by technology companies such as Cisco, IBM, Siemens.

- How do you cope with data management in respect to personal data privacy as well as malware and cyber-attacks on the system?

DIPAS, digital participation system, is a project collaboratively created in Hamburg. And, it emphases on enhancing online participation process. Architects, urban planners and policy-makers have already been supporting their urban development proposals for improvement of service quality with conventional data sources from administrative documents, technical expert views, neighbourhood meetings or surveys.

- Are there any strategies to utilise data from the Information and Telecommunication networks and the Internet of Things efficiently to increase opportunities for public service and management quality?
- Is it possible to use data from Information and Telecommunication networks and the Internet of Things to the urban planning and design process?
- How do you see this new digital approach and data analysis from connected devices change the perception of different stakeholders dealing with a city?
- Do you foresee a digital city of Hamburg where it abandons conventional paper-works or does the city plan more diverse options to include different methods in the process?

There is a small but significant difference in the academics between Smart City and Digital City. In short, Smart City encompasses the improvement of socio-economic well-being of inhabitants as well the physical city and participatory governance aspects and sees digital technology is a tool for this transformation, whereas Digital City emphases on the hi-tech usage in the city.

- How do you or Urban Data Hub see Smart City Hamburg: a solely technologically advanced city, a branding name or more than these?

C. Interview – III

Questions for Interviewee – III from the HafenCity Hamburg GmbH

I was tracing online articles for the process of Hamburg being branded as Smart or Digital City. The IT and Digitalisation office under the Senate was formed on January 2018. Then, Hamburg.de website has article of forming "Projekte der Digitalen Stadt" on February 2018, and later Smart City Project and Digital First, and Urban Data Hub. Beside to all, HafenCity development has announced on 1997.

- ¬ When did the HafenCity GmbH founded? Who administrate HafenCity quarter in the Hamburg-Mitte borough?
- ¬ Are there any administrative body dealing with digitalisation in HafenCity GmbH? What is the role and focus of this office?

On Hamburg website, there are several projects tackling to urban issues e.g., Digitale Verwaltung, Intelligente Verkehrssysteme, smartPORT, Hamburg Open Online University, Intelligente Bildungsnetze, Smarte Geodaten, Smart Energy, eCulture.

- ¬ What additional smart developments HafenCity quarter has: Smart mobility, Smart Building Solution, Smart Port?
- ¬ What is your opinion about Hamburg having a unique feature of both municipality and city-state (Stadtstaat) (i.e. Freie und Hansestadt Hamburg); does it create opportunities or challenges in decision-making processes regarding digitalisation of the city?

There are also various public and private small-sized projects, initiatives, and start-ups in Hamburg.

- ¬ Is there a communication-network platform or a strategy to create one in Hamburg?
- ¬ How do you support start-ups? Do you give them expertise or information? What are the challenges did you encounter?

There is a small but significant difference in the academics between Smart City and Digital City. In short, Smart City encompasses the improvement of socio-economic well-being of inhabitants as well the physical city and participatory governance aspects and sees digital technology is a tool for this transformation, whereas Digital City emphases on the hi-tech usage in the city.

- Would you agree that we need smart solutions in our cities for sustainability, better and efficient services with high-technological infrastructure?
- What is the strategy of the City of Hamburg: a solely technologically advanced city, a branding name or more than these?
- How would you describe the characteristics of Hamburg's Smart City vision? Does it differ in HafenCity quarter?

Another issue widely discussed in academics is the infrastructure network built and rarely operated by technology companies such as Cisco, IBM, Siemens.

- How do you cope with data management in respect to personal data privacy as well as malware and cyber-attacks on the system?
- Does HafenCity GmbH have personal data collection and management platform, or do you use Geo-Data or other sources of Urban Data Hub?
- Do you have any service to enhance public participation? What and how?

Architects, urban planners and policy-makers have already been supporting their urban development proposals for improvement of service quality with conventional data sources from administrative documents, technical expert views, neighbourhood meetings or surveys.

- Are there any additional strategies to use Information and Telecommunication networks and the Internet of Things efficiently to increase opportunities for public service and management quality?
- Is it possible to implement data from Information and Telecommunication networks and the Internet of Things to the urban planning and design process?
- How do you see this new digital approach and data analysis from connected devices change the perception of different stakeholders dealing with a city?

- Do you foresee a digital city of Hamburg where it abandons conventional paper-works or does the city plan more diverse options to include different methods in the process?

D. Interviews – IV & V

Questions for Interviewees from City Science Lab

City Science Lab is working in HafenCity University with cooperation to MIT.

- When did City Science Lab created? What is its role, focus and strategies? Are there any other cooperative public or private bodies?
- What services do you offer and to whom? What are the on-going and finalised digital projects? Can you describe them briefly?
- What opportunities does it bring in decision-making processes in regard to digitalisation to have a unique feature of both municipality and city-state (Stadtstaat) (i.e. Freie und Hansestadt Hamburg) create? Or does it create confusion either on administrative or citizen's sides?
- What are the challenges you observe during the data management process?
- Would you categorise a typology of data processed: real-time data, user-generated data, socio-economic data or behavioural data? And, is the system Open Data?

Another issue widely discussed in academics is the infrastructure network built and rarely operated by technology companies such as Cisco, IBM, Siemens.

- How do you cope with data management in respect to personal data privacy as well as malware and cyber-attacks on the system?

DIPAS, digital participation system, is a project collaboratively created in Hamburg. And, it emphases on enhancing online participation process. Architects, urban planners and policy-makers have already been supporting their urban development proposals for improvement of service quality with conventional data sources from administrative documents, technical expert views, neighbourhood meetings or surveys.

- Are there any strategies to utilise data from the Information and Telecommunication networks and the Internet of Things efficiently to increase opportunities for public service and management quality?
- Is it possible to use data from Information and Telecommunication networks and the Internet of Things to the urban planning and design process?
- How do you see this new digital approach and data analysis from connected devices change the perception of different stakeholders dealing with a city?
- Do you foresee a digital city of Hamburg where it abandons conventional paper-works or does the city plan more diverse options to include different methods in the process?

There is a small but significant difference in the academics between Smart City and Digital City. In short, Smart City encompasses the improvement of socio-economic well-being of inhabitants as well the physical city and participatory governance aspects and sees digital technology is a tool for this transformation, whereas Digital City emphases on the hi-tech usage in the city.

- How do you see Smart City Hamburg: a solely technologically advanced city, a branding name or more than these?

E. Interview – V

Questions for Interviewee V from the Smart City Hamburg Initiative

Introduction

- Would you like to begin by describing what the Smart City Hamburg initiative is, your role, and how did it start?
- Were you alone in the process of starting this initiative or did you get any support from local authorities such as district municipalities, the city of Hamburg?
- Did the involvement of the Hamburg Transport Association change the focus of an initiative to only digital transport solutions or is the project also thinking over other urban fields such as smart-connected devices, virtual platforms, big data & personal data security, smart grid, e-governance, and more?
- So, who are the members or participants of these meetings & workshops? Are the authorities, business people, architects, planners and maybe regular citizens?

Opinion about Smart City

- What would you think if I say that Smart City is a solely technologically advanced city, would you agree? Do you think it is mostly used as a branding name or more than these?
- How would you describe the Smart City concept? Also, what are the characteristics of Smart City?

Data Issues & Analysing Process

- What is your opinion about the data management: big data, personal data privacy, data analysis, malware and cyber-attacks to the infrastructure networks?

- Also, another problem widely discussed in academia is Smart Cities creates monopoly under big corporations such as CISCO in Hamburg or IBM, Siemens, and more?
- Urban actors have already been supporting their city development proposals or improvement of service quality with conventional data sources from administrative documents, technical expert views, neighbourhood meetings or interviews. How do you see this new digital approach and data analysis from connected devices change the perception of different stakeholders dealing with a city such as local governments, urban planners, and businesses?

Governance

- How would you interpret the role of government in the Smart City?
- There is also a participation subject in this debate which ICT and IoT are increasing the opportunities. What is your opinion about inhabitant participation? Do not you think it excludes non-digital users such as older people, people who refuse to obtain smart devices, children, or even low-income citizens?
- Moreover, another aspect is the non-citizens such as refugees, migrants and tourists, expats. How will they be included in the decision process? Because if we use, for example, mobile phone data or any digital online platform, data analysists cannot distinguish.
- Do you see - if there is - any positive and negative sides of the Smart City of Hamburg than other European counterparts? What should be the issues for improvement here?
- So, do you have any further plans for Smart City Hamburg initiative?