



universität
wien

MASTERARBEIT / MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

„Digitalisation and Modern Urban Development. A Case Study of Smart City Vienna.“

verfasst von / submitted by

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angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of

Master of Arts (MA)

Wien, 2023 / Vienna, 2023

Studienkennzahl lt. Studienblatt /
degree programme code as it appears on
the student record sheet:

UA 066 905

Studienrichtung lt. Studienblatt /
degree programme as it appears on
the student record sheet:

Masterstudium Soziologie

Betreut von / Supervisor:

Univ.-Prof. Yuri Albert Kyrill Kazepov, PhD

ABSTRACT

The intersection of human and technological progress has catalyzed a transformative era in societal dynamics, with digital technology playing a pivotal role in shaping dimensions of modern cities. The emergence of the Smart City concept exemplifies this integration. However, this paradigm shift brings forth multifaceted challenges in social inclusion, democratic participation and surveillance. Through an exploration of Urban Theorie, Smart City concept, Digitalisation theory, Science and Technology Studies and Technology Acceptance theories accompanied by a case study and content analysis of Vienna, this thesis contends that the integration of digital technologies is a nuanced process influenced by technological, organizational, institutional, and social factors. By emphasizing relevant dimensions of technology integration and outlining correlated challenges, this thesis provides valuable insights and research directions for future empirical studies. The research findings highlight both the complexities and opportunities associated with digital technology adoption in smart cities.

Das Zusammentreffen von menschlichem und technologischem Fortschritt hat eine transformative Ära in gesellschaftlichen Dynamiken eingeleitet, in denen die digitale Technologie eine zentrale Rolle bei der Gestaltung der Dimensionen moderner Städte spielt. Die Entstehung des Smart-City-Konzepts veranschaulicht diese Integration. Dieser Paradigmenwechsel bringt jedoch vielfältige Herausforderungen in Bezug auf soziale Integration, demokratische Beteiligung und Überwachung mit sich. Durch eine Untersuchung der Urban Theorie, des Smart City-Konzepts, der Digitalisierungstheorie, der Science and Technology Studies und der Theorien zur Technologieakzeptanz, begleitet von einer Fallstudie und einer Inhaltsanalyse von Wien, wird in dieser Arbeit behauptet, dass die Integration digitaler Technologien ein nuancierter Prozess ist, der von technologischen, organisatorischen, institutionellen und sozialen Faktoren beeinflusst wird. Durch die Hervorhebung relevanter Dimensionen der Technologieintegration und die Darstellung der damit verbundenen Herausforderungen liefert diese Arbeit wertvolle Erkenntnisse und Forschungsrichtungen für zukünftige empirische Studien. Die Forschungsergebnisse zeigen sowohl die Komplexität als auch die Herausforderungen auf, die mit der Einführung digitaler Technologien in Smart Cities einhergehen.

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1. Introduction

The history of human development has always been linked to technological development. It has brought various changes to our everyday lives and laid the foundation for snowballing shifts in our society. Its consequences cannot be summarized in a simple sentence; however, the goal of technology is to improve and enhance social practices: make them affordable, equal, and sustainable; increase efficiency; automate various processes; and reduce risks - overall to accelerate progress. Societal shifts caused by technology can be observed predominantly in cities. From ancient times, cities provided a “neverending” playground for planners and scientists to embody their ideas. According to the United Nations (2018), more than half of the world’s population lives in urban areas and this proportion is expected to increase to 68% by 2050.

When it comes to acceleration of progress, however, digital technology is an undoubted leader here. Globalization has altered our understanding of social space and time (Schaeffer, 2003). The Internet, as one of the key technologies here, has blurred long-time established borders and created a new space where information became a decisive factor. The opportunity to share information throughout our planet has significantly changed established foundations. In 2002, Manuel Castells highlighted this historical transformation as a network society. The network society is characterized by globalization and digitalization of information, the increasing role of urban centers - network hubs, and redistribution of power (Castells, 2002). Urban Sociology shows how cities became the main actors in global relationships, transforming into Global and World cities, in which commercial and cultural practices from once vastly different parts of the world all fuse within one place (Harding & Blokland, 2014, ch. 3; Sassen, 2005). Such cities in the information age were in need of new theories capable of grasping countless changes (Castells, 2002; Harding & Blokland, 2014). Scientists also needed a system that would allow them to compare and conceptualize urban changes. One of the first attempts to establish such a model was performed by Rudolf Giffinger and his colleagues in 2007, who used the term ‘Smart City.’ The Smart City model was meant to

provide indices measuring six core dimensions: economy, people, governance, mobility, environment, and living (Giffinger et al., 2007). Most cities, such as Barcelona, Vienna, Singapore, New York, Amsterdam, Bhopal, Taipei, and many more, have published their smart city strategies. Nowadays “Smart” has become a buzzword accompanying any new practice, but mostly technology: Smart Phone, Smart Watch, Smart Security, Smart Car, Smart City etc. Despite not having a general definition, a Smart City is a field that shows how technology is integrated in all dimensions of the city and even goes beyond it.

Digital technology has become a key tool for determining the development of modern cities. It can be divided into three core dimensions. 1) Internet of Things (IoT), which is a network of physical devices, such as scanners, sensors, and cameras, that collect and exchange data over the Internet. IoT solutions can help monitor, manage, and most importantly, predict various activities of the city. 2) Artificial Intelligence (AI): is an ability of machines or software to imitate human intelligence and adapt to changes occurring in the process. AI can help analyze and optimize the data collected by IoT devices, suggest strategies, and become a full-fledged actor in decision-making. 3) Cloud Computing Services: These provide computer-related resources, including servers, databases, storage, software, etc., through the Internet. The utilization of cloud-computing services can facilitate the storage and processing of enormous amounts of data produced by cities. In 2014, Barcelona launched a project called Sentilo, which installed more than 12,000 sensors across the city to monitor various aspects of urban life such as traffic, noise, air quality, and waste management. In Oslo, Norway, the city has installed intelligent sensors on streetlights to reduce energy consumption and maintenance costs. The sensors can adjust the brightness of the lights according to weather, traffic, and time of day. In New York, USA, the city created a platform called OneNYC 2050, which integrates data from various sources to monitor and improve the city’s performance on various indicators such as health, education, environment, and equity. The platform also allows citizens to access information and services online. In Singapore, the city has developed a system called Virtual Singapore, which is a 3D digital model of the city that simulates various scenarios and outcomes. The system can help planners, researchers, and policymakers to test and optimize solutions for urban challenges, such as traffic, flooding, and energy. In Amsterdam, the

Netherlands, the city launched a project called City-zen, which aimed to create a smart energy grid that connects renewable energy sources, storage devices, and smart meters. The project also involves citizens and communities in co-creating and testing innovative solutions for energy efficiency and sustainability. In Vienna, Austria, the city has a project called “Aspern Smart City Research,” which aims to test and develop smart energy solutions in a new urban district called Aspern. The project uses smart meters, grids, buildings, and appliances to optimize energy consumption and production.

The rise of the smart city concept has sparked a wave of innovation and experimentation in urban planning and design as cities seek to leverage the potential of digital technology to address their pressing challenges. However, the adoption of digital technologies in smart cities is not a straightforward process as it involves multiple factors, challenges, and stakeholders. The major challenge faced by local governments and institutions is the question of how to successfully implement and control such technologies. There is also a lack of comprehensive and systematic understanding of how digital technologies are adopted in smart cities, the drivers and barriers to adoption, and the impacts and implications of adoption for urban governance and development.

As will be shown later, the importance of co-creation in urban planning and governance is one element emphasized by most Smart City theories and plans. Co-creation refers to the active participation of citizens, residents, and city guests. Digital technology has provided a unique opportunity to involve the majority of people in the decision-making process. However, the most common approach is indirect. It is based on gathering information that people share in digital spaces and does not require the deliberate intent of people to cooperate. This presents a sequence of potential risks and challenges. This method is widely misused by social media platforms and big IT companies, which is discussed more precisely in the next paragraph. The failed implementation of digital technologies can lead to contrary results, which is why it is very important to consider all social aspects. Sociological research can provide vital information on how potential risks can be avoided or addressed.

The aforementioned network societies are mostly associated with digital transformation, such as the Internet, mobile applications, web platforms, trackers, and beacons.

Developing this concept further, José van Dijck et al. (2018) describes the modern world as a platform society that emphasizes the role of digital platforms and their hegemony over information. Recently, a major power diffusion caused by digitalization was theorized by Zuboff (2019), who described it as Surveillance Capitalism. This concept explains how big IT companies exploit their services and algorithms to control and predict human behavior. This caused significant issues in trust, not only in the governmental structures that are supposed to control it, but also in the technology itself. Although digital technology brings great opportunities, it cannot solve all problems by itself. It requires the collaborative work of those who develop, legitimize, implement, govern, and use it. The issue of trust can prevent people from using beneficial technologies; unsuccessful implementation practices by the government can reduce people's trust even further. Newly emerged technologies, such as blockchain, are trying to address the question of trust by developing "trustless technology." Contrary to expectations, it still has major limitations such as power centralization, limited availability, and dependence on third parties (de Filippi, 2019).

This thesis argues that the adoption of digital technologies in smart cities is influenced by a complex interplay of technological, organizational, institutional, and social factors and that adoption has significant implications for urban governance, such as enhancing transparency, accountability, participation, awareness, and efficiency. The significance of this thesis lies in its contribution to the ongoing debate on the adoption of digital technologies in smart cities and its implications for urban governance. The adoption of digital technologies in cities is a fast-growing trend that promises to revolutionize the way we live, work, and interact with the environment. However, this trend is not without its challenges and risks. The rapid pace of technological innovation, combined with the complexity of urban systems and the diversity of stakeholders involved, has created a complex web of issues that must be addressed to realize the full potential of digital technologies in smart cities. This thesis seeks to address some of these issues by providing a comprehensive analysis of the factors influencing the adoption of digital technologies in smart cities and their implications for urban governance. By doing so, it will contribute to the development of a more nuanced understanding of the opportunities and challenges associated with the adoption of digital technologies in smart cities and

will provide insights into how urban governance can be strengthened to ensure that the benefits of these technologies are shared equally and sustainably.

The main ideas and problem statements are introduced in this chapter. Chapter 2 provides a comprehensive overview of current research on smart cities. The chapter will begin by discussing the definition and evolution of the smart city concept, highlighting the different interpretations and perspectives in the literature. The chapter also critically reviews existing empirical studies on smart cities, identifying the gaps, limitations, and challenges of the research. Chapter 3 suggests a theoretical framework for analyzing the smart city phenomenon. This chapter draws on literature from urban studies, Science and Technology Studies (STS), media research, and technology acceptance theories to construct a conceptual framework that captures the complex interactions between technology, society, and politics in the smart city context. Section 4 presents the research question, design, and methodology of the study. This chapter will describe the case study approach adopted for the research, which will focus on Vienna as a long-term competitor in the smart city arena. Data collection methods, including document analysis and interviews, are also discussed. Chapter 5 provides an in-depth analysis of the Viennas Smart City Plan. The chapter critically examines the digital technologies deployed in the project and their intended and unintended effects on urban governance, citizenship, and democracy. Experts from the field will provide a deeper understanding of the challenges of adopting digital technology in SC strategies. Chapter 6 presents the research findings, including the main issues and opportunities. The last chapter provides a conclusion to the thesis, summarizing the main findings, contributions, and limitations of the research. The chapter will also discuss the broader implications of the research on smart city discourse and practice, and suggest policy recommendations for more socially and politically sustainable smart city development.

2. Literature Review and State of Research

As a smart city is a diverse concept that covers all processes happening in the city and even goes beyond it, this chapter presents various aspects of the SC paradigm. First, the historical aspect of the concept is presented, followed by the state of the research. Next, the critical perspective and limitations of smart cities are discussed. The emphasis of this thesis will be given to digital technologies and the corresponding debates about trust and privacy.

The concept of Smart Cities has gained popularity over the last 15 years. However, the idea of a technology-driven city appeared earlier. A progenitor of modern smart city was Los Angeles which introduced the first urban big data project: “A Cluster Analysis of Los Angeles” in 1974 (Vallianatos, 2015). The second step took 20 years, while the third took twice as little; after 2008, the growth of the paradigm gained recognition all over the world. The table below illustrates the key milestones in smart city development, including individual cities and global organizations.

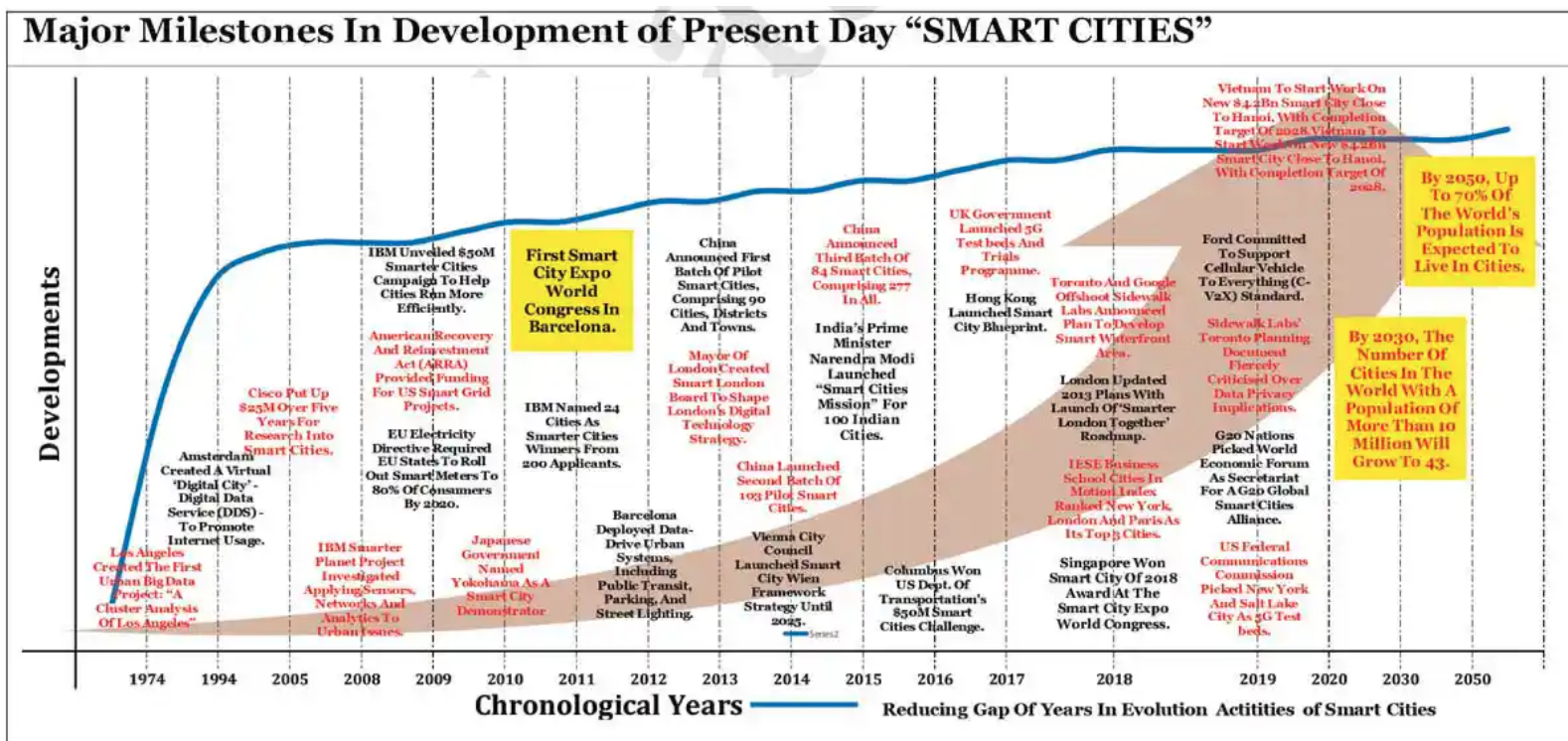


Figure 1: Major milestones in the development of present day "Smart Cities". Source: Khare, 2022.

The term itself also underwent several changes over the years: digital city, intelligent city, and future city. Earlier iterations emphasized the role of technological intervention in the decision-making process and urban planning (Montes, 2020). However, one of the key challenges in the study of smart cities is defining the term itself. The earliest studies proposed various definitions reflecting different perspectives on what constitutes a smart city. Giffinger et al. (2007) define a smart city as one that uses information and communication technologies (ICTs) to enhance the quality of life, efficiency of urban services, and competitiveness. Hollands (2008) suggested that smart cities leverage technology to create sustainable and livable environments. Batty et al. (2012) emphasize the importance of real-time data and analytics in smart city development. Technological innovations as well as governance, social capital, urban planning, environment, and economic aspects have been recognized as key challenges for a successful smart city (Cocchia, 2014). Even though the particular elements could be different depending on the city or study, the common elements of a smart city are Information and Communication Technologies, Internet of Things, cyber physical

systems (CPS), sustainable development practices, and quality of life (Ependi et al., 2022; Montes, 2020; Cocchia, 2014; Manville et al., 2014; Harrison et al., 2010). Overall, the literature on smart cities highlights the potential of technology and data to improve urban life while also emphasizing the need for citizen engagement and democratic decision-making in smart city planning and governance. The importance of sustainability has probably become the most discussed topic in current political and scientific debates. On October 21, 2015, the United Nations presented a paper with a title: “Transforming our world: the 2030 Agenda for Sustainable Development”. It is a 15 year recommendation plan on how countries and cities should enhance sustainability practices in various ways. The sustainability goals of the agenda were followed by many cities in their ‘smart city frameworks,’ as will be shown later as an example of Vienna.

Sociology is an empirical discipline; however, research requires a theoretical background (Joas and Knöbl, 2009). Theory and empirical research are in a constant cycle where first generates concepts, questions and hypotheses and second provides tools to investigate them and data to provoke new ideas. Extensive smart city research began with the study by Giffenger and colleagues in 2007. The goal of the researchers was to define and operationalize a smart city. “Cities in Europe face the challenge of combining competitiveness and sustainable urban development simultaneously. This challenge is likely to have an impact on issues of Urban Quality such as housing, economy, culture, social and environmental conditions changing a city's profile and urban quality in its composition of factors and characteristics.” (Giffenger et al., p. 5, 2007) The goal of the research was to understand how medium-sized cities in Europe develop under the global competition by structuring a city ranking model. The reason for choosing the medium sized cities was that they: “had to cope with competition of the larger metropolises on corresponding issues” (ibid), their capabilities, however, are not at the same level. That forced medium sized cities to “identify their strengths and chances for positioning and ensure and extend comparative advantages in certain key resources against other cities of the same level” (ibid). Literature Reviews has shown that most empirical studies were published before the COVID-19 pandemic, after which the majority of the papers mostly engaged with the theoretical constitution of a smart city. In summary, the empirical research aims to fill the dimensions of smart cities defined in theoretical papers with indexes and operationalizing various city activities. It

is important to mention here that operationalization to the full extent happens through the use and implementation of digital technology, both for data collection (sensors, beacons, trackers, etc.) and data interpretations (AI, statistical software, prediction models, etc.). The first stage of smart city research mainly focused on establishing dimensions and indexes to make a common model that would be applicable to any city, thus making them comparable. The majority of researchers have identified six key characteristics of a smart city: Governance, Economy, Mobility, Environment, People, Living (Manville et al., 2014). Later the concept was expanded to further dimensions such as: infrastructure, technology, security, water and waste, and agriculture (Wahab et al. 2020). The new dimensions had to fill gaps, mainly in the problematic area of sustainability. The latest systematic literature review revealed a new approach for smart city assessment. Instead of multiple dimensions, later strategies consider challenges that emerge through the process and emphasize only service delivery (output) while considering living impact and attention to smart city achievement standards outside (Ependi et al., 2022). As this study suggests, the balanced redistribution of indicators remains an issue for empirical assessments of a smart city (ibid., p.1095).

A review of the literature reveals two main characteristics of a smart city. First, state-of-the-art technology emphasizes the physical environment and contributes to the improvement of infrastructure and services (Korninos, 2002; Giffinger et al. 2007; Deakin & Al Waer, 2011; Nam & Pardo, 2011; Albino et al., 2015; Anthopoulos, 2017). Second, it represents an intangible social sphere, offering various interaction opportunities with city inhabitants (Townsend, 2013; de Lange & de Waal, 2013; Gretzel et al., 2015; Bibri & Krogstie, 2017). In order to achieve smart city goals both should be taken into consideration and addressed accordingly. However, this represents the biggest gap in current research. On the one hand the concepts give a priority to technology intervention and making decisions based on gathered results. On the other hand, they simultaneously promote an inclusive and sustainable society that should involve the active participation of citizens and expect highly qualified and skilled people as early adopters of the previously mentioned technology (Chen, 2019; Zhao et al., 2021; Mora et al., 2023). Recent publications see solutions in artificial intelligence and blockchain governance, which should enhance transparency and inclusiveness for all

potential social groups (Singh et al., 2022; Herath & Mitta, 2022). However, both are in the development stage and still have a long way to go (de Filippi et al., 2019).

A large variety of concepts makes the definition of smartness impossible, thus weakening its feasibility. The Smart City paradigm has also been critically studied, further exploring gaps in theory. Historically, the foundation of an intelligent and later smart city was boulded to ICTs and IoT. Investigating different dimensions, it has become clear that technology does not always play a decisive role in decision-making and is sometimes not required (Greenfield, 2013; Kitchin, 2014; Hollands, 2015; Han and Hawken, 2018). Another critical aspect of the smart paradigm is that it undermines its core principles of citizen engagement and participation. When transitioning from theoretical discussions to real-world cases, numerous authors have raised doubts about the concept's ability to achieve social inclusiveness and democratic participation (Townsend, 2013; Prado et al., 2016; Cardullo & Kitchin, 2019; Streitz & Riedmann-Streitz, 2022). Moreover, the neoliberal logic and surveillance nature of smart cities have the potential to exacerbate urban challenges such as exclusion, instead of addressing them (Graham & Marvin, 2016; Elwood & Leszczynski, 2018). Despite recent efforts to align with sustainable development practices, the resource-intensive nature of smart city logic often takes precedence over sustainability, representing a significant limitation (Caragliu et al., 2011; Neirotti et al., 2014; De Jong et al., 2015; Alawadhi & Al-Mutawa, 2017).

Nevertheless, one of the primary reasons for the popularity of smart cities lies in their potential to enhance efficiency and resource management. By deploying advanced sensors, real-time data analytics, and interconnected systems, smart cities can optimize the utilization of resources such as energy, water, transportation, and waste management. This efficiency translates into cost savings, reduced environmental impacts, and improved services for citizens. The adoption of digital technologies in smart cities has significant implications for urban governance (Akkaya et al., 2010; Ciara et al., 2016; Abdulkareem & Mohd, 2022). Technology can enable greater transparency, accountability, and citizen participation in decision-making processes as well as improve the efficiency and effectiveness of public services (Schaffers et al., 2011; Zanella et al., 2014). However, it also raises concerns about privacy, security, and

the potential for the exclusion of marginalized communities (Kitchin, 2014; Abdoullaoui & Zeadally, 2019; Wiseman & Preist, 2020). The success of smart city strategies depends significantly on the readiness of people to use and benefit from services offered through digital technology. As discussed above, readiness itself depends on a multitude of factors and variables. In a scenario where people do not follow the path, a smart city framework expects them to, not only the critically examined dimensions such as inclusiveness, democracy, and sustainability could not be achieved, but also the core principles of the paradigm itself. As mentioned earlier not all city activities rely on digital technology. At the same time if we consider all interactions happening in these non-digital services there will be enough cases where ICTs and Cloud Computing are required at a certain level. The effectiveness of digital communication and significant influence of global media sources, which use the same digital technologies, allows them to dominate the information field and form opinions by providing selected data. Open Data is another core principle of Smart City development, which provides information for non-governmental actors and private companies (Schrock, 2016). Digital data protection and regulation of web-based platforms has always been a challenge for the policy makers. The European Union has launched such regulatory projects as General Data Protection Regulation (GDPR) and The Artificial Intelligence Act (AI Act, proposed in 2021). All together - these are the reasons why successful adoption of digital technologies for communication and execution remains the biggest milestone for any smart strategy.

Smart City models are not only a hot topic in scientific discussion or in local contexts within a certain city, it also became a wide recognition in international projects and private statistical institutions. Positive coverage in social media highlights successful implementations, innovative projects, and potential benefits, which contributes to the popularity of smart cities in the public consciousness. Weak points and limitations of the concepts can rarely be found in public discussion or even in scientific publications (Fanelli, 2012). As it will be shown later the city reports are generally optimistic and share successful practices, while obstacles remain hidden for a naked eye. As for international projects the Smart City Research Group of Shanghai Academy of Social Sciences together with UN Public Administration Network (UNPAN) publish yearly reports highlighting 20 cities (placed in three categories: leading, advanced and

following), where the goal is to provide a benchmark for everyone else (similar to Giffinger et al. study). Smart Cities Index Report and IMD Smart City Observatory also provide publicly available studies on the indexation of smart cities and global rankings. The disadvantage of such reports is the small number of indicators, which are, at the same time, not publicly available for readers. In 2015 the European Union launched a research project called CITYKeys. The goal of the project was to develop and validate a performance evaluation system for European smart cities. Compared to the global ranking the advised system in this case was too complex to implement, thus there is no evidence the results were applied anywhere and even the project web-page is not available anymore. The cities require an advanced infrastructure which allows integration of digital technologies in order to provide data for various indicators and metrics. On the one hand smaller models can not fully unleash the potential of smart city concepts, but on the other, more complex ideas make it complicated to offer reasonable suggestions and benchmarks for cities with less resources.

Being a Smart City has become a sought-after brand in the global arena, attracting investors, international companies, and tourists (Coca-Stefaniak, 2019; Vijaygopal et al, 2023). The marketing side of the concept focuses on operationalization and a certain pool of indexes/indicators used by popular ranking reports. From a marketing perspective, positioning a city as "smart" offers numerous advantages. Smart city branding offers cities a distinctive edge in the highly competitive global landscape. By adopting this brand, cities can emphasize their commitment to innovation and technological advancement, setting themselves apart from rivals, and attracting tourists, businesses, and talent. The smart city concept resonates with individuals seeking a contemporary urban experience, evoking images of intelligent infrastructure, seamless connectivity, and a high-tech lifestyle that appeals to tech-savvy consumers who value convenience and efficiency. Furthermore, smart city brands align with the growing importance of sustainability and environmental consciousness, allowing cities to position themselves as responsible and forward-thinking destinations. By emphasizing eco-friendly practices, renewable energy integration, and efficient resource management, cities can attract environmentally conscious consumers who prioritize destinations aligned with their values. Additionally, the smart city brand serves as a catalyst for urban regeneration and revitalization. This enables cities facing economic

challenges or seeking to reposition themselves to leverage the brand's positive associations, attracting attention and investment. By projecting an image of dynamism, forward thinking, and adaptability, the smart city brand instills a sense of optimism and rejuvenation in both residents and potential stakeholders. Pursuing certain indicators and metrics can have harmful consequences, as shown by the example of universities (Hazelkorn, 2015). Different rankings can deliberately highlight the strengths of universities that are already at the top of the list. Their success, however, does not guarantee the same results for other educational institutions that are incentivized to copy the culture and organization of the „elite“ (Espeland & Sauder, 2007). Although a direct comparison cannot be made in the context of cities, the empirical side of the SC paradigm is still exposed to the same issues.

Summarizing the Smart City Concept has become a trend in city planning, governance, citizen inclusion, analytics and forecasting, marketing, social media, sustainability, and scientific discussion. Each has its own interpretation and use for the paradigm, thus pushing it beyond the original idea of a model to indicate big and global cities' strengths, which would be used as a benchmark for medium-sized and smaller cities. Despite this, digital technology remains the main mechanism that fuels smart cities. The definition of a Smart City can also take different directions depending on a discipline and starting from a generalized view of modern cities up to the in-depth specification of a particular, or in some cases unique, indicator. Therefore, instead of following the whole dimension, in this thesis, a Smart City will be examined as a combination of modern challenges for urban developments that summarize the feasible (physical) and not feasible (social) spheres of the city. As the Smart City theory advocates, digital technology is a tool that allows us to deal with current urban challenges. Even though the technology itself can imply challenges, as shown in this chapter, the case of how a specific city uses it is the best way to learn from either mistakes or success, thus truly benefiting from the Smart City idea. The table below illustrates the study's approach to defining and investigating an SC.

3. Theory

This chapter will cover several theoretical perspectives, which later will contribute in analyzing the role of technology intervention in city development and planning. First, an introduction to the urban theory will be given, which explains the current role of the cities in global relationships and their transition to global cities. Next we will see how smart cities became a leading paradigm in current urban planning. The consequences of digitalisation and its surveillance nature will be covered in the third sub chapter. Science and Technology studies will give a deeper look into some core concepts and principles that laid the foundation of smart cities. Last paragraphs reflect the importance of technology adoption in the current world.

3.1 Introduction to the Urban theory

The study of cities has long attracted sociologists because urban areas serve as complex social structures that shape the lives of individuals and communities. Urban theory within sociology delves into the interplay among urban spaces, social relationships, and power dynamics. Sociologists such as Karl Marx, Ferdinand Tönnies, Émile Durkheim, Max Weber, Robert Park and Georg Simmel have laid the theoretical foundation by examining the social consequences of urbanization, focusing on topics such as urban communities, class formation, social alienation, social interactions, and the impact of urban environments on human behavior.

Many questions arise when one attempts to study a city. Urban sociology investigates what makes places distinctive and provides identity to neighborhoods and cities, how special structures influence social interactions, how social bonds are being transformed within a city, and the political consequences of urbanism. However, before answering these questions, we must understand what a city is. Cities are being studied in various disciplines, each providing a unique context and definitions. Sociology studies these contextual relations to each other in order to understand how social bonds are being

produced and reproduced. There are numerous definitions of “City” and “Urban” which can be placed in four constantly evolving categories: 1) Quantitative dimensions, 2) Administrative/political dimensions, 3) Economic dimensions, 4) Social dimensions. As these are in perpetual shifts due to human progress, especially in recent years, considering the technological boom, a city in China can be nothing like a city in Norway. Neil Brenner and Christian Schmidt (2015) outline five challenges to why the current view of urbanization is problematic:

- The concept of urbanity can undergo significant changes over time.
- Attempts have been made to evaluate spatial density, instead of measuring urban areas.
- Cities are typically regarded as fixed entities and their definitions are universally applied.
- The urban–rural dichotomy overlooks the impact of urban influence.
- What characteristics define urban spaces? Do they remain consistent in different contexts?

Although recent definitions (such as the EU and OECD) address some of these, other issues are still open, and it is the goal of urban sociology to deal with these questions by exploring the analytical dimensions of the city, both conceptually and empirically.

The emergence of urban sociology as a distinct field of study can be traced back to the industrial revolution when rapid urbanization and the growth of cities led to significant social changes. Towns and cities were no longer seen as useful units for social scientific analysis, and the term ‘urban’ is difficult to contrast with anything else. In their overview of Urban Theory Blokland and Harding (2014) highlighted two approaches to examining urban age (in current urban sociology). The relaxed view of urban theory suggests that theories concerning general social processes can be (simply) applied to or deduced from the aspects of towns and cities. The alternative view argues for a stricter approach, requiring each school within social science to carefully define its core concepts and field of study. This relaxed position is more common nowadays, with urban theories generated through general social processes or specific urban observations. The second position proposes a more restrictive focus for urban theory, but previous attempts to

provide urban studies with a distinct theoretical object have resulted in conceptual confusion and deadends.

Several key theories have shaped the field of urban sociology, such as the Chicago School of Sociology, the Marxist theory, and New Urban Sociology (Blokland & Harding, 2014). *The Chicago School*, prominent in the early 20th century, developed an ecological perspective emphasizing the interplay between social groups and urban environments. From this perspective, cities can be understood as ecological systems, and social groups occupy distinct territories within them. The concentric zone model proposed by Ernest Burgess and colleagues (1925) illustrates the progression of urban zones from central business districts to suburbs, each with its own social characteristics and functions. Smart City also represents a certain environment with multiple dimensions occupied by specific social groups. The dimensions however are not bound to a territory, but rather are linked to action areas or fields of interest. For example, the political dimension would include governmental actions and cities' interaction on the political arena. The main difference is that a Smart City suggests a virtual dimension, an environment that is not linked to a certain spatial form, but can be applied to any dimension. This makes the interplay between urban environments and social groups even more complex and harder to outline. *The political-economy* approach examines the relationship between urbanization and capitalism. This perspective emphasizes the role of economic factors, power relations, and class dynamics in shaping cities. Marxist urban theory, for instance, argues that cities are shaped by capitalist production processes and the exploitation of labor. This highlights the concentration of wealth and resources in urban centers, leading to social inequalities and the commodification of urban spaces. As it will be shown later, the original idea of a Smart City was influenced by the market intervention into cities activities. The city became a collective actor, providing a playground for capital driven stakeholders. This resulted in power diffusion and, with ongoing globalization, it forced cities' to compete with each other in order to attract investment, make companies locate headquarters and branch offices within a city. *New Urbanism* has emerged as a response to the negative consequences of urban sprawl and suburbanization. It advocates the creation of mixed-use, pedestrian-friendly neighborhoods that promote social interaction and a sense of community. New Urbanism emphasizes the importance of urban design, public spaces,

and sustainable development. These milestones became inherent to the later generations of Smart Cities, which tried to shift the focus from the technology and effectiveness to the social needs and environmental impacts of a city.

While these theories have contributed significantly to our understanding of urban sociology, they have also been criticized for their limitations (Abrahamson, 2013; Blokland & Harding, 2014). For example, the Chicago School has been criticized for its lack of attention to social (such as race, gender, and class) and cultural factors. Marxist theory has been criticized for its overemphasis on economic factors at the expense of other factors, such as culture, politics, and identity-based dynamics within cities. New Urban Sociology has been criticized for its lack of attention to issues such as power relations and social inequality. The more recent editions of New Urban Sociology include issues surrounding urban publicks and how spatial aspects contribute to the development of inequalities within different social groups (Gottdiener et al., 2019). As we will see later, some of these critiques surround the ongoing debates around smart cities as well.

The postmodern stage of urban sociology represents a theoretical perspective that has emerged in response to the limitations of traditional urban sociological approaches (Abrahamson, 2013). *Postmodern urban sociology* challenges the assumptions of objectivity, stability, and grand narratives that characterize the earlier stages of urban theory. It emphasizes the complexity, diversity, and fluidity of urban spaces and rejects the notion of a singular, universal urban experience. Many of its characteristics correlate with the neo-liberal practices (termination and deregulation of state functions), specifically flexibility, bottom-up regulations and individual activation (Storper, 2015). Neo-liberalism emphasizes market-driven development that can offer solutions to any social need, while challenges will be stabilized within a certain period of time. Postmodern urban development and neoliberalism emerged in the late 1970s. One of the consequences was the establishment of global cities, capitals of the globalized economy.

What, however, is a global city? In order to answer this question, we must understand globalization theory and its consequences. Globalization theory refers to a framework that seeks to understand the interconnectedness and interdependence of nations,

economies, cultures, and societies in the contemporary world. It examines the processes and dynamics through which various aspects of human life such as trade, finance, communication, and cultural exchange are increasingly integrated on a global scale. The main consequences of globalization theory include both positive and negative impacts. On one hand, it has facilitated increased economic growth, technological advancements, and access to information, promoting intercultural understanding and cooperation. On the other hand, globalization has also led to concerns about economic inequality, cultural homogenization, environmental degradation, and the erosion of local identities and traditions. The key theorists of globalization theory are Immanuel Wallerstein, who argues that leading countries extract labor and material through their peripherals, similar to the exploitation of the working class in Marx theory by the bourgeoisie (Robinson, 2011). Thus, the constantly expanding network of capital flow (examples/through) connects distinct actors but simultaneously reinforces inequalities among them. David Harvey in his most prominent article *The Condition of Postmodernity* (1991) links globalization with fundamental changes in our experiences of time and space. His idea of “time–space compression” refers to the acceleration of economic activities, where advanced communication and transportation technologies allow instant transition from production to exchange to profit (like Wall Street currency transfers), thus eliminating spatial time and distance barriers. In Harvey’s view, this compression is the driving force behind globalization. Another big name in Sociology Anthony Giddens (2003) was more concerned with the negative consequences emphasizing the uncontrollable nature of globalization which had led to the “global risk society.” In the modern world, the consequences of decisions taken by particular actors now have a global character, but their management remains an open question. In the aforementioned *Network Society*, Manuel Castells (2000, 2002) argues that culture and power are now shaped by advanced technology, while global capitalism’s goal is to embrace them. Consequently, new global forms of exclusion or fragmentation are inevitable. Saskia Sassen’s (1998) understanding of globalization refers to the notion of global human rights, which, she argues, could override distinctions of nationality and citizenship. She also established the concept of world cities. In her influential work, Sassen (2005) defined a global city as a strategic site for the production and coordination of global economic activities. Global cities are characterized by their concentration of advanced producer services such as finance,

law, consulting, and information technology, which serve transnational corporations and facilitate global capital flows. As a result the administrative power of such cities is disconnected from their geographical borders.

Globalization also has a significant influence on the production and consumption of cultural meanings (Abrahamson, 2013). The global market allows commodities to be traded all over the world, representing the same items at a similar price. The most prominent example here is McDonald's which offers the same tasting food no matter where you get it. The culture underwent the same homogenization process (Hopper, 2007). Thanks to the media and internet, local cultures spread all over the world with the help of global commerce. The entertainment industry has rapidly acquired new tools provided by technology to grab markets outside cities' physical borders, while simultaneously advertising certain places from the city through video or audio clips. As shown by Abrahamson (2013), global economic centers have successfully become global cultural centers as well, where their financial capabilities allow them to dictate the mode and trends to other parts of the world. In Global Cities, culture has also become a ranking system thanks to media, global entertainment, and advertising. Thus, Smart City is not only an analytical framework, but also reflects the ongoing trends in urban development incorporating a variety of cultural aspects. Global City can be considered as a predecessor for a Smart City. This reveals an interesting contradiction in the smart concept. Global cities pursue uniqueness and compete to increase their influence. Smart framework, however, was presented as an accessible model of urban transformation, which was supposed to help in equalizing the differences.

The urban era still faces numerous unsolved challenges, such as environmental degradation, concentrated poverty, social isolation, gentrification, unequal housing, crime, traffic congestion, and inadequate infrastructure. These issues have forced urban theory to develop in specific directions, which is expected to help in understanding the empirical side of a particular challenge. In their analysis Storper and Scott (2016) critically examined three currently most influential debates of urban analysis: 1) postcolonial urban theory, 2) assemblage theory and 3) planetary urbanism. *The postcolonial urban theory* emphasizes the importance of locality, particularity, and

differences in urban studies. This calls for a provincial and comparative approach, rejecting the transfer of analytical results from the Global North to the Global South. It recognizes the enduring impacts of colonialism on various parts of the world, but lacks a coherent concept of the urban itself. *Assemblage theory* focuses on relational dynamics and contingent arrangements of urban social outcomes. It views social processes as complex combinations of diverse elements without providing insights into genetic or enduring spatial and institutional structures. It attributes agency to passive objects, potentially undermining our understanding of fundamental social and economic processes. *Planetary urbanism* challenges the traditional notion of the city and argues for the assimilation of urban areas into a global space economy. This downplays the significance of agglomeration, density, and distinctive urban processes, offering little conceptual value. Denying scalar dimensions to space diminishes the structured sociogeographic entity of the city, potentially hindering effective urban studies.

The authors emphasize that all three, however, are still unable to achieve their goals for the following reasons. Postcolonial theory emphasizes particularity and rejects generalized theoretical concepts, hindering the transfer of analytical results between different urban contexts. Assemblage-theoretic approaches focus on ever-changing relational arrangements but overlook the structural aspects of spatial and institutional formations. Planetary urbanism claims the dissolution of a city and its assimilation into a global space economy, distorting the meaning of urbanization. To overcome these challenges, the author advocates a more disciplined and precise approach to urban research, focusing on the material and relational structures of the urban land nexus. They stressed the need for an urban theory that effectively addresses the complexities and challenges of the contemporary urban era. Furthermore, the authors call for abandoning the classification of cities into Global North and Global South, as it oversimplifies the diverse spatial outcomes of today's world. They emphasize the importance of building more effective theories of urban and urbanization processes that can provide a comprehensive understanding of the urban landscape. Due to these limitations the theories have found no success in conceptualisation of smart cities. A smart city is supposed to be a generalized theoretical concept of a modern urban city, providing data for analytical evaluation comparable between different contexts. Smart

City evokes the formation of new institutions and restructuring of governance practices. The SC paradigm is closer to Planetary urbanism, as it shares some characteristics with a global city. Yet, the recent shifts in smart urban planning moved towards the internal organization and independence from the global market. This direction is examined later in a case of the Smart City Vienna. Two other possible reasons for the lack of attention from urban theorists to the concept of smart cities are: SC concept being too young and in need of an established theoretical approach itself; the limited attention of the smart paradigm to the urban challenges the Urban Sociology is trying to address.

While still working on theoretical foundations, an increasing number of challenges have appeared in urban landscapes. The COVID-19 pandemic has shown weakness in decision-making within a city, as well as cooperation among them to tackle a common problem. What has become obvious is that the governance of urban centers, global cities, and smart cities has to change and adapt to the multinational level of decision-making. Thus, it should strengthen inner city planning and governance by learning from other cities and successful practices all over the world - what, in a nutshell, was the initial idea of a Smart City.

Developing urban landscapes increased the interest of the city elites to turn a city into a collective actor (Bagnasco & Le Galès, 2000). It had to create a collective identity and promote the local society. Territorial changes were accompanied by wide criticism of public institutions, which resulted in new policy patterns and new actors. On the one hand, this critique led to privatization and 'new public management.' On the other hand, it also led to the tailoring of services, individualization, and participatory practices. Overall, this has made the landscape of stakeholders even more fragmented and complex. Le Galès (2002) suggests that the restructuring process between government, market, and civil society has led to the demand for alternative forms of political and social organization beyond the national level. Cities were considered intermediate levels, where actors, groups, and institutions could be structured. The spread of market forces paradoxically led to a resurgence of political activities within cities, where social groups, institutions, and public-private actors form alliances and collective projects to

adapt to economic changes and protect themselves from market effects. Governance is understood here as the process of coordinating actors and institutions to collectively discuss and define objectives in fragmented environments. The actual execution is highly dependent on the context of the particular city. At the same time, the idea of E-Governance can be applied in many cases, thanks to its effectiveness and robustness (Heeks, 2001). The negative side is the high reliance on digital technology, which leads to the common problems of data protection, the digital divide, and other forms of inequalities. However, e-governance remains the 'easiest' tool to control and coordinate actors within newly emerging, highly technological urban landscapes.

3.2 What a Smart City is?

In the previous chapter, the phenomenon of a modern city was presented as a fuzzy and chaotic concept. The same can be applied to the 'Smartness' idea. The roots of it can be traced way back to the 1981 when George T. Doran proposed an acronym S.M.A.R.T as project management and goal attainment framework. An acronym stands for:

Specific – target a specific area for improvement.

Measurable – quantify or at least suggest an indicator of progress.

Assignable – specify who will do it.

Realistic – state what results can realistically be achieved, given available resources.

Time-related – specify when the result(s) can be achieved.

As the author points out, not all objectives or activities can be quantified, and not every project has all five criteria (Doran, 1981, p.2). Despite having an idealistic view, this idea has successfully transitioned to the context of cities. A smart city is a strategy for urban development, which is usually quantified and measured through indicators. That said, the understanding of what 'smart' is highly dependent on the context of a particular city

and its opportunities. While indicators can be directly compared to a certain extent, non-quantifiable aspects of the framework represent one of its biggest limitations.

First-generation smart cities were mostly techno-economic and centralized, and as the Trencher (2019) study suggests, the approach failed to advance social agendas and address resident needs. The framework proposed by the author expects cities to use app development and ICTs with a focus on citizen needs. A case study of the Japanese city of Aizuwakamatsu revealed that smart city benefits can also encourage the participation of non-technically minded residents and other actors. As technology remains the main driving force of smart cities, more recent discussions suggest that it can be used not only for analytical purposes but also for engagement purposes (Figueiredo et al., 2019). Norbert Streitz (2019) critique of the 'smart-everything' paradigm argues that people e.g. users should be put in control of technology development and it should be designed for the needs of city residents as well as guests. Such an approach could be less efficient as it moves towards the second non-quantifiable side of smart cities. Simultaneously, it is expected to deal with the issues caused by first-generation smart cities, such as inclusiveness, privacy, bottom-up decision-making, and collaborative participation. In summary, the smart city paradigm represents two sides of a coin. On one hand, it is a statistical machine that seeks effectiveness by quantifying city activities. On the other hand, it attempts to foster social engagement and prioritize the needs of citizens. Importantly, digital technology remained essential in both cases. The question is whether its role is decisive or supportive.

The debates around the paradigm also designate neoliberal attributes to smart cities, mostly in the smart economy. As shown earlier, neoliberal logic is very close to postmodern urban planning. The association can be drawn on three core characteristics of a SC: Public-private partnerships: smart city initiatives often involve collaborations between municipal governments and private companies. These partnerships can lead to increased privatization of public services and the transfer of responsibilities traditionally held by the government to the private sector. Emphasis on efficiency and market-driven solutions: Smart cities aim to use technology and data to improve the efficiency of urban services such as transportation, energy, and waste management. This emphasis on efficiency and optimization aligns with the neoliberal principles of market-driven

solutions and cost-effectiveness. Entrepreneurial focus: Smart city initiatives often promote entrepreneurship and innovation as the key drivers of economic growth. This can be seen in the encouragement of startups and creation of a supportive ecosystem for technology-driven businesses. Neoliberalism also emphasizes entrepreneurship and market competition as essential for economic development.

Empirical research has also pointed out that European strategies integrate neoliberal logic into their strategies while pursuing efficiency, sustainability, and freedom of choice (Cardullo and Kitchin, 2019). These goals might sound like they fit the overall paradigm, but as mentioned earlier, they represent the first generation of the framework. All three benefited from market imperatives while limiting citizen engagement and power (*ibid.*). This represents a certain inconsistency of smart approaches, where the success of goals is decided by a certain actor and not a collective. In this case, experts and elites decide what would be best for the citizens. Centralized decision-making empowers not the citizen initiative but rather the engagement of private companies who can provide tools for the city to achieve desired 'smart indicators.' While theoretical discussion views people as political actors, the practical implementation of the framework describes them as customers (Grossi and Pianezzi, 2017). The role of tech companies and digitalization will be discussed in further sub-chapters.

The complexity of the smart city concept is being enhanced by its multidisciplinary nature, plurality of definitions, variation of contexts, constantly developing urban landscape, and attempts to apply different theories. Current discourses can be grouped into four categories, each emphasizing one particular agenda/motive.

Technocentric Perspective: This perspective focuses primarily on the application of advanced technologies and data-driven solutions to enhance urban infrastructure and services (Zanella et al., 2014). It emphasizes the use of digital technologies, such as Internet of Things (IoT) devices, artificial intelligence, and big data analytics, to improve efficiency, sustainability, and quality of life. This perspective is mostly influenced by technological determinism (e.g., first-generation smart cities). A city is seen here as a cyber-physical system (CPS), where computing elements coordinate and communicate with sensors and actuators to control the environment (Lom & Pribyl, 2021). **Smart City Agents** (a particular element or an actor in an SC that can be classified by its

inputs/perception or output outputs/actions) represent the building blocks of the city where physical (hardware) and virtual (software) worlds are interconnected. System Theory proposes a dynamic model that can simulate different benchmarkable scenarios (ibid.).

Sustainable Development Perspective: This perspective emphasizes the integration of smart city initiatives with the principles of sustainable development (Toli & Murtagh, 2020). It focuses on environmental sustainability, resource efficiency, and resilience to climate change. The goal is to create cities that minimize their ecological footprints, promote renewable energy, optimize resource allocation, and foster sustainable transportation and infrastructure. As discussed in the introduction, sustainability has become the main goal of many smart city frameworks. Transitioning to the new meanings of production and consumption, however, contradicts the project management side of SC and its orientation toward effectiveness above everything else. While still dealing with urban challenges and globalization, a smart city is expected to simultaneously benefit people and the planet. Compared with the technocratic perspective, sustainability is a long-term goal without a well defined solution. The perspective suggests that implementation should be sustainable, but what in fact sustainability is and what methods should be used is left to the last instance, in this case, a particular city.

Citizen-Centric Perspective: This viewpoint places the needs and well-being of citizens at the center of smart city initiatives (Streitz, 2021). It emphasizes citizen engagement, participation, and empowerment in decision-making processes. The citizen-centric approach aims to create inclusive and equitable cities, ensuring that the technology benefits all residents and communities. Although most of the strategies in the aforementioned studies emphasize such an approach, they are hardly noticeable in practical cases. Compared to other perspectives, this is the most recent and can be considered as the further step of smart city development or otherwise as a second-generation. The citizen-centric perspective criticizes the overuse and misuse of technology for surveillance purposes, and argues that humans should be integrated into the decision-making process. Some of such projects and ideas will be analyzed later in the case study of Vienna.

Governance and Policy Perspective: This perspective recognizes the importance of effective governance structures and policy frameworks for smart city development (Pereira et al., 2018; Meijer & Bolívar, 2016). It highlights the need for collaborative governance models that involve multiple stakeholders, including the government, private sector, academia, and community organizations. It also emphasizes the importance of data privacy, cybersecurity, and ethical considerations in smart city planning and implementation. Here, a smart city should achieve a balance between top-down and bottom-up approaches. Communication between actors is supported by ICTs. Its integration in the controlling mechanisms of the city, otherwise E-Governance, is mostly oriented toward experienced, tech savvy people, which again raises questions of exclusion and inequality.

It is important to note that these perspectives are not mutually exclusive, and many smart city initiatives incorporate multiple perspectives to create comprehensive and balanced strategies for urban development. At the same time, such complexity confronts goals such as sustainability vs. efficiency or surveillance vs. security. This makes the nature of smart cities even more chaotic and difficult to regulate and study.

3.3 Digitalisation, Surveillance Capitalism and Platform Society

The impacts of digitalization pervade nearly every facet of daily life. While the advantages may be readily apparent and easier to identify, the challenges and risks constitute the darker side of digitalization (Townsend, 2017). As previously mentioned, the internet serves as the core technology enabling the interaction of digital systems. Notably, there is no single organization that controls or holds authority over the internet. Ongoing discussions present two perspectives: 1) the internet is inherently uncontrollable and, therefore, not subject to control; and 2) a small group of individuals and corporations exerts authoritative hegemony over the internet (Eriksson et al., 2009).

Discussions about digital privacy are closely intertwined with discussions on digitalization. Personal information and users behavior become essential for enhancing customer experience and digital platform services. Consequently, individuals often share certain aspects of their private data, entrusting them to a digital environment. This raises questions about digital security. In 2007, Norberg et al. published an empirical study revealing a disparity between people's privacy intentions and their actual behaviors. Despite expressing strong concerns about digital privacy, individuals tend to disclose more information in reality to gain specific benefits (ibid.). Some studies have attempted to challenge this notion. For instance, Dienlin and Trepte (2014) demonstrated that introducing additional variables, such as privacy attitudes and intentions, can dissolve the privacy paradox. A recent literature review on privacy paradox studies highlighted the lack of consensus, noting that researchers employ different constructs and definitions, preventing a unified perspective on the problem (Barth & De Jong, 2017). Another significant change caused by digitalization was the concept of context collapse (Davis & Jurgenson, 2014). In the digital realm, the distinction between private and public spheres becomes blurred, as spatial, social, and temporal boundaries—integral to physical practices—are absent (ibid.).

Despite the abstract nature of the digital realm in contrast to our physical environment, it necessitates specific spaces for user interaction and information exchange. An example of such space would be a digital platform. Expanding upon Castells' concept of the Network Society, it has evolved in a new domain referred to as the platform society (Van Dijck et al., 2018). A platform, in itself, serves as a space, be it a website, application, or program where users can execute various actions, involving diverse forms of communication beyond direct interaction between the user and the platform owner. Crucially, the entire infrastructure relies on a limited number of private tech behemoths commonly known as the Big Five: Amazon, Apple, Alphabet (Google), Facebook, and Microsoft. According Van Dijck et al., "Virtually all platforms outside of the Big Five constellation are dependent on the ecosystem's infrastructural information services" (ibid., p. 15).

Given that platforms are crucial, if not obligatory, for individuals to utilize digital technologies, it becomes imperative to examine how they are structured. Van Dijck's (2021) visualized this new ecosystem as a platformization tree:

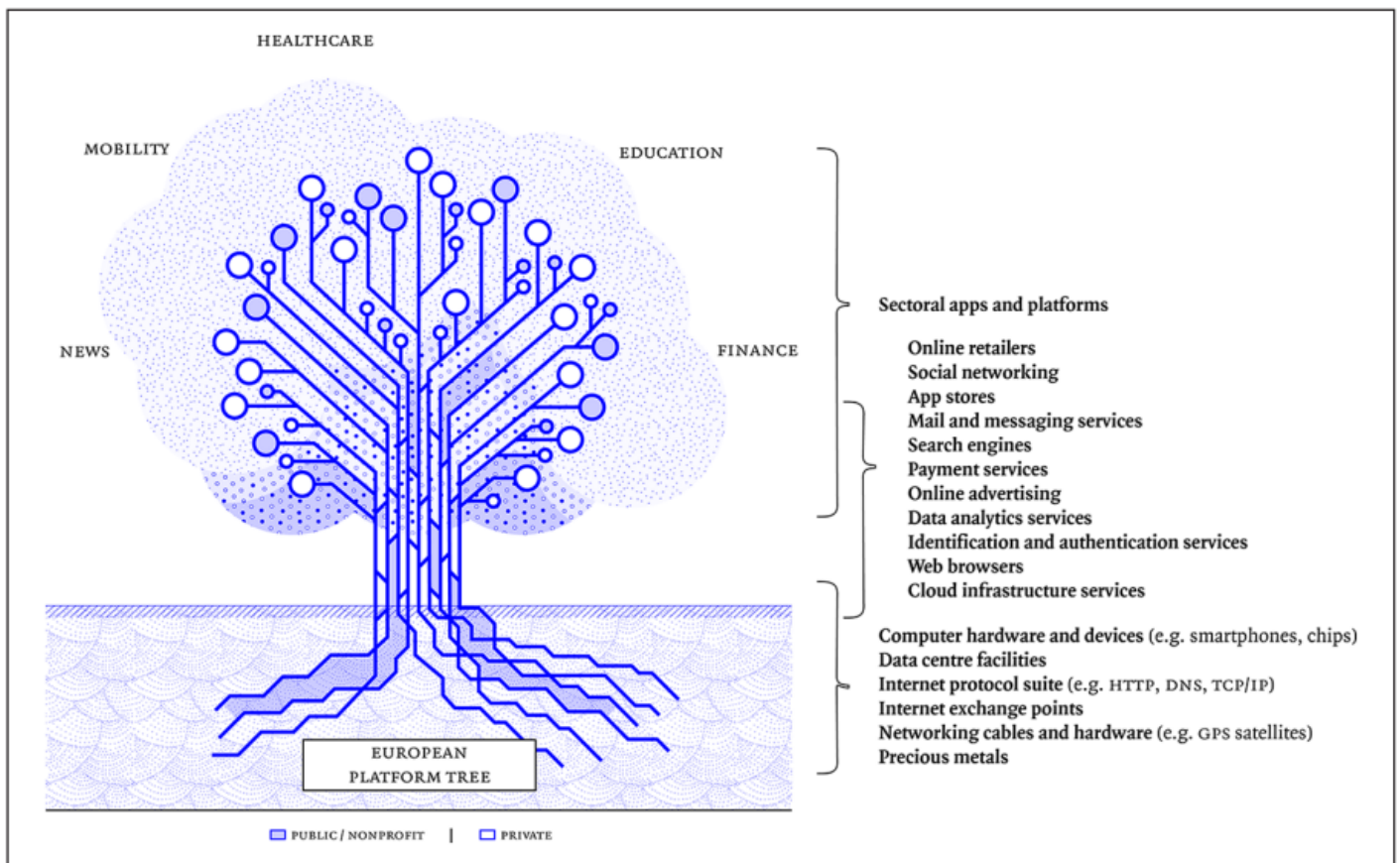


Figure 2. European platform tree.

Source: Van Dijck, 2021

The foundation of the platformization tree lies in the physical infrastructure owned by the Big Five companies. Thus, a limited number of private corporations exert control over and hold dependencies for all subsequent digital services and platforms. Comparable to a closed ecosystem, the tree operates independently, shielded from external interference, posing a challenge for external entities, including the government, to regulate. Van Dijck underscores the significant effort companies invest in intricately integrating their products to optimize data extraction, enabling the prediction and, in some instances, manipulation of human behavior. The control over information provides

numerous opportunities for its owner, in this case not an individual, but a platform. This also means that information is the biggest asset for individuals in the digital ecosystem, which should be protected and secured.

The concerns about privacy and the ethical side of platformization are further discussed by Zuboff's (2019). She proposed a concept of Surveillance Capitalism (SC), which centers on the monetization of user behavior through the utilization of artificial intelligence. The fundamental idea behind this concept is the value derived from user behavior within the investment cycle. In this model, digital companies accumulate extensive data, subsequently processed by AI, and then sold to business enterprises. This information facilitates the prediction of user behavior, leading to the creation of markets for behavioral futures (ibid., p. 97). Zuboff asserts that in the realm of surveillance capitalism, individuals are not viewed as customers but as suppliers of raw material for predictive products generated through artificial intelligence (ibid., p. 10).

Behavioral Value Reinvestment Cycle

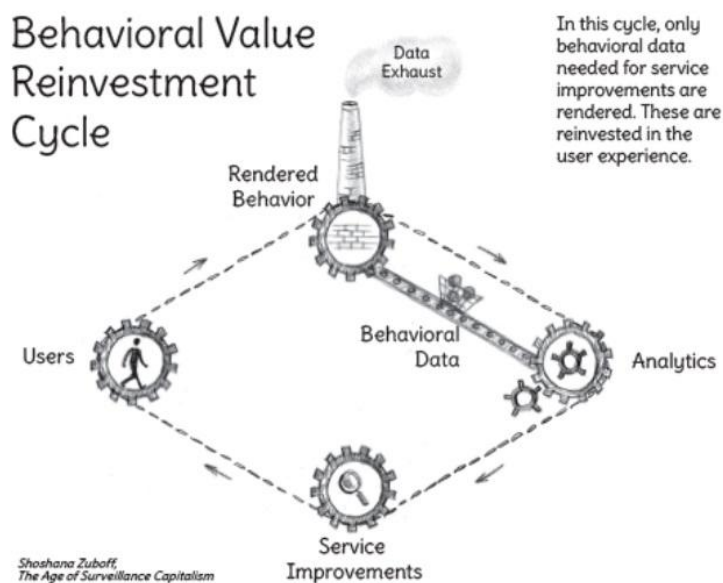


Figure 1: The Behavioral Value Reinvestment Cycle

The Discovery of Behavioral Surplus

Surveillance capitalism begins with the discovery of behavioral surplus. More behavioral data are rendered than required for service improvements. This surplus feeds machine intelligence - the new means of production - that fabricates predictions of user behavior. These products are sold to business customers in new behavioral futures markets. The Behavioral Value Reinvestment Cycle is subordinated to this new logic.

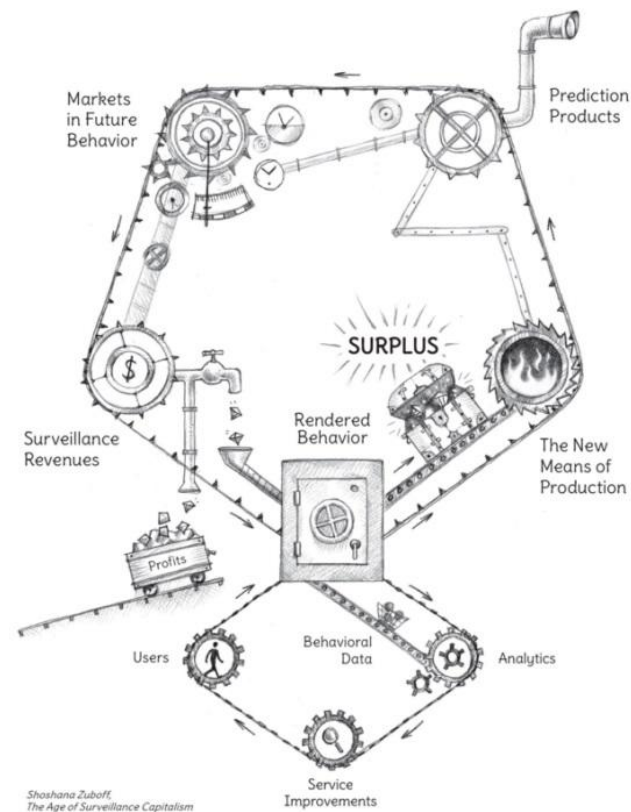


Figure 2: The Discovery of Behavioral Surplus

Figure 3: The behavioral value reinvestment cycle. Source: Zuboff, 2019, p70.

Figure 4: The discovery of behavioral surplus. Source: Zuboff, 2019, p. 97.

The figures above illustrate the transition from the traditional behavioral reinvestment cycle to surplus generation. The rendering of behavioral data occurs through the analysis of information that people leave in the platforms described in the beginning. Most of the time, this occurs automatically and remains unseen by the user (E.g. Marelli et al., 2020). The prediction of human behavior allows corporations to not only offer new means of production and personalized services but also manipulate individuals' decisions. The success of such practices is only possible because of digitalization. That is what Staffan Mau (2018) calls "the Quantification of the Social." According to him, metrics and rankings become central to shaping society in every possible sphere.

Data-driven decision-making processes have advanced as the primary approach to governance. Although they provide a high level of effectiveness and accountability, Mau argues that quantification has significant disadvantages that cause issues of surveillance, privacy, and inequality. The most prominent example is the Social Credit System in China, which Mau used as an introduction to his book. Big Data, another buzzword that emerged within digitalization, provides numerous opportunities but is also a huge concern for social research (Burrows & Savage, 2014) and privacy dynamism (Cohen, 2013).

Digitalization further enforces new types of inequalities. People who do not have access to infrastructure or tools that allow you to use digitalization products. Groups that do not possess knowledge about how certain interactions in the digital world are happening, thus making them vulnerable to it. The issue of digital inequality was addressed by Jan van Dijk (2012), who claimed that digitalization creates more instead of less inequalities in a network society. The main reason is that there are no adequate policy regulations to effectively address such issues (*ibid.*, p. 105). Inequality in information specifically widens the gap between individual users, thus allowing them to advance toward others.

Van Dijck (2021) contends that regulatory bodies and policymakers should empower changes. In Europe a variety of such projects and initiatives have been launched in recent years, for example: the General Data Protection Regulation (GDPR), The Artificial Intelligence Act, and The EU Cybersecurity Strategy. They share the common goal of regulating the conduct of private digital companies and safeguarding users against potential or actual misuse of their personal data. The question is whether the governments themselves or, in this case, a city, would become an even bigger surveillance actor by trying to regulate both individuals and tech companies. The Smart City concept shares many practices with those discussed in this chapter, and the extent to which they can be (or are) implemented is a question that warrants examination through a case study.

3.4 Science and Technology Studies

Science and Technology Studies (STS) is a young discipline that emerged in the 1970s and the 1980s with the first ethnographic laboratory studies. The goal was to view science as a cultural activity. STS's main argument is that wider social meanings and symbols play a role in how knowledge and technologies are produced, both socially and in terms of form and content. Contrary to technological determinism, which views technological progress as an explanatory factor for societal change, STS considers how societal actors and changes influence technology, thus understanding technology as a culture itself (Wyatt, 2008). When we take technology as a cultural artifact, it reveals how social understanding is highly dependent on the context when it was first produced. Recent STS empirical studies have analyzed how scientific knowledge and technological artifacts shape culture (Michael, 2006). For example, Ingold (2011) illustrated how the infrastructure and practices of walking that developed along with laced shoes and paved roads have significantly re-shaped urban spaces. STS provides an in-depth analysis of some core characteristics attributed to a smart city, such as inter- and transdisciplinarity, co-production (new public management), metrics, public participation, vulnerability, risks, and disasters. From the perspective of STS, a Smart City can be seen as a cultural phenomenon fueled by modern technology, in which contextual particularities shape the vision of smart cities. For this reason, an SC in America would be quite different from that in Europe or Asia, as the production of knowledge follows different guidelines in these regions (for example see: Traweek, 1988; Knorr-Cetina, 1999).

Inter- and trans-disciplinarity have become the main form of current scientific sociality. Collaboration between disciplines is seen as necessary to deal with real-world challenges (Stehr & Weingart 2000, Barry & Born 2013). This also had led to the so-called *Mode 2* of knowledge production where offering solutions for societal actors and problems substituted production of reliable knowledge; societal relevance and „robustness“ became new central quality criteria, rather than peer review (Nowotny et al., 2001). The second mode can be found in Smart City discussions, where the boundaries between science and other societal domains are increasingly blurred. As a

research field, the city opens unending opportunities for any potential actor. The same dimensions of a city can be studied simultaneously by different disciplines and nonscientific entities. This makes it problematic to meet a final decision if the involved parties do not cooperate with each other. One of the consequences and, to some extent, the solution for this issue was the establishment of a new ideal and ideology—New Public Management.

The basic idea of New Public Management is to transfer management techniques from the private to the public sector in order to increase transparency and efficiency and raise the quality of the services offered to society. Competition became the central discourse around new public management, as the amount of public funding depended on output. Such a mode of governing required the establishment of rankings and standardized metrics for institutional performance. STS analysis mostly explores the negative consequences of knowledge production in universities. The example can be that Universities who are trying to achieve the metrics of the top ones, in fact, hinder their excellence (E.g. Burrows, 2012; Hazelkorn, 2015). What is important in the context of a Smart City is that audit culture can have the same negative consequences for the actors (not only universities) involved in the city planning process. The metrics are also not designed to measure inputs that question the idea of citizen participation in that case (Grossi et al., 2020).

In STS, public participation is the main way science can be communicated; thus, empowering people to co-create should solve the issues of exclusion and inequalities. Such behavior from citizens, for example, could also help distribute science to the broader society. In the case of smart cities, people would receive information about urban planning, and their needs are communicated and later translated into practical actions, at least in theory. There are two questions that should be answered. First, what is co-creation? Second, is the co-creation explained by STS the same as in Smart City agendas, or does the latter just follow the modern trend? To answer these questions, we have to look at two related concepts in STS: ignorance and production of non-knowledge.

STS argues that ignorance, like knowledge, is a constructed phenomenon. The idea is that ignorance cannot be simply filled by knowledge and new discoveries; it is a rich

social field that has a unique way and particular uses (Nielsen et al., 2017). To put it simply, the production of knowledge aims to describe certain practices; simultaneously in the process, it renders other things that are invisible and remain undescribed. As previously discussed, scientific facts can be interpreted differently by different disciplines. This later also translates into the practices produced by these facts. Urban science, in this case, would highly depend on the context it was developed in and what actors contributed the most to its establishment. Later, the execution of the theory could also be altered by the parties responsible for implementing a specific project or technology. Ignorance is not only an issue for science in general, but also affects the public by producing misinformation. The chapter about digitalization revealed how impactful technology and social media could be on the production of misinformation. Mostly, misinformation comes from people's unawareness of how media algorithms work or how digital technology interprets social facts (Tandoc et al., 2018; Guess & Lyons, 2020). What does this mean for citizen participation? STS shows that in our case, citizens are also actors who produce knowledge and facts. This can happen at different levels, but as studies show, such knowledge is unique for a specific place. People are represented as experts in the specific context they exist in, thus allowing them to reveal issues that are not seen for those who are outside. Finally, we have a certain middleground between bottom-up and top-down approaches, where each follows its own approach of knowledge production and distribution. The problem is that the uncertainty and non-knowledge produced in both scenarios should be communicated and acknowledged; otherwise, the whole concept of co-creation would now work. Later, in the case study, we will look at some examples of how citizens could be engaged in the city planning process and what social practices are established in the process. Answering the two questions from the previous paragraph, co-creation is the mutual shaping of technoscience and social order. Its goal is to control uncertainty and produce reliable knowledge that would later be embodied in a specific context. Smart cities follow the same idea of citizen empowerment, where gaps in the smart city planning theory can be filled with the practical knowledge of citizens. It is still unclear who will meet the final decision and how participation can be measured to indicate success or failure.

Ignorance, in turn, leads to another global challenge for contemporary society, which is risk and uncertainty. In the 20th century, risk and uncertainty became the dominant frame of thinking about scientific non-knowledge (Wynne, 2002). STS scholars have criticized this framing, which is mostly based on technocratic assessments and risk calculations. Recent moves towards public engagement and Responsible Research & Innovation (RRI) can be viewed as a practical response to the critique of risk. The big notion of risk is that it leads to disasters. An STS definition of disaster is: „failures of diverse, nested systems, producing injurious outcomes that cannot be straightforwardly confined in time or space, nor adequately addressed with standard operating procedures and established modes of thought.“ (Fortun et al. 2016, p. 1004). From the STS perspective, all disasters in a technological society are socio-technical (Hilgartner, 2007). This means that disasters (including natural ones) can be caused by the failure of technological systems or by unintended side effects of technological systems, mitigated or amplified by technological infrastructures, predicted, or failed to be predicted by early warning systems and scientific expertise. The order of the current society is achieved through reliable technological systems, where disasters disrupt this vision and fundamentally question established practices (ibid.). Risk and exposure to it have also become new forms of societal inequality. Perrow's (1984) argument is that accidents are inherent to complex technological systems. They can never be fully safe and produce this kind of “normal accident.” Summarizing technology is expected to deal with risks and uncertainty at the same time it is being exposed to them. The same problem can be seen between the first- and second-generation Smart City theories, as well within the surveillance discussion. The step towards co-creation, which will shift responsibilities and support sustainability, is expected to resolve this issue. The only question is how can this be achieved?

3.5 Technology Acceptance Theories

It is not worth arguing that the world is constantly evolving and changing. Most, if not all, changes can be linked to certain technologies. As discussed in this chapter, major shifts in modern society are caused by urbanization, globalization, and digitalization. Cities became the informational centers, thus attracting capital and people who sought for

opportunities. Urbanism later faced the consequences of globalization, making a city's influence exceed its geographical and physical borders. The drastic changes, which happened in a relatively short amount of time, are reflected in social urban theory which still struggles to conceptualize urbanity and unify a variety of perspectives. In addition, in the political landscape and economic arenas, technology has opened new opportunities for power distribution, competition, and regimes such as surveillance capitalism. While investigating this matter, it becomes clear that the technology itself changes significantly. To exemplify, The 'Affordance Concept' presented by Nicole Zillen (2008) suggests that technology always has latent and potential functions. Both have a chance to be discovered in the future by accident, unintended use, or personal perception of the user. A practical example is the mobile phone. At first, it was designed as a tool to call others, later it allowed users to take photos, listen to music, share files, and so on. This leads us back to STS discussion and production of non-knowledge, where technology is a multifaceted unit designed for a better future, but at the same time carries many risks and potential challenges, including social ones like exclusion. This makes it almost impossible to theorize every aspect of technological change and to summarize it in a single generalized theory. This chapter presents three major accounts of how we can evaluate technological change, its consequences, and its causes.

The entry point comes from Science and Technology Studies. In 1987, Pinch and Bijker published the Social Construction of Technology (SCOT) framework. The goal of their work was to understand how social factors shape the development, design, and implementation of the technology. Its main argument is that technology is not determined solely by its functionality or inherent characteristics but is instead influenced by social processes, values, and power dynamics. As different social groups are involved in the process of creation and use of technology, it is important to understand 1) all participating perspectives and interests and 2) how a technology is embedded in its social context. The theory can also be seen as a response to technological determinism, which assumes that society and culture play no role in the success or failure of technologies and that they are not influenced by societal developments (Wyatt, 2008).

SCOT is not only a theory but also a methodological approach which analyzes how criteria of being 'the best' are defined and measured in the society. Reconstructing

social practices should allow researchers to understand the causes of technological successes or failures. This approach involved two stages. First - *Interpretative Flexibility*: the development of technology may have different meanings and interpretations of its purpose and potential uses. This stage includes *Relevant Social Groups*—people who produce and use a particular technology, but also other actors who can intervene in processes, such as politicians, social media, and the scientific community. *Design Flexibility*: The reconstruction of a technology varies depending on the starting point, that is, the perspective of a relevant group. Problems and Conflicts two previous aspects can cause conflicts between actors like “Anit-5g” movements. Second stage is *Closure*. It is divided into *Rhetorical Closure* when social groups agree on one particular design and *Redefinitions of the Problem* when closure comes from designing a new problem, where a conflict technology suddenly becomes a solution¹.

The SCOT approach has been extensively criticized by Langdon Winner (1993). In his view, social constructivism is limited in its ability to investigate the broader consequences of technological change. Thus, it oversees actors who remain excluded in practice and the power dynamics that scale beyond the chosen context. As Winner, Klein and Kleinman (2002) argue that SCOT went too far in the opposite direction of technological determinism while leaving it behind completely. According to them, Pinch and Bijker did not clarify what constitutes a relevant social group or what exact influence can be executed.

The second is Innovation Diffusion Theory (IDT). It was proposed by Everett Rogers in 1962, whose interest was to explain how new technologies spread and are adopted within a society. IDT focuses on the factors that influence the diffusion e.g. how an innovation is being spread and adopted, as well as on the characteristics of adopters. Diffusion can be understood as a social process that occurs over time, and its rate is dependent on adoption factors such as *attributes of the innovation* (e.g., cost, effectiveness, compatibility, etc.), *characteristics of adopters* (opinion leaders), and *social and political context* (salience of issues related to an innovation and its framing). (Dearing & Cox, 2018). Diffusion itself consists of four main elements. The first is *Innovation* which Rogers describes as “...an idea, practice, or project that is perceived

¹ ‘The Zero Dollar Car’ example from TED talks (2017).

https://www.ted.com/talks/john_ellis_the_zero_dollar_car_the_transportation_industry_transformed
John Ellis illustrates how technology becomes a solution to the issue of surveillance and data privacy.

as new by an individual or other unit of adoption” (Rogers, 2003, p. 12). It is a social consensus when a certain artifact or phenomenon becomes an innovation rather than its appearance in time. The adoption or rejection of an innovation can lead to a state of uncertainty, where individuals do not possess full information about its consequences; thus, an innovation might fail despite its practical efficiency. Second are *Communication Channels* in which information flows can be controlled or altered. It ranges from dialogue between two people to the global coverage of mass media. Third, *Time* or rate of adoption, which will be illustrated in the next paragraph. Fourth, *the Social System* is an area where innovations are influenced by social structures and vice versa. It also determines people's innovativeness, which Rogers used as a criterion to categorize adopters (ibid., p. 24).

For Rogers the diffusion process occurs in five stages as illustrated in the table below:

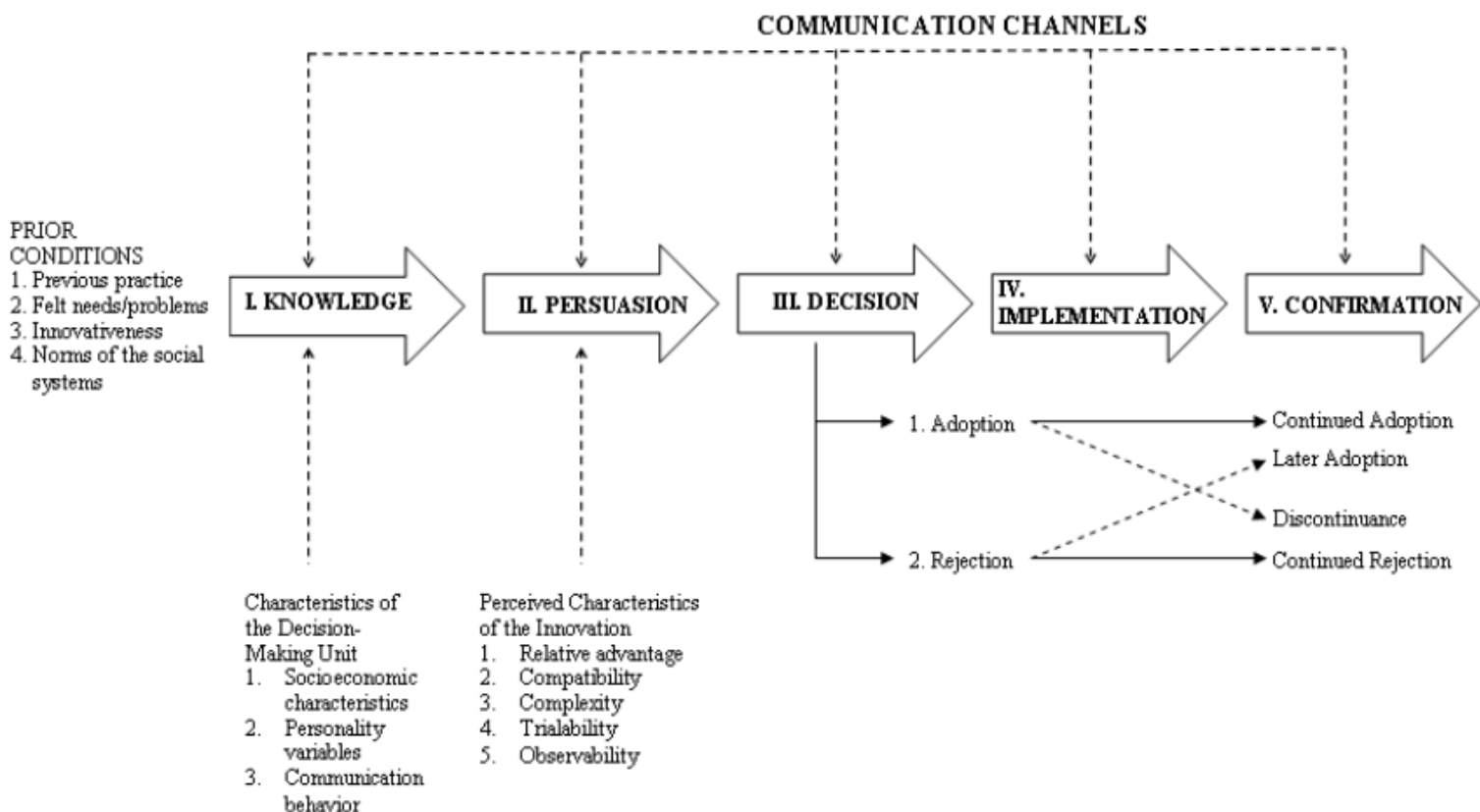


Figure 5. A Model of Five Stages in the Innovation-Decision Process. Source: Rogers, 2003.

The rate or otherwise time starts with *knowledge* - with basic questions “what?,” “why?,” and “how?” related to an innovation. In the *persuasion* stage, an individual forms positive or negative opinions as well as attitudes. After the *decision* is made to adopt or

reject an innovation. This decision can be changed later and is not permanent. The complexity of an innovation significantly influences the time required for the initial choice. Trivial things like faster Internet connection would be accepted almost instantly, while concepts like blockchain might be stuck for a long period. *Implementation* occurs when a technology or innovation is put into practice. *Reinvention* also occurs during this stage, meaning that an existing idea becomes institutionalized, considering all the changes that occur during other stages (ibid., p. 180). The more opportunities an innovation can have, the more reinventions it can take; thus, adoption occurs more rapidly. In the last *confirmation* stage an individual seeks support for a decision that was made. This step can be followed by *discontinuance* if a better innovation appears or if performance is not satisfactory.

Rogers suggests five categories for adopters. His classification includes innovators, early adopters, early majority, late majority, and laggards.

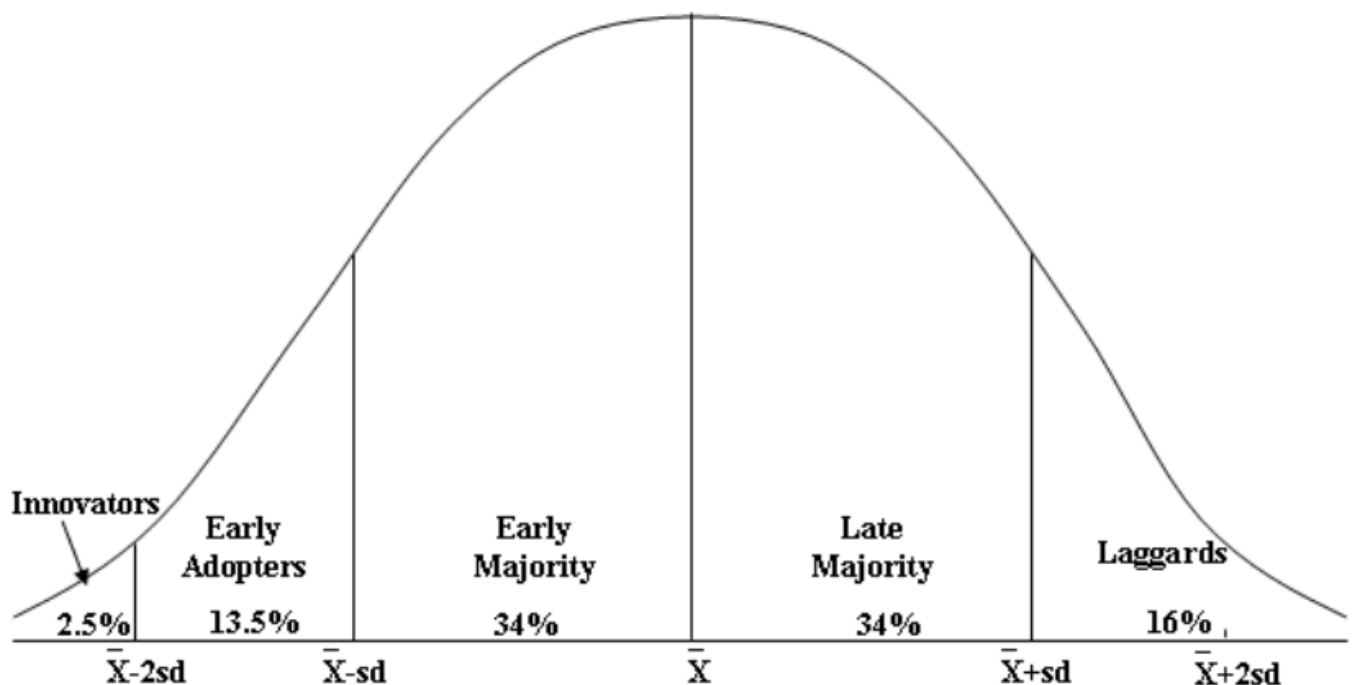


Figure 6. Adopter Categorization on the Basis of Innovativeness. Source: Rogers, 2003.

Innovators always look for something new. They possess high technical knowledge, but may not be respected by other participants due to rush and sometimes reckless

attitudes, as they are not focused only on profitability and success. Compared with the first group, *Early Adopters* are limited by the boundaries of the social system. They take responsibility for adopting innovation and mostly hold leadership roles in society. In this process, they also decreased the level of uncertainty for further users. The *Early Majority* includes one-third of all members and is generally active and interacts with other members of the social system. The *Late Majority* are people who hold a certain degree of skepticism and wait while their peers adopt an innovation. Their decision is mostly influenced by interpersonal communication. *Laggards* are the most localized group in society. They usually have limited resources and a lack of awareness and knowledge; thus, they need to ensure that an innovation actually works. In Rogers' analysis, the left half usually has a higher socio-economic status, better communication skills, and personality variables. People with lower education and lower income, who have higher potential benefits, are generally last to adopt new innovation (Rogers, 2003, p. 295).

The critiques of IDT point out that the theory overemphasizes individual attributes and gives too little attention to contextual factors (Damanpour, 1991; Brown & Duguid, 2001). IDT was questioned in the ability to cover all possible variables when it comes to practical cases of implementing innovations, specifically in the healthcare sector, where successful adoption is crucial (Plsek & Greenhalgh, 2001). In later editions, Rogers (2003, p.105) acknowledged and summarized the critique of IDT into four categories. A *Pro-Innovation Bias* implies that all innovations are positive, and therefore, should be adopted. *Individual-Blame Bias*, in many cases, the communication channels flow in one direction from the developer to the user, thus neglecting the participatory approach and power dynamics. *Issue of Equality*, the potential negative consequences for marginalized groups, and growing inequality is not considered. *The Recall Problem in Diffusion Research* challenges in accurately recalling the events related to adoption.

The third and final concept appeared way later compared to the first two. It was proposed by Viswanath Venkatesh and his colleagues in 2003 as The Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT is a comprehensive framework that attempts to extend and incorporate several earlier models, such as the theory of reasoned action, theory of planned behavior, social cognitive theory, the technology acceptance model, and IDT. The ultimate goal of unified theory is to explain individuals'

intentions and behavior in using and adopting technology in various contexts. The framework follows a simple logic: individuals' initial reaction to using a technology is followed by an intention and after actual use. Usage or behavior was studied as a dependent variable, which in turn can influence the reaction and vice versa. Intention in the study was described as a predictor of behavior (Venkatesh et al, 2003, p. 427). In 2012, Venkatesh et al. suggested extensions and new factors in addition to the original model.

The original framework is based on four key constructs illustrated below:

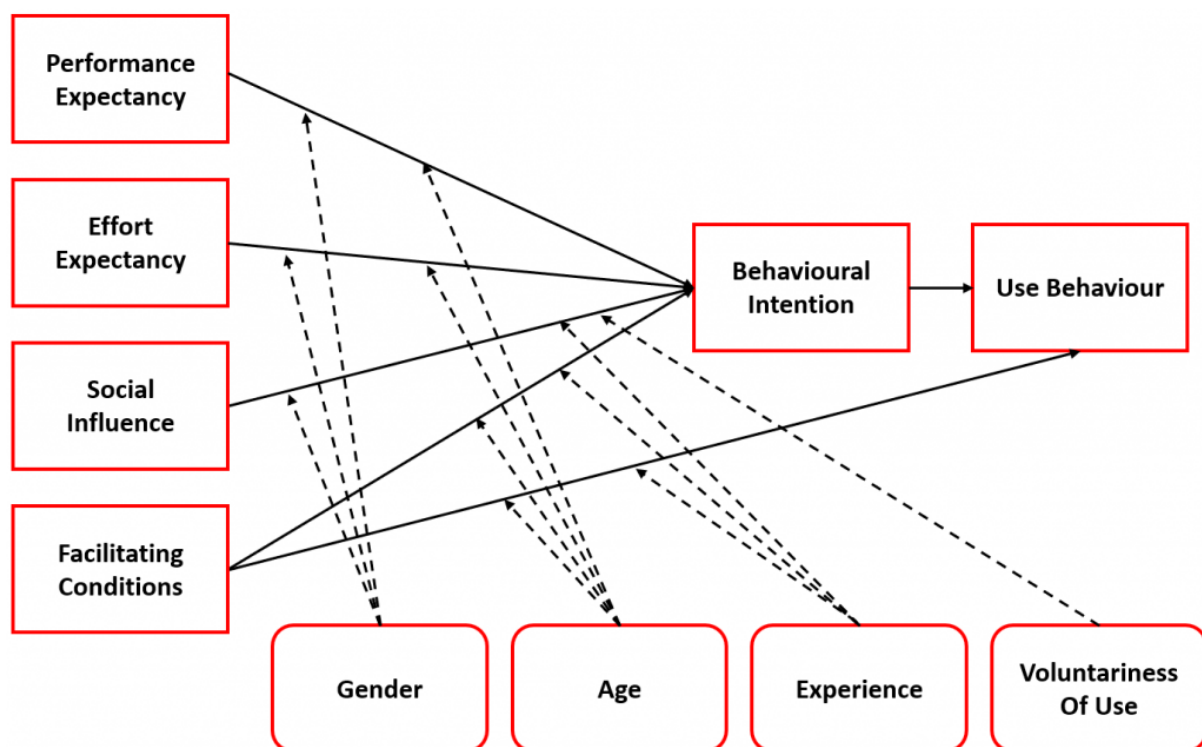


Figure 7. Innovation Diffusion Model (ver. 1). Source: Venkatesh et al., 2003, redrawn by Innovation Acceptance Lab.

Performance expectancy measures individuals' beliefs about how technology can enhance their personal experience or productivity in their job. *Effort expectancy* is the degree of ease associated with the usability of technology. *Social influence* refers to social factors such as rules, norms, and opinions that affect an individual's intention to

adopt a technology. *Facilitating conditions* are the organizational and technical infrastructure that supports the use of a system. The first three categories are direct determinants of the intention to use a technology, in which facilitation conditions directly influence use. According to Venkatesh et al., social factors at the bottom have a significant impact and moderate four key constructs. (Venkatesh et al., 2003, p. 427).

The second edition added three key constructs and removed voluntariness of use as a moderator. The three new factors were relevant to the consumer market and were added for evaluation, compared to the first model, which analyzed the use of technologies within an organization. The most recent iteration was published in 2022 as a synthesis of all extensions:

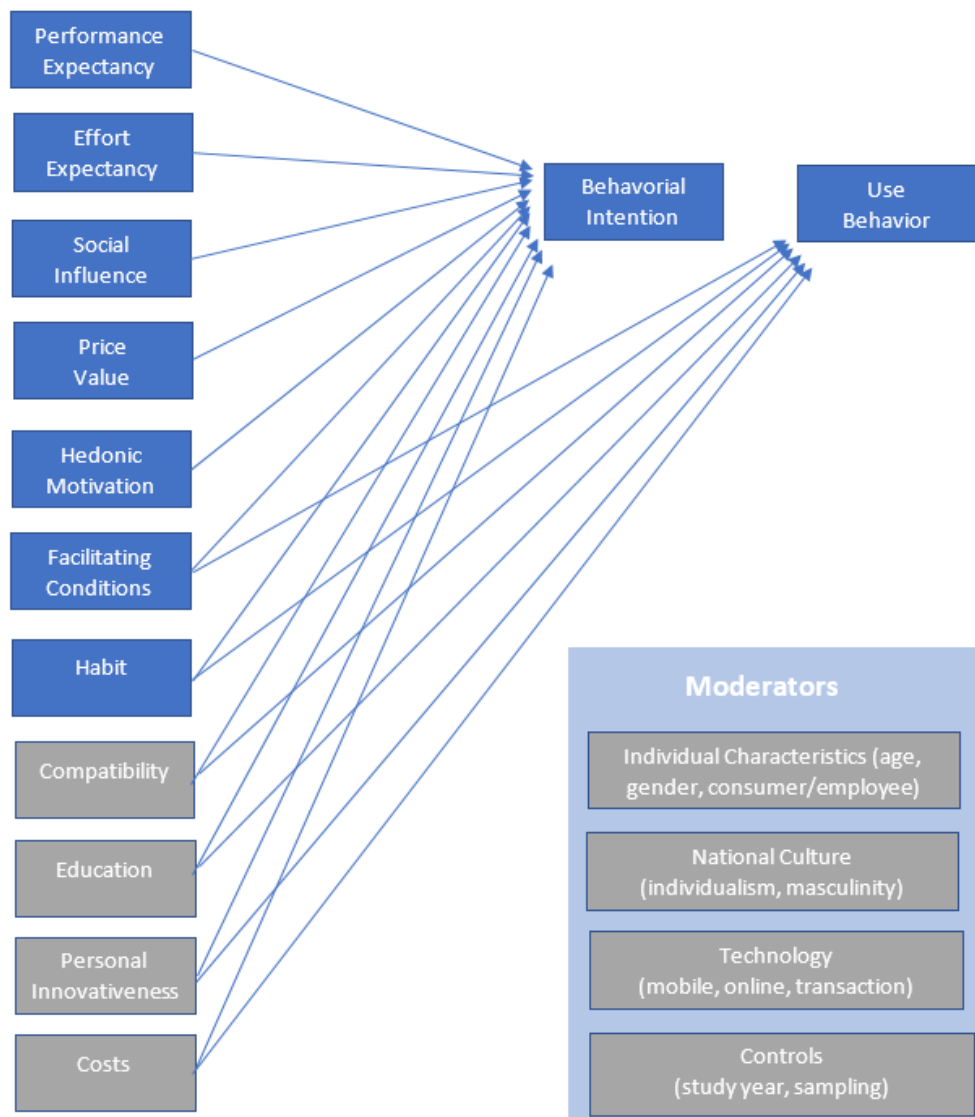


Figure 8. Innovation Diffusion Model (with all extensions). Source: Venkatesh et al., 2022, redrawn by Innovation Acceptance Lab.

Hedonic Motivation is simply pleasure or fun derived from using new technology. Price Value is the difference between costs and benefits. When benefits are higher, the value is positive. Habits are generally individuals' routines regarding how they use technology. The final four constructs include: *Compatibility* of a technology with one's lifestyle, user *Educational* background, *Innovativeness* as an interest in using a technology, and the point when people perceive a technology as *Costly*. Additional moderators were added to strengthen the final results of the study.

The last model showed very high explanatory power (Behavioral Intention: $r^2=74,1$ %; Use Behaviour: $r^2=47,2$ %) and it can potentially be applied in other contexts and different technologies. The biggest limitation, which was already criticized for the first iteration, is the complexity and broad variety of moderators. An interesting finding was reported by Dwivedi et al. (2019) who discovered that studies citing the original UTAUT did not apply the model. In fact, the high citation rates did not indicate model robustness. As it was tested in an organizational setting, critics argue that UTAUT may have limited external validity (Marikyan & Papagiannidis, 2023).

Despite focusing on different aspects all three theories emphasize the importance of technology adoption. The success of innovations designed for the general public, such as citizens, tourists, students, and seniors, depends on a multitude of contextual variables, including individual characteristics, cultural aspects, locality, and global trends. Surprisingly, the smart city discussion does not refer to any technology adoption or development theories. The smart City itself is an innovation for the urban planning, structuring, monitoring, and comparison of cities. Innovations, in turn, always carry risks; thus, if a single step in the development fails, it can lead to significant challenges and, contrary to set goals, reinforce already existing inequalities. As the IDT shows, technology is usually presented from a positive side. To explore its real benefits and disadvantages, extensive analysis is needed. While projects such as Smart City mostly provide an internal view, scientific observation can expand it to a broader context, including overseen practices and interactions.

4. Methodology

4.1 Research Question

It is not worth arguing that smart cities have become the main trend in modern urban development. Although understanding the paradigm itself remains a challenge for researchers and city planners, the consequences can already be observed in real cases. A smart City is a complex multilevel phenomenon that encompasses activities within and beyond the city. Additionally, as a knowledge construct, it can be addressed by various disciplines that address specific social domains. Thus, the scope of a Smart City exceeds the capabilities of a single researcher and requires a comprehensive approach that includes multiple actors who are directly or indirectly involved. For these reasons, this study tackles a specific dimension or challenge of a Smart City, which is digital technology. As discussed in previous chapters, technology is not always illustrated as a solution to all possible urban challenges, but it is always involved in practical execution to a certain degree. Despite its undoubtable efficiency, digital technology has high risk and potential to be destructive to society. The goal of this study, however, is not to debate digital technology per se, but to investigate how it affects the interactions between a city and its citizens. A smart City provides a necessary research field that not only allows us to explore the consequences, but also incorporates the entire process of technology adoption. This leads me to the research question of the thesis:

RQ: How does the implementation of digital technology within the context of a citizen-centric Smart City influence the dynamics of interaction between the city and its citizens, and what role does it play in shaping new social practices and influencing citizen participation and engagement in urban decision-making processes?"

To answer this question, one should follow the entire path starting from the conceptualization of the Smart City plan to its actual execution and final evaluation. This study also asks the following sub-questions to examine subsequent stages of digital technology implementation in the Smart City framework:

- 1) How digital Technology is being addressed by the Vienna Smart City plan?
- 2) What dimension could be influenced by the integration?
- 3) What social challenges should be tackled by DT?
- 4) Are there any risks associated with DT within the Smart City
- 5) Who is the target group of digital technology?
- 6) What is the adoption plan for the DT?
- 7) What were the challenges faced by the Vienna authorities and what could/should be changes in the future?

4.2 Research Design

This study follows a qualitative approach as it provides tools for an in-depth understanding of the investigated social phenomena. Compared to quantitative research, which focuses on numbers and mathematical explanations, qualitative studies inductively interpret social facts by considering particular contexts and perspectives. Social facts are formed by subjective meanings and understanding; thus, they do not carry universal truths like mathematical formulas do. The key principles of quantitative social research are: the *inductive approach* - based on the collected data new theories and hypotheses are being generated; and *subjective interpretation*, which applies both to the researcher and the subject of the study. Personal roles should always be reflected and considered in the interpretation of results; *contextual understandings* - social phenomena can exist in their unique realities influenced by cultural and historical aspects (Taylor et al., 2016). As a social phenomenon, a smart City represents a rich field of study mirroring major social practices and the development of particular cases. Due to its global character, individual characteristics can blend with broader trends. This fusion potentially will provide answers for multiple urban and social challenges, but at the same time, negative consequences are also hidden in such compound structures.

Quantitative research suggests the following methods for data collection: interviews, observations, and textual or artifact analysis. Each can be further divided into subcategories designed for a particular question and interest. In fact, any social phenomenon produces data that are open to qualitative research. In the case of Smart Cities, numerous interviews can be performed with those who design, implement, or use smart solutions. These practices can be observed in a particular city and compared with other competitors or followers. Smart Cities also produce an extensive number of documents such as official written strategies or scientific publications. Even though a Smart City is a mathematical model of evaluation, its parameters, such as indexes and variables, could also undergo qualitative interpretation in order to understand what constitutes the 'smartness' of modern cities and, most importantly, why.

Data interpretation in quantitative research does not have a generalized set of rules compared with qualitative evaluation (Ritchie, 2014). The most prominent approaches are *Grounded Theory*, which builds analytical categories of social dimensions; *Discourse Analysis* studies language in a social context; *Content Analysis* works with documents and texts; *Ethnographic Accounts* and *Narrative Analysis*, which describes the life history of social actors and reconstructs their stories. Overall, all focus on specific cases and aim for a detailed explanation of the investigated phenomena. The interpretation can later be applied to more general cases or populations, considering the changes in the context.

This study follows a descriptive design (Mayring, 2014, p.12). The categories for the research questions were deductively formulated based on theoretical discussions and systematic literature review. Content analysis suggests the building of categories which later can be used to design a model. Mayring outlines 7 steps of a structuring content analysis illustrated below:

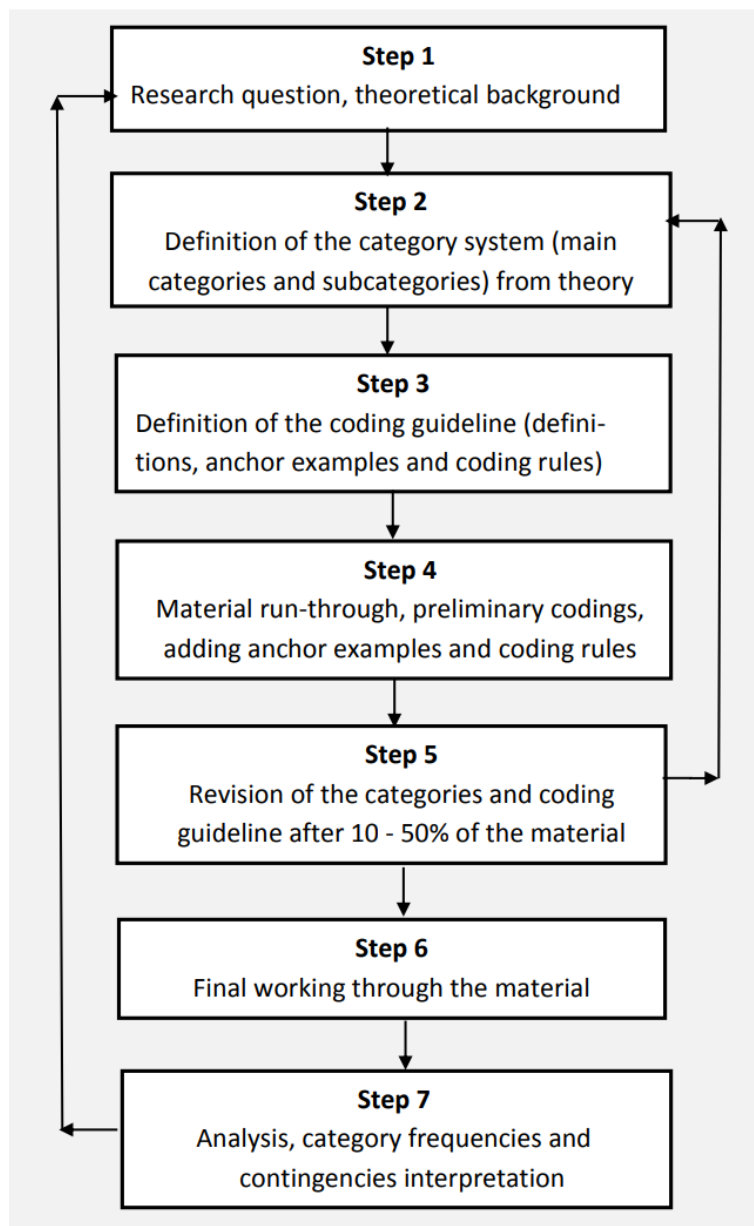


Figure 9: Steps of deductive category assignment. Source: Mayring, 2014.

In this thesis the main categories will be structured around the implementation of digital solutions or tools, where subcategories are built with the reference to the Smart City concept. The approach has a cycle structure meaning going back and forth with the theoretical background, content analysis and additional information from external sources. The assembled model with final categories and its explanation is presented in the 6th chapter.

4.3 Data Collection and Analysis

The following methods were used to answer previously stated research questions. Literature Review: helped to get an overview of how the Smart City paradigm evolved, its goals, challenges, and limitations. LR provided insights to the theoretical foundations of SC concept and how the discussion translated into the benchmark model of city investigation proposed by Rudolf Giffenger and colleagues (Giffenger et al., 2007). A literature review was conducted to collect the results of the empirical research and compose a generalized view of a smart city. This has allowed the establishment of a base for further investigation in the field of digital technology. The literature Review also helps to strengthen the results by comparing them to other studies; thus, the findings can either be supported or gaps in the research identified.

The following methods are used in the main empirical section. *Secondary Data*: Smart City became quite popular among different institutions; thus, they can offer significant information needed to answer some questions. Usually it is collected by research institutions or governmental organizations in the form of quantitative data. This will help to understand some contextual peculiarities relevant to Smart City development. As secondary data, different digital platforms and websites providing additional information are used. For example, digital projects' official web pages: <https://mitgestalten.wien.gv.at>. *Documents and Official texts*: most of the information will be extracted from the official documents and publications such as 'Smart Klima City Strategie Wien' and 'Digitale Agenda 2025' with the focus on digital technologies. Official reports and evaluations of Smart City goals provided by the Austrian government support the findings and arguments made throughout the investigation. Previous methods mostly aim to obtain an overall image and reflect the positive aspects of smart urban planning. To stress the limitations and challenges of the Smart City *Expert Interviews* are conducted. Interviews should help to fill the gaps faced during documents analysis. They also can help to reveal the obstacles that Smart Cities can face. Mostly, the challenges in implementation remain hidden for the general public, and only partially can they be discovered in official reports. In total three experts interviews were conducted. The interviews were semi-structured with the pre-prepared question based on the research model (model is presented in the discussion chapter). Experts

represent two following institutions: Urban Innovation Vienna GmbH and MA 01 (Viennas' digital department). The goal was to connect with the people who are directly involved in the process of designing or implementing digital technologies within the smart city strategy. The evaluation of the Smart City paradigm requires an all-around perspective, as potential negative consequences have a high chance of occurrence, especially in the domain of digital technology.

Collected data will be analyzed through content analysis (Mayring, 2014, p. 88) and some elements of objective hermeneutics (Reichert, 2004). Context analysis has two phases: 1) *narrow*, where the main texts are being reviewed, and 2) *broad*, where additional material is being used to cover the gaps (expert interviews, projects papers, and web platforms). In combination, this would allow the building of categories of how digital technology is being implemented and understood within a Smart City paradigm. The model based on the discovered categories should help to identify the changes in the digital development of Smart Cities and analyze the decisions proposed by the Smart City Vienna plan.

4.4 Case Study Approach

This study follows a case study approach (Merriam, 1988). Case studies are used to obtain an in-depth understanding of a phenomenon in its real-life context (Crowe et al., 2011). It allows for a holistic and detailed examination of complex social practices that cannot be easily generalized. Although smart cities are a global trend, they follow a particular hierarchy in which a certain number of cities are always positioned on top of the ranking boards. The decisions made in such cities are considered the best practices. Additionally, as mentioned in the Introduction, smart city understanding varies significantly depending on the region studied.

Smart cities are a phenomenon that can be observed in many leading cities worldwide. Because one of SC characteristics is to set a benchmark for others, the case example should correspond to a variety of requirements. Another important factor is the social and geographical context. Most of the empirical literature presented earlier was

conducted in Europe. Similarly the theoretical papers took European cities as examples and analyzed their frameworks. Therefore, the decision was made to research a city in a European context. Some of the criteria for selecting a city are as follows.

1. Already established Smart City strategy with publicly available Status Reports
2. Focus on state of the art technology
3. High placement on global rankings
4. Availability of public documents in German or English
5. Potential to reach experts from the field
6. Variety of projects involving digital technology
7. High standards for privacy and digital security
8. Emphasis on sustainability and citizen empowerments (second generation smart cities)

Considering all criteria and other external factors, the decision was made to investigate the city of Vienna. The Smart City initiative was launched in Vienna in 2011 as a more sustainable way of urban development. The framework was adopted and legislated on 25 June 2014. Vienna always takes high places in global Smart City rankings². An extensive number of public documents reflect how the framework changes over time. Digitalization on par with sustainability and citizen cooperation are the milestones of the city. Vienna also has very high standards for data protection and far-reaching goals of becoming digital capital in Europe (Smart City Vienna, n.d.). Vienna has many commonalities with other European cities, such as its immense historical heritage that can complicate the integration of technological facilities. Overall, according to publicly available information, the city can provide a rich research field to answer the questions raised.

² Examples of Vienna's rankings:

Vienna Tourist Board <https://b2b.wien.info/en/statistics/benchmarking/vienna-rankings-391704>
 Smart City Platform <https://smartcity.wien.gv.at/en/approach/references/>

5. Case Study Analysis: Digital Technologies in Vienna's Smart City Framework

5.1 Vienna as a Smart City (City Profile)

The city of Vienna has various sources that provide information about the city and its activities. Key statistics are compiled by Statistics Vienna in an annual booklet "Vienna in Figures." The latest edition, published in August 2023, will be used to illustrate the key characteristics of the city. As of January 2023, 1,982,097 people live in Vienna, with an average age of 41 years. (second biggest city in Austria). Since 2013, population growth has reached 240,851 people (+13.8%), with an average annual rate of 1.1%. The city is expected to surpass 2 million inhabitants by the end of 2023 (Vienna in Figures 2023, p.2). Vienna is a highly multicultural city, where 65.8% come from Austria, 14.5% from European countries, and 19.8% from other places.

The total area of the city is 414.9 km² of which 49% consists of green spaces and bodies of water. Vienna has 23 districts, with an average population density of 4,778 people per km². According to the report, over the last 10 years Vienna reached the second highest population growth among the largest European cities (+12.8%), first being Bratislava (+15.1%) and third Berlin (+11.8%). The figure below illustrates the population density:

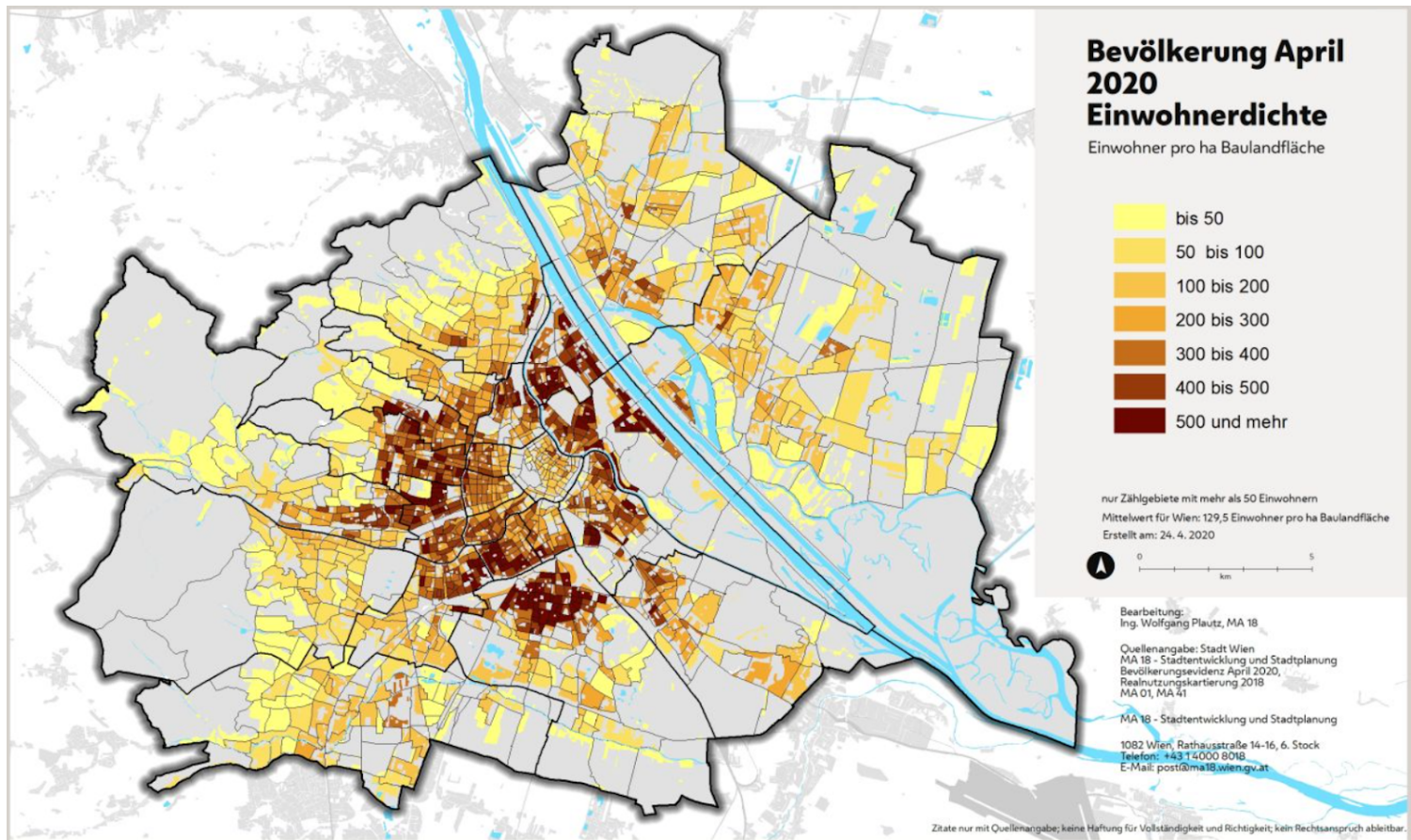


Figure 10: Inhabitants density in Vienna, 2020. Source: Stadt Wien MA 18 - Stadtentwicklung und Stadtplanung Bevölkerungsevidenz April 2020, Realnutzungskartierung 2018 MA 01, MA 41.

Most of the population is concentrated in the center of the city. The highest density district is Margareten (a bit below the middle zone), with 27,350 people per km². According to the 'Vienna residents' attitude towards tourism' report (2019) 35% of the respondents agree that the city is already very crowded with tourists. Vienna is an old city with many historical heritage sites. Approximately 68% of all the construction projects were built before 1980. This data, however, comes from 2011 and might be far from the current ratio. This implies that the integration of digital technologies might be rather problematic, as it requires new physical infrastructure or its redesign. Thus, the city might have to find new places or completely rebuild its old constructions.

The gross domestic product (GDP) of Vienna was €102bn (2021). This corresponds to 25,1% of the Austrian GDP in total. The Figure 11 shows the distribution of the budget in Vienna:

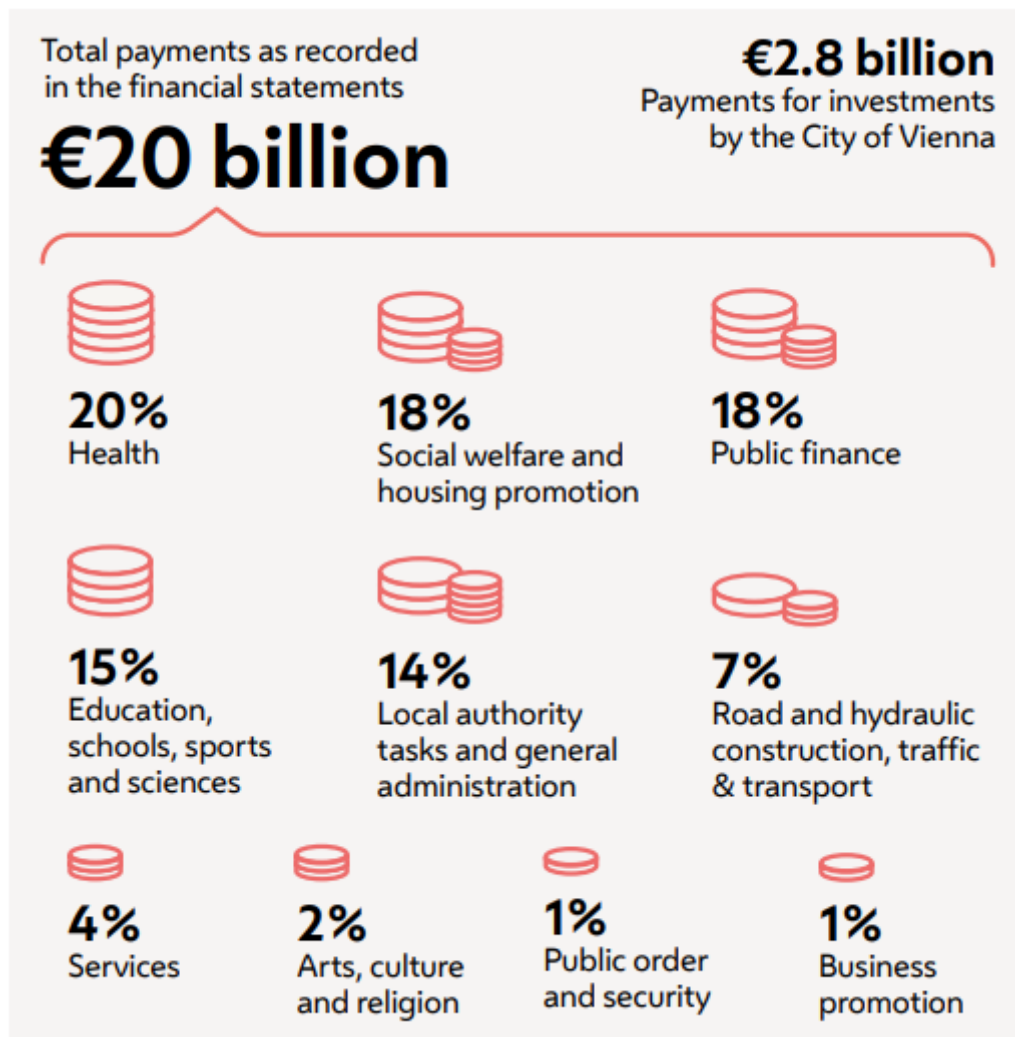


Figure 11: The budget of the City of Vienna in 2022. Source Vienna in Figures, 2023.

The four main investment areas are health, social welfare, education, and administration. However, there is no clear information on how much the city invests in digitalization or the Smart Klima plan itself. Digitalization is not highlighted as a separate category, but can be involved in any area.

The Smart City Initiative was launched in 2011 and the first plan was officially approved in 2014. The Urban Innovation Vienna institution adopted the goals of city administration

and presented a framework for future development. The first official paper published was “Smart City Wien Framework Strategy”. In 2019 and 2022, it was revised and adopted for the Sustainable Development Goals (SDGs) of the UN Agenda 2030:



Figure 12: The Sustainable Development Goals (SDGs). Source: The 2030 Agenda for Sustainable Development.

The SDG is a universal call for tackling the world's most persistent challenges. It serves as an overarching reference framework and can be applied both to a country or to a city. As the figure above illustrates, the UN Agenda covers 17 thematic fields, each with multiple targets. In Europe such international programs have a higher priority and are more likely to be adopted or used as a reference. As of 2023, 191 countries have voluntarily adopted this strategy in their development plans. The UN provides annual progress and sustainable development reports. The figure below illustrates the progress of all participants:



Figure 13: Progress assessment for the 17 SDG Goals. Source: General Assembly Economic and Social Councils' annual report on SDG progress, 2023.

Only some goals met their targets, but overall all areas needed an acceleration. The reason for such results is the lack of data provided by the participating countries. Most SDG indicators cannot be calculated, and most of the time, they are not internationally comparable. (p. 6). In the latest ranking, Austria was placed 5th with an overall score of 82.28 and only 3% of data were missing (Finland being first with 86.76):



Figure 14: Austrias' SDG progress. Source: Sustainable Development Index Dashboard, 2023.

Surprisingly, despite Austria's focus on climate challenges, goals 12 and 13 were reported to have a significant decrease in major challenges (CO₂ emissions, electronic waste, and nitrogen emissions embodied in imports and exports of plastic waste). Overall, the situation moderately improves with gender equality, showing the best results. SDG collects data through international non-private organizations such as WHO, OECD, Worldbank Data, and others. Thus it doesn't directly utilize the data provided by cities, but rather relies on already aggregated information. Currently the Smart Cities Network Austria consists of 8 cities: Vienna, Graz, Salzburg, Villach, Klagenfurt, Innsbruck, St. Pölten and Linz. Only Klagenfurt has a written Smart City strategy, which is also structured around SDG goals. Other cities mostly focus on the climate and environmental goals. In this group Vienna can be seen as a leader and a pathfinder with much more experience and also resources when it comes to establishment of Smart City strategies.

The Vienna Smart City Strategy shares guidelines for the medium- to long-term transformation of the city. The three pillars of this framework are: Quality of Life,

Resources Conservation and Innovation. The pillars were further separated into 11 thematic fields:

- 1) Energy supply
- 2) Mobility & Traffic
- 3) Buildings
- 4) Economy & Employment
- 5) Zero Waste & Circular-Economy
- 6) Climate Change Adaptation
- 7) Urban Ecology, Environment & Water
- 8) Health & Social Inclusion
- 9) Education, Science & Research
- 10) Digitalization
- 11) Participation, Engagement & Culture

All information about the strategy is available in german or english on the dedicated website <https://smartcity.wien.gv.at/>. The German version has more content and more recent updates compared to the English variant. The site provides information for the general public outlining the framework dimensions, goals, projects, teams, and strategy document itself. Currently, only one report has been published in 2017, which has already lost its relevance. The biggest question that remains after looking through the site is how the goals will be achieved: what methods will be used, who will execute the strategy, what is the budget, who is responsible, and so on.

The organizational landscape of Smart City Project look following:

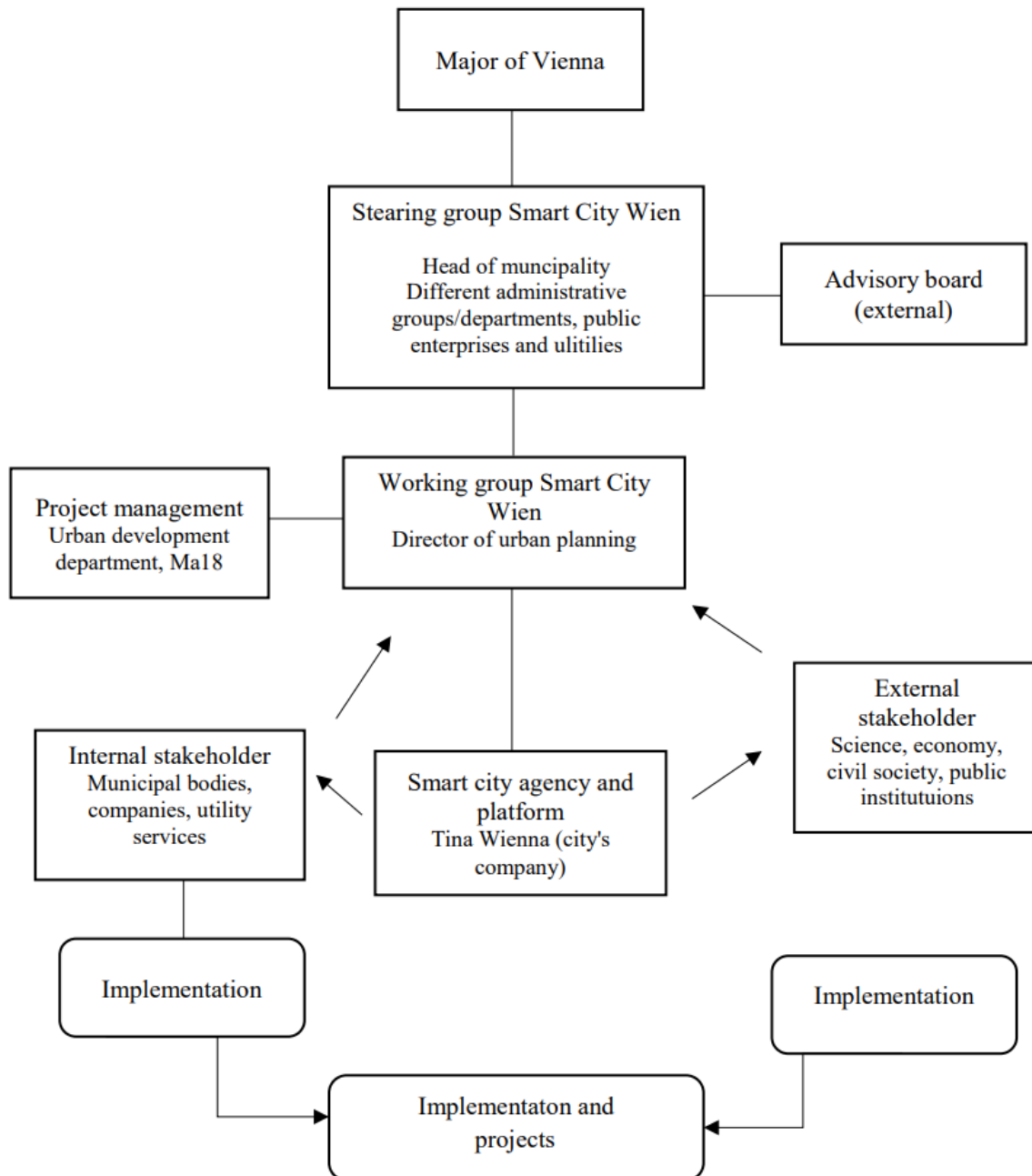


Figure 15: Governance structure of Smart City Vienna. Source: Vasja Roblek, 2019.

The framework represents the goals set by the mayor of Vienna. These are then summarized and adopted by the advisory board Urban Innovation Vienna GmbH,

together with the Smart City Agency. Each municipality and administrative department develops its own approach and methodology to achieve them. There is no central authority responsible for monitoring the process; thus, each individual actor is responsible for the outcomes and for providing the data for reports. The smart city plan involves various stakeholders both inside and outside the city. The implementation step comes after a circular discussion among stakeholders, private and public institutions, governmental bodies, and civil society. The contribution and influence of each highly depend on a particular project and its characteristics. As there is no central regulatory body, the evaluation of the projects occurs at different levels simultaneously and then communicated vertically. Essentially, implementation follows a strict top-down approach of governing with bottom-up discussion, taking place only in the final steps of project execution. From the perspective of an ideal Smart City, the framework should include citizens or elected civic representatives already at the stage of development, and the methodology should be designed according to the needs and wants of both parties. This places Vienna somewhere between the two smart-city generations outlined by Trencher (2019). The discussion in public sources and official publications leans towards the second generation of smart cities, while actual execution follows the first. However, depending on the target area, this ratio is quite different. Smart City Plan was presented as the central framework, and all other strategies in the city were based on its goals and principles. This includes the Digital Agenda 2025, City Development Plan (STEP 2025), visitor strategies, Healthcare, Economy, Education, and others. In the following chapters, an in-depth look will be given to the practices of digitalization and civic participation presented in the ‘Smart Klima City Wien’ and ‘Digital Agenda 2025’ documents.

5.2 Smart Klima Wien Strategy

The latest revisited version of the Smart Climate City Strategy Vienna was presented on February 23, 2022. The major changes were caused by the integration of two new objectives: “Climate neutrality by 2040” and a Vienna “greenhouse gas budget.” All

previous goals were adjusted to meet new requirements. This development was financed by the Vienna Climate Budget. This time the city also presented an evaluation authority the 'Vienna Climate Check,' which however is only responsible for the climate goals. Lastly the programme introduced 'Vienna climate teams' an initiative which provides an opportunity for the citizens to participate in the city development plans and climate protection.

The Smart Climate City Strategy Vienna is available in German and English. It is approximately 130 pages long, with five thematic chapters. The goal of this study is to identify and analyze practices based on digitalization and digital tools. The strategy has a dedicated chapter to digitalization; however, other parts refer to it as well. Overall the text has 126 mentions of the word "Digital-" most of which are concentrated in the dedicated chapter. The city is presented here as Europe's digitalization capital (Smart Klima Wien Strategy, 2019, p. 38). Digital capital is defined based on how digital tools are being used. This includes:

- 1) Digital Humanism - digital tools should improve the quality of life for the people.
- 2) Driver of Innovation - as digitalisation offers numerous opportunities, a city should promote innovative culture and co-creative practices.
- 3) Transparency and Participation - digital platforms should provide equal opportunities and empower citizen participation.
- 4) New jobs - a city should help in transitioning to the new labor market established by digitalisation
- 5) Climate and Sustainability - digital toll are key in achieving the strategy goals. However this applies only if the costs of digital systems do not exceed the benefits.

Overall, the focus was on participatory opportunities and the effectiveness of digital tools. Interestingly, there is no mention of digital security, and possible negative consequences are left away here.

The vision about Vienna as a digital capital is also presented in 'Die Wiener Fortschrittskoalition' (Vienna Intergovernmental Agreement, 2020) - a program arranged by two social-liberal parties SPÖ und NEOS. Within the Smart City strategy, it proposed a digital agenda with seven thematic fields. *Data Strategy* establishment for digital platforms for different purposes (social, political, educational, etc.). Plan development for future technologies, such as AI and their regulations. *Data Protection* new institutions like "Security-Hubs" and "Vienna Cybersecurity and Privacy Research Centers" who would secure digital activities. Increasing population awareness of the topic through new projects and programs. *Digital Business Center* further developed the Open Government Data platform and the distribution of the OpenSource software. Digital replica or 'twin' of the city for monitoring planning and simulation. New services and product infrastructure that allows integration of digital solutions at the individual and political levels. Attractive conditions for IT companies and the support of small local ones. *Education and Science* IT tools for educational institutions. Professional development for teachers and IT professionals who will support them and students. *Digital Competence* educational measures to support responsible behavior in virtual space. Support for digital crime victims. *Digital City Governance* services promote digital participation in city administration and planning. E-governance platforms like mein.wien.gv.at for all potential citizens' needs.

The Digitalization chapter is six pages long. It includes an introduction, goals, current plans, and ongoing projects. It is not explicitly explained what is being understood through digitalization. The introduction part again shares the vision of a digital capital but also includes the importance of data protection: ". At the same time, members of the public retain full sovereignty over the utilized data at all times" (ibid., p. 108). The goals of the city are to fully automate all possible services by 2030; build demand-oriented, resource-saving, and resilient digital infrastructure; establish resource-efficient digital services, where 75% of the energy requirement will be covered by renewables and 100% in 2030; build a publicly available extensive data pool for decision-making and management purposes; empower digital participation; and promote digital rights and competencies. Overall, the goals are oriented toward general achievements without emphasizing the specific target areas or challenges of the city. The main challenges

remain climate and sustainability. The current plans are categorized into five groups, as summarized in table below.

Plans	Achievement Strategy
Creation of digital services	Digitalisation of municipal services and provision of alternative analogue channels for communication
Long-term planning and delivery of digital infrastructure	Establishment of an infrastructure for IoT services
	ICT infrastructure for Vienna's educational institutions with high-performance broadband and Wi-Fi
Data utilization as the basis for Smart City	Applications and sensors for data collection
	Open Government Data
	Personal data protection measures
	Digital replica of the city for prognosing and future management
Building up digital participation	User-friendly design for public participation platforms
	Digital 'Living Labs' for direct development of city solutions bypassing bureaucratic obstacles
	Network of digitalisation-driven city initiatives like DigitalCity.Wien
Support digital equality for all groups	Qualification programs to train and promote digital skills
	Integration of IoT and AI into municipal administration
	Educational programs designed for specific social groups (schoolchildren,

	people aged 65+ and women)
	Support of medium-sized enterprises (SMEs) by service digitalisation
	Policy making for data protection and digital security at National and European level
	Support of interdisciplinary research on the topic of digitalisation

Table 1: Smart City Vienna digitalisation plan. Source: Summary from the “Smart Climate City Strategy Vienna”, 2023.

The achievement strategy shared in the document does not provide a methodology but rather illustrates different areas where various activities will be found. However, these areas do not exist independently. They share the spheres of interest of different departments, smart city dimensions, and Vienna’s 11 thematic fields. Thus, implementation and monitoring can be performed by different institutions, stakeholders, or actors. While the ‘Vienna Climate Check’ is assigned to observe climate-related challenges, other areas do not seem to have centralized monitoring. Simultaneously, the utilization of data provided by smart city projects is supposed to provide reliable information that would allow us to summarize the results across multiple levels. Areas that cannot be fully digitalized or quantified remain unclear. Digital service effectiveness is described as the possibility of direct transactions between two or more actors, while the process can be recorded and statistically analyzed. This also means that if a participant is not willing to share such data, other stakeholders would not be able to benefit from it. The current solution is to anonymize the digital data and embed certain restrictions on how it can be used. At this point, there are two contradicting fields of digital agenda by design: open data vs. personal data protection.

The document emphasizes a collective planning process at the federal level, where all stakeholders should question projects’ digitisability” (ibid., p. 121). This can be explained as a redesign or reassessment of currently established practices by integrating digital tools. Addressing “digitisability” could also mean an acknowledgment

that not all services can be digitized or that some interactions still require analog practices. This topic also raises concerns about unequal representation in digital projects. In advance, they require citizens with certain skills and access to digital platforms and tools. Even if alternative analog services are provided, digital options will always be as effective as they are supposed to be. Following the document, analog services should be fully automated; however, it does not discuss whether everyone will be ready and 'included' at this point.

This chapter also suggests three projects that are currently running. 'Digital building permit' or BRISE is a project which uses Building Information Modeling (BIM) software to create 3D models of constructions. It uses augmented reality where future projects could be integrated into already existing infrastructure, in other words, a digital twin of the city. Overall, it allows the acceleration of the permit process and evaluation of changes in the area. These results are expected to be shared among other cities across Europe. The second project was the 'Culture Token' App. It is a bonus system for Vienna's residences, where people are rewarded with Tokens for environmentally friendly activities, such as walking, cycling, or using public transport. Tokens can later be exchanged for museum or theater tickets. It is currently in a pilot phase with 2.000 participants who are recruited from the Vienna Digital Test community. The last project is also an app called Sag's Wien. It is a platform that allows people to notify municipal administrators of any problems. According to this document, local authorities received more than 100.000 reports from the app launch in early 2017. As mentioned earlier, this project cannot be placed in one specific category in Table 3x. The latter two are mostly oriented toward citizen participation, which is voluntary and does not necessarily encourage people to use the app.

Digital solutions are also discussed in the other chapters of the text. If we look at 17 SDG goals, 10 include digitalization (ibid., p. 120-121). However, in real-life scenarios, all would require digital activity at a certain point. The city expects that digital platforms will improve the logistics of drivers' services, thus reducing CO2 emissions (ibid., p. 57). In the construction sector, digital services should replace analog long-lasting bureaucratic improvement processes and allow for better planning through 3D modeling, such as BRISE (ibid., p.64). Social inclusion is acknowledged to be a problematic sector when it comes to digitalization; thus, the city has to consider

negative aspects (ibid., p. 96). However, it is not communicated whether the approach would be the same as in Climate and Sustainability, where benefits should significantly surpass the costs of digital systems. In the social sphere, this would mean that the gap between groups with and without knowledge of digital systems will constantly increase. To address this issue, the city proposed a “Digital Education 2030’ strategy, where schools will be provided with the required digital tools. How the Internet can be used, media, and digital skills will be included in the study program (ibid., p. 104).

Summarizing this document provides an overview and vision of the digital development of the city. The strategy itself is a guideline for other city departments and stakeholders responsible for implementation. Therefore, it does not provide a methodology or a detailed explanation of particular tasks. As responsibility is split among all actors, it is also difficult to outline a centralized authority. Digitalization can be described as a decentralized phenomenon. However, if we look at the platformization tree suggested by Van Dijck (2021), all digital services defend the same physical infrastructure owned by several IT companies. The city also depends on it. For example, to provide apps you have to follow Apple or Android store regulations which can collect data for internal use. From this perspective, a city acts as a surveillance machine that possesses full authority over the produced data. In the opposite scenario, where individuals receive full authority, the city or other stakeholders would have to buy the data or receive it by other means. The second scenario was used purely as a theoretical example. Currently, the design of digital services expects users to always agree on the service terms. It means that users willingly pay with their data to use some service for ‘free,’ in return becoming more and more dependent on a certain company like it was illustrated by Shoshana Zuboff (2019) in her behavioral surplus model (see p. 30). The question is whether digitalization within the Smart City Framework follows the same principles. To answer this question, the following chapter reviews Digital Agenda 2025 for the city of Vienna.

5.3 Digital Agenda 2025

This document was published in September 2019. It was published by the City Councillor of Finance, Business, Digital Innovation and International Affairs. The

following governmental bodies took part in its assessment: the Chief Executive Office of the City of Vienna, Executive Group for Organization and Security, Group Process Management, and ICT Strategy (CIO for the City of Vienna). The document is available on a dedicated platform 'digitales.wien.gv.at,' which also provides updated information. The content of the platform will be used to obtain additional material beyond the limits of the text (Mayring 2014, p. 88). The agenda is 83 pages long and is available in German and English. Similar to the Smart City Strategy, it operates as a guideline for city institutions responsible for execution. The agenda is designed not as a set of rules, but as a "to-do list" with seven fields of action. It follows the goals of the Smart City strategy in achieving the status of European Digital Capital. The document emphasizes the role of citizens, whose interests should define digital priorities, projects, and services (Digital Agenda 2025, 2019, p.9). Two questions are outlined in the agenda:

- 1) How can the potential of new technologies be put to the service of all citizens of Vienna?
- 2) How can related opportunities be taken advantage of while simultaneously avoiding risks?

The focus here is clearly made on social inclusion and sustainability. Following the previous discussion, Digital Services should be available to all citizens, empower participation, and overcome related urban issues and inequalities. Simultaneously, the city should follow its sustainability goals, where the benefits of digital services should always exceed the costs. It is clearer and more measurable when it comes to environmental issues, while the social aspects of the issue remain unclear. Yet, in both documents and other used sources, it was not clearly communicated what is being understood under 'digital risks.' So far, this is referred to as data protection and equal access to digital services (availability and education). In the text the risk issues are described with a term 'Digital Divide' which is being explained as a "...differences between various population groups in terms of their access to new information and communication technologies and their use. This digital gap leads to new or perpetuates existing inequalities in people's social and economic development opportunities." (ibid., p. 68). From the perspective of Technology Acceptance Theories (see Chapter 3.5), the 'digital divide' is an intrinsic element of digital innovation that includes individual attributes and cultural and contextual meanings. The citizen-centric Perspective on

Smart Cities advocates that the design of smart solutions (including digital projects) should be structured around individuals, which, in turn, can hinder the pure effectiveness of a technology. These two questions raise the dilemma of digital technology implementation: equal and inclusive distribution versus achievement of all potential advantages.

As digitalization significantly changed numerous interactions and developments happening in the city (ibid., p.11), Vienna sees it essential to cooperate with all actors who now can access the decision-making process through ICT services (ibid., p.12). This includes not only citizens but also businesses, local and global companies, different departments of the city, tourists, etc. Social inclusion is seen here as an “...opportunity for everyone to participate in the benefits of digitalization, regardless of age, education, etc.’ (ibid., p. 15). At the same time the agenda suggests that alternative, traditional communication channels are still needed. If we look at the Rogers (2003) adopters model (see p. 39), the adoption of innovation does not result in equality between different groups. Thus, technology needs time, and when it eventually loses its ‘innovation’ status, it reaches the entire audience. Technically, analog channels or alternatives, as described in the agenda, should decrease the initial spiking gap between those who do and do not use digital services. The question is whether it will always work and if all projects in Vienna provide such an opportunity. Agenda proposed the set of principles summarized in the table below:

Principle	Challenge
Age appropriateness, accessibility and digital equality	Social Inclusion
Citizen orientation	Social Inclusion
Autonomy	Automation of Services
Flexibility and learning	Responsible Behavior
Gender equality	Social Inclusion
Innovation	Digital Governance
Consolidation	Governance
Sustainability	Responsible Behavior / Sustainability

Openness, transparency and participation	Trust and Security
Strengthening the business hub	Economy
Independence	Automation of Services
Trust and security	Trust and Security

Table 2: Digitalisation principles of Vienna. Source: summary from the “Digital Agenda 2025”, 2019.

Overall, the principles try to cover all potential intervention points of digital technologies at a superficial level. Most refer to the same categories without providing a significant explanation of a particular issue or solution to the corresponding challenge. A city is responsible for the regulation and security of its digital services. While it is supposed to be transparent, from a digital perspective, a city acts as a surveillance mechanism. The autonomy principle does not suggest a decentralized manner of data transactions or the autonomy of individuals over their data. This is not an ethical evaluation, as it would require studying a particular project; rather, from a theoretical standpoint, these principles are also applicable to the surveillance model global IT companies follow.

Digital Agenda dedicates a chapter on 11 projects that are being identified as successful practices. As some of the projects are already over-or facing structural changes in the process, external sources are needed for an appropriate evaluation. The document also did not provide any quantitative reports or statistics to evaluate whether a project was successful. The projects can be grouped as follows:

Applications: Sag’s Wien, WienBot, Stadt Wien Live

Digital Platform: Open Government Data, Mitgestalten

Events: : DigitalDays

Integration: Social Media Strategy, Vienna’s IoT strategy, MA 01 – IT Department, Pilot projects with blockchain technology, AAL project "WAALTeR"

Most of the presented projects target the integration of new digital solutions and the integration of society into this new environment. Their evaluation is problematic due to the absence of data. Some of the examples are included in the discussion. The

following sub-chapters provide a summary of the seven action fields defined in the agenda. Each specifies its objectives and key project.

1. SECURITY action field: RELIABLE CITY

Vienna has a very high data security standard. The approach of a city is to provide reliable and secure infrastructure, even at the cost of efficiency. This makes the biggest difference to the surveillance nature of IT companies. While both are concerned with the security of data, Vienna does not collect or sell information beyond the needs of the city. The needs are defined in accordance with citizens' rights and interests; thus, in some cases, they can be quite limited. This mechanism also helps to build trust among people in digital services.

Security Hub Wien manages digitalization-related activities in the city. The HUB is responsible for developing educational strategies for residents, supporting research, and ensuring the sustainability of digital services. E-learning is seen as a powerful tool that can introduce people to the digital world and simultaneously educate them about its inner structure. Digitales.wien.gv.at platform provides six quick online courses (5 to 20 min) covering the most important tools and processes the digitalisation offers. Users can check their learning using a 20 questions quiz.

The Computer Emergency Response Team (WienCERT) in the main office is responsible for comprehensive IT security. It acts in emergency situations and maintains the protection of platforms and apps provided by the city. The city plans to integrate blockchain technology and encryption to protect the data. In Vienna, the implementation of digital solutions often requires changes in laws or the establishment of new ones, which can take a significant amount of time. The city also has an electronic directory for all data applications (DAVID) that lists all apparitions in accordance with the GDPR goals.

2. SERVICE action field: THE CITY AS A DIGITAL SERVICE PROVIDER

The second field ensures the digitalization of key services provided by the city. This involves redesigning previously used communication channels. Participation through digital services is represented here as the new main organizational principle of the city. An optimization of governance through digitalization is expected to contribute to sustainability issues in the city. Most services are available through platforms or apps such as Mein Wien, WienBot, and BRISE. Viennas vision is to structure the city as a “service.” Direct transactions between citizens and city authorities should be made available through digital services. It is unclear what happens with services that require physical presence or face significant limitations while being digitized. Again, this leads us to the idea of a platform society by José van Dijck (2018). All relevant actions are happening on platforms; thus, those who do not have access are excluded from pretty much any participation. One of the experts mentioned that approximately 30% of Viennas residents did not have the right to vote. This significantly limits opportunities for participation. Additionally, if a city does not collect all the available information as a private IT company, such platforms would be limited to an evaluation. This can lead to new breaches and gaps between various social groups and detach some from the governance processes.

The agenda shares several projects that are under review and design. This involves real-time monitoring and tracking, such as traffic simulations or smart city dashboards. The city is expected to establish a new digital payment system. It would contain a summary of citizens’ obligations and quick payment methods. A large emphasis was placed on the automation of public office services. In the long run, this means that the majority of the ‘supporting’ jobs in the administration would be substituted by digital tools such as AI or algorithms. Some automation examples from the agenda are driverless bus lines and fully automatic subways. As most of the services will be digitized, human intervention will only be needed in the case of an emergency or at a high end of management.

3. KNOWLEDGE action field: FIT FOR DIGITAL SOCIETY

To achieve the ideals of a second-generation smart city, not only an advanced infrastructure but also a knowledgeable society is needed. Even the chapter name refers to digital society as a new group in which people should be integrated. Education, training, and professional development should deliver the required knowledge and skills regarding digital transformation, thus empowering people to participate in the future. A step-by-step approach such as this allows the city to homogenize adopter groups (see p. 39). This is a long-term strategy and, as in many Smart City goals, the results can be seen only after several years. Digital tools are expensive and unaffordable to some people. This is another obstacle that needs to be addressed. Currently, the city plans to provide all the necessary technologies to all educational institutions. Considering the shifts in the labor market, such a strategy would allow the city to obtain more experts and people with sufficient knowledge of the digital environment. Later, it should be easier for them to find a job, since they already acquire general skills in school. However, the city needs to train teachers and obtain more digital experts involved in the educational process. Considerable attention has been paid to unequal representation in the IT sector and the support of senior citizens. Citizen-centric development of Smart Cities expects that the peculiarities of social groups, instead of raw efficiency, should determine the design of digital solutions.

Vienna has established and supported many research centers in the city. The goal is to build a network of research institutions that conduct research in all areas. This network goes beyond city or country boundaries, as a shared contribution is required for success. The COVID-19 crisis exposed areas that suffered significantly due to lockdowns and mobility restrictions. From the author's personal experience, observations, and research, it took a significant amount of time for the University of Vienna to adapt to these changes. At the same time, the consequences have proven that full digitalization of educational areas could work for a certain period of time.

4. WORKING WORLD 4.0 action field: FAIR RULES FOR NEW WOR

According to the Agenda around 200.000 people in Vienna work in the IT Industry. The city expects a loss of a number of jobs due to digitalization and acknowledges that the new ones will require highly qualified people (ibid., p.7). The main objective of the city is to establish a sharing economy strategy, a collaborative economy model in which individuals and organizations share various goods through online platforms. At the same time, the city plans to strengthen its traditional physical retail. As digital trade and e-commerce advance constantly, brick-and-mortar retail small businesses, which provide a significant number of jobs, need support. The city approach currently is: "profits should be taxed where they are generated" (p.50) other possibilities should be developed in the nearest future. The current main project of the city is "Digi Winner". The Vienna Chamber of Labor and the Vienna Employment Promotion Fund (WAFF) provide 5.000 funding for their members for continuing vocational education and training. Vienna is currently experimenting with establishing a bridge between e-commerce and physical retail, where the latter gains access to platforms established by the city like "Shöpping Wien." Overall, the plan resembles a transition step. By the time old jobs vanish, the city expects to have enough skilled people to fill new positions. Experts expressed concerns that within the timeframe set by the agenda, it is rather unrealistic. The timeframe of both the Smart Klima Strategy and Digital Agenda is very short. Thus, it can be expected that the correlated goals will eventually be achieved simultaneously; however, they will exceed the current timeframe.

5. BUSINESS action field: STRONG ICT LOCATION VIENNA

The ICT industry is seen as the most promising sector in Vienna's economy. Around 6.000 ICT firms generate around 8% of the sales achieved by all companies located in Vienna (ibid., p. 51). The main advantage of this sector is that it provides interdisciplinary technologies that are used in all other areas of the city. The initiatives are funded by the Wien Digital program and are available for small and medium-sized enterprises (SMEs) operating in Vienna for at least one year. The city continues to build the DigitalCity.Wien network that supports local businesses. Vienna also has a digital trade exhibition "Digital Days" where ICT companies share their experience and discuss technological trends. Open Source Software (OSS) is considered the main driver for

innovation and the implementation of new technology trends. This creates cooperative opportunities for businesses and the city, thus creating transparency and increasing security.

Vienna also aims to become one of the main research and innovation centers in Europe. The approach is to support ICT start-ups and attract international companies to work in cities. Meeting Destination Vienna is a project that attempts to make the city the most attractive destination for international conferences and discussions by providing reliable and accessible infrastructure. This includes not only business or political meetings but also other industries such as entertainment and science.

6. INFRASTRUCTURE action field: INTELLIGENT TECHNOLOGY FOR THE CITY'S FUTURE

The implementation process for any digital solution begins with building an infrastructure. Similar to the platformization tree, the roots of any smart city would also be hardware, data centers, sensors, and devices, for example, physical infrastructure. One of the biggest digitalization advantages is the speed at which information can be transferred and utilized. The digital infrastructure of Viennas is described as an intelligent "nervous system" that enables the interconnection of various data points in a sustainable manner.

One of the key projects outlined in this chapter is the AI strategy for Vienna, which aims to identify use cases for artificial intelligence to enhance existing workflows and develop new services. Another project focused on making Vienna a European pioneer in 5G technology, with pilot projects and a strategy being developed to provide comprehensive 5G coverage in the city. Other projects include intelligent traffic control, the integration of environmental sensors on traffic lights, smart support for senior citizens using new technologies, open government data initiatives, the use of blockchain technology, and various digitalization projects such as smart parking, trend monitoring, drones for inspection and surveying, and the use of virtual reality (VR) and augmented reality (AR) for training and building permit applications. This chapter emphasizes the importance of APIs for facilitating access to a city's data and promoting the creation of valuable

ecosystems around data repositories. Most of the ideas are oriented towards the nearest future, and only some projects, such as BRISE, have been implemented.

7. CONTROL action field: IT-GOVERNANCE & INTERNAL PROCESSES

The 'nervous system' of Vienna is being controlled through the E-Governance coordination. The objectives of the control action field include establishing digitalization control groups and executive boards, developing the city's CIO department as a think tank and innovation driver, appointing digital officers for each department, establishing a dynamic ICT strategy, and employing modern ICT equipment throughout the city. The city has established "Municipal Department 01" (MA 01 – Wien Digital), which manages digitalization-related activities happening in the city. The motto of the department is "Stadt der kurzen Wege" which means a city where interactions are happening through ICT services, significantly outperforming traditional methods of governing. They should allow citizens and other actors to save time while interacting with a city and bypass the usual bureaucratic procedures. The department uses approximately 5.300 databases. It operates primarily through the Mein Wien platform. According to the city administration, the platform has 430.000 active users (~22% of Vienna's population) and 2,2 million people visited it in 2022³.

Key projects of this field outlined in the Agenda include the Digitalization Control Group, responsible for setting clear goals and projects to make Vienna a capital of digitalization, and the Digital Officers, who drive digitalization initiatives in collaboration with the ICT department. The Chief Information Officer (CIO) plays a key role in the planning and implementation of ICT and digitalization strategies. Similar to the 'Vienna Climate Check,' Vienna tries to establish a centralized authority responsible for the digital life of the city. Interestingly, Blockchain and AI technologies that are mentioned on multiple occasions in the agenda follow rather opposite principles. For example, blockchain is built on the idea of a decentralized peer-to-peer network, and its functionality is regulated by the users themselves. In the case of AI, it is still not clear who should be responsible for the outcomes: people who wrote the code, institutions, or organizations that implemented it, users who accepted the terms of service (TOS)? In the digitalization path, a city has to bear negative consequences by itself.

³ Wien Digital in Zahlen: <https://www.wien.gv.at/kontakte/ma01/zahlen.html> (Retrieved August, 2023).

This could be one of the reasons for choosing a citizen-centric approach, in which technology only has a supportive role instead of surveillance. This limits the controlling possibilities, but at the same time, takes some responsibilities away.

5.4 Monitoring and Evaluation: Smart City Indicators

Building indexes and metrics still remains the best way to provide an overview of the progress of becoming a Smart City. As discussed previously, some areas remain hidden or cannot be quantified. Some aspects, such as participation, do not reflect accurate progress, as it is difficult to set the point of reference. In such situations, indicators should be used to compare current data with previous years. Metrics also help identify areas that are lacking in monitoring and should receive more attention. For these reasons, a Smart City requires continuous evaluation to identify the challenges and risks appearing in the process. In this section, we explore the measurement system developed in Vienna. Furthermore, the chapter discusses the role of data in smart city indicators, emphasizing the importance of data collection, analysis, and visualization to derive meaningful insights. The material for the analysis is the Vienna Smart City report 2017, Preliminary indicators for monitoring and evaluation (2022) and Indicators suggested by SDG 2030. The results of such reports can serve as a guide for policymakers and urban planners. Thus, in a case study, they would reflect particular cities' understanding of the corresponding issues and measurement of success. Compared to the Smart City Strategy and Digital Agenda, the evaluation of chosen indicators would help reveal how Vienna will actually try to achieve its goals and what city actors take part in execution and analysis.

Monitoring Report 2017 Smart City Wien Framework Strategy

The only currently available monitoring report (as of summer 2023) was carried out in 2017 by the Municipal Department MA 18 (Urban Development and Planning) and covers the period from the initiatives launched in 2014. The results of the document are outdated; thus, some of them may not be relevant to the time of writing. The prior versions of the Vienna Smart City strategy did not include the eleven thematic fields. The report follows the same three pillars: Resources, Innovation and Quality of Life, each with specific sub-categories. All digitalization-related results can be found under the ICT category in the Resources section.

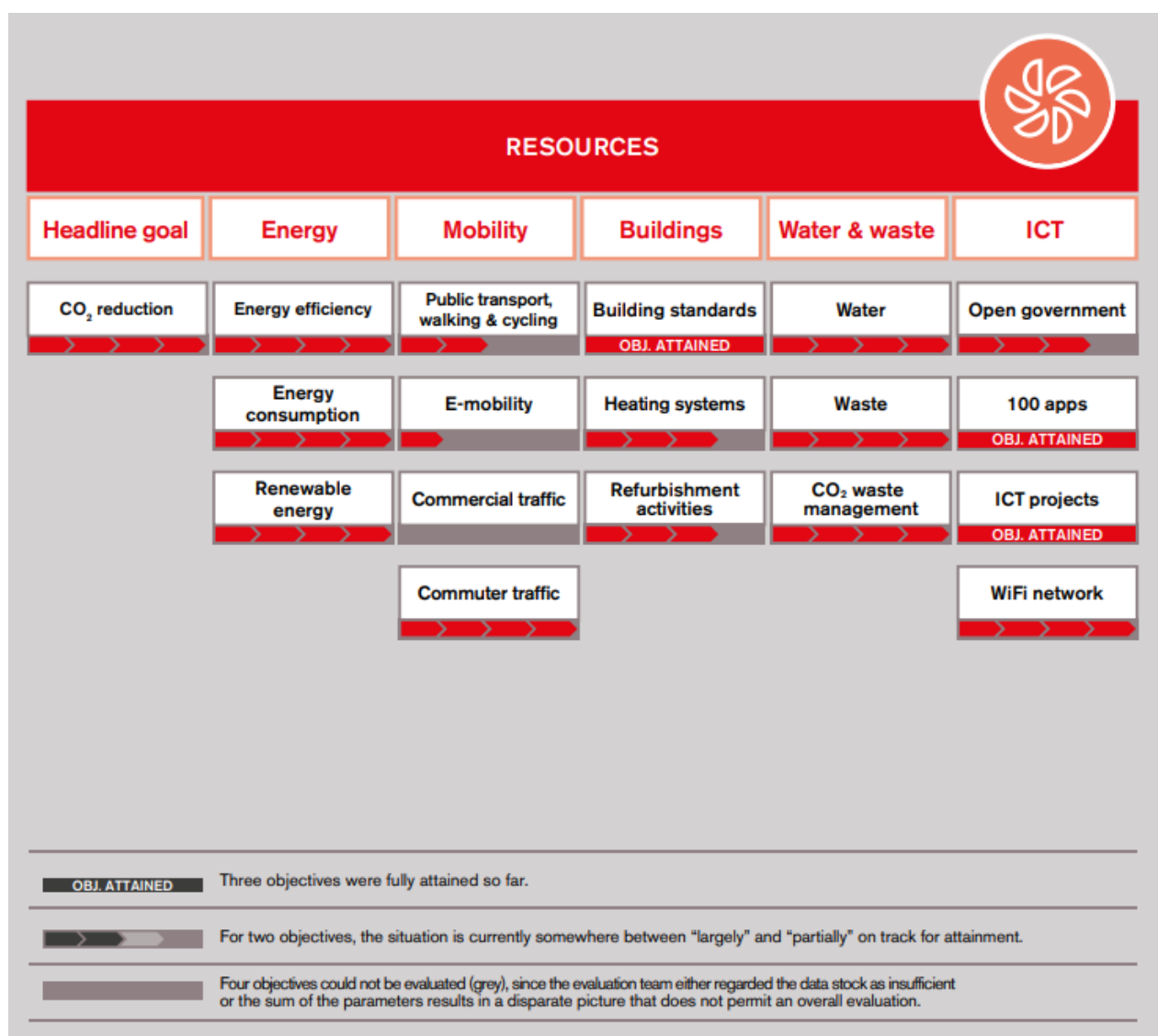


Figure 16: Smart City objectives evaluation. Source: Monitoring Report, 2017

As the Figure suggests, two objectives were fully achieved, WiFi and open government were largely on track for attainment. A table of indicators is no longer available. According to the report, 210 open government data applications were launched in this period, 425 public Wi-Fi hotspots were installed, and seven pilot projects were initiated. Digitalization was identified as a relevant thematic field that requires a separate assessment and evaluation (Monitoring Report, 2017, p. 67). A generalized outlook also caused some objectives to conflict with each other, such as economic growth and sustainable consumption (ibid., p. 61). Overall, the report does not provide detailed data. Rather, it offers a visual representation that is open to subjective interpretations. Some important conclusions were drawn after reviewing the city actions: adjustment of the indicators, better data management, cooperation between municipal departments and involved actors, and a set interval for future monitoring reports (ibid., p. 75-76). This example shows that smart city benchmarks can help cities identify implementation issues and allow reporters to discover problematic areas that either lack attention or require new appropriate methodology and tools. It remains unclear how this experience can be shared with other cities. Looking at the new list of indicators should help clarify some uncertainties discovered in the Monitoring Report.

Smart Climate City Vienna Preliminary Indicators

In May 2022, the city administration published preliminary indicators to evaluate the renewed climate strategy. Compared with the previous approach, a combination of qualitative and quantitative indicators was used in this study. The document covers all 11 thematic fields. The information is presented in the form of a table with four categories: goals, indicator(s), definitions, and data sources. The indicators are available only in German and cannot be found in the English variant of the smartcity.wien.gv.at website. The digitalisation thematic field has 6 goals and 17 corresponding indicators.

Goal	Indicator(s)	Data Source
Digitalization and automation of all relevant services by 2030	Proportion of digitized processes out of all processes/services	Survey by Stadt Wien, MA 01 - Wien Digital
	Number of applications submitted or services used via Mein Wien.gv.at	Survey by Stadt Wien, MA 01 - Wien Digital
	Joint digital agenda of the City of Vienna and its institutions	Stadt Wien, Magistratsdirektion, Geschäftsbereich Organisation und Sicherheit, Gruppe Prozessmanagement und IKTStrategie (MD-OS PIKT)
Demand-oriented, resource-saving and resilient digital infrastructure	Area coverage with current digital network infrastructure	Breitbandatlas Bundesministerium für Verkehr, Innovation und Technologie (BMVIT) resp. GIS data of the city Vienna, MA 41, Stadtvermessung; Wirtschafts-/Nutzungsdaten der Stadt Wien, MA 23, Wirtschaft, Arbeit und Statistik
	Expansion of a modern, secure and stable ICT infrastructure at Vienna's schools.	Survey by the City of Vienna. MA01/MA56
	Number of IoT sensors used in the city	City of Vienna - MA01, Wiener Stadtwerke (WSTW)
Resource efficient digital services	Percentage of digital services energy use from renewable energy sources	Survey of municipal IT: City of Vienna, MA 01, Vienna Digital network operators: Survey by City of Vienna, MD-OS PIKT.
Publicly available extensive data pool for decision-making and management purposes (Open Government Data)	Established set of rules on digital data and its processing	MD-OS PIKT
	Quantity of digital data used	Survey by the City of Vienna, MA 01 - Vienna Digital
	Number of real-time applications based	Survey by the City of Vienna, MA 01 - Vienna Digital

Goal	Indicator(s)	Data Source
	on digital data	
	Share of publicly available OGD datasets of Viennese companies in the total dataset - HVDS	Wiener Stadtwerke and other Viennese enterprise(s)
	Share of publicly available OGD datasets of Vienna in the total dataset - Total	City of Vienna, MA 01 - Vienna Digital
Empower digital participation, create transparency and enable active co-decision-making.	Number of available digital participation tools resp. specific use cases.	Coordination of the survey by the City of Vienna, Magistratsdirektion, Geschäftsbereich Bauten und Technik, Kompetenzzentrum übergeordnete Stadtplanung, Smart City Strategie, Partizipation, Gender Planning (MD-BD KPP)
	Number of established city labs	City of Vienna, MA 01 - Vienna Digital
	Number of piloted technologies	City of Vienna, MA 01 - Vienna Digital
Promote digital rights and competencies	Number of schools participated in the DigitalCity.Wien Education Initiative.	UIV Urban Innovation Vienna GmbH
	Number of departments with Digital Officers	MD-OS PIKT

Table 3: Preliminary indicators for Smart City evaluation. Source: translation from Vorläufige Indikatoren für Monitoring und Evaluierung, 2022.

Of the 17 indicators, only two were qualitative: a joint digital agenda strategy and an established set of rules on digital data. The remaining indicators reflect the overall number of digital tools used or the number of people and institutions that use them. At the time of writing, there were no published points of reference or base values to be determined during the first survey in 2020. Based on the table, the success of the current strategy is evaluated based on the number of digital services and their share from the overall or analog services provided in the city. There are no criteria to measure

the quality of services or their efficiency. The latter will be analyzed through comparison to the base values of 2019 and 2020. It is not mentioned if (or how) the COVID-19 consequences would be considered, which significantly increased the use of digital services at that time. Little attention has been given to the security of digital data. The topic of AI or blockchain is also not mentioned here. From the selected indicators, it is not clear how digitalization will impact sustainability issues and what solutions it can provide. Most of the data will be gathered and provided by Municipal Department 01. Surprisingly, no statistical institutions, such as Statistik Austria, are planned to be involved. It remains an open question of how the city could use these data to improve the current approach or indicate the tension points, as in the first report. The path to the 'Digital Capital of Europe' will be measured based on the "Digital Economy and Society Index" (DESI) (Preliminary Indicators, 2022, p.3). The SDG 2030 Agenda does not have any specific digitalization indicators, but it uses data from the International Telecommunication Union's (ITU) "Measuring digital development: Facts and Figures 2022". Both of these are reviewed in the next section.

DESI and ITU

The Digital Economy and Society Index is a summary of the indicators of Europe's digital performance. It was launched by the European Commission and has monitored all member states. Recent reports have mostly been based on data collected during the COVID-19 pandemic. According to the DESI, European countries have invested EUR 127 billion to support digital transformation. Both rankings are provided for the countries; thus, it is not possible to extract the data for a particular city or any populated area. The DESI report aims to provide the general characteristics of a country, pinpoint areas that can be improved, illustrate progress (or decline) over time, and compare countries at similar development stages to suggest better policy strategies. The index highlights five core dimensions: Human capital, Connectivity, Integration of digital technology, Digital public services. Each dimension has subcategories and correlated

indices. All four are equally weighted among each other (25%), while the sub-dimensions are attributed to different weights (p.12). The data were collected at the national level through six sources verified by member states. Overall, the indicators are focused on people with digital skills and ICT specialists, broadband coverage and prices, state-of-the-art technologies for businesses, e-commerce, and e-governance. Compared to Viennas' digitalization goals, DESI does not cover the participatory opportunities provided by digitalization. This characteristic is implicitly addressed by e-governance, but only at the level of provided services. It also does not reflect the sustainability challenges. In the 2022 rankings, Austria is ranked 10th, with a score of 54.7 (EU average 52.3):

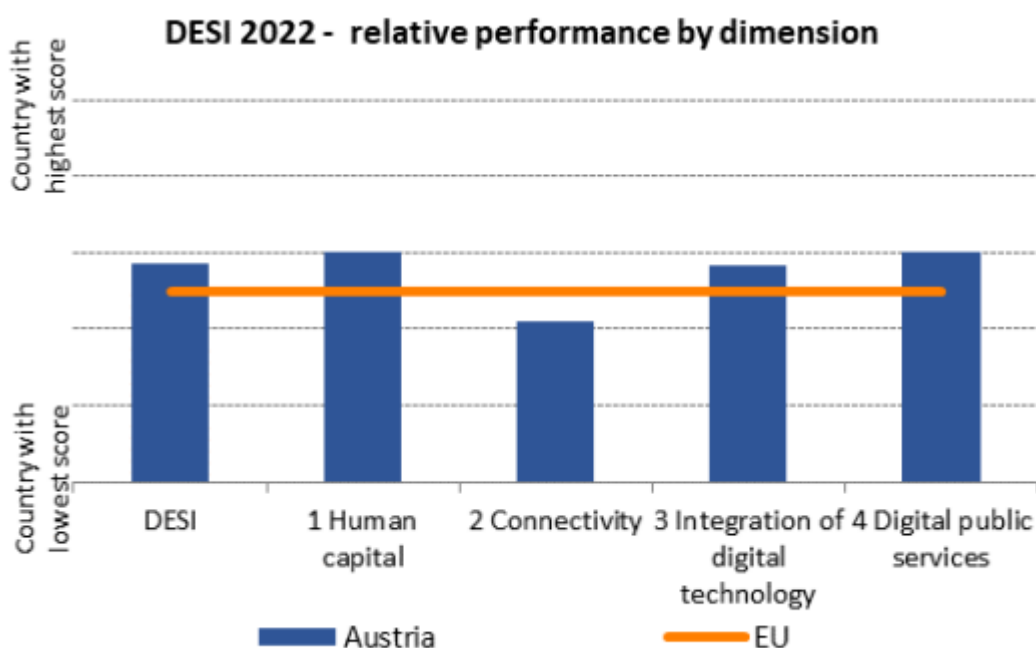


Figure 17: Austrias' relative digitalisation performance by dimension. Source: Digital Economy and Society Index (DESI) Austria, 2022.

Starting in 2017, the average annual growth in Austria reached 8%, which is in line with the EU average. Overall, the country showed mixed results for all the dimensions. Austria underperforms in the connectivity dimension, mostly because of the low coverage of fixed high-capacity networks in rural areas. Another significantly underperforming area is the use of big data and cloud cover. The country significantly exceeded the EU average for individuals with digital skills, the 5G spectrum and

coverage, SMEs at a basic level of digital integrity, and individuals who use e-governance services. DESI also provides data from previous reports (2019 onwards) for comparison. Only the connectivity dimension showed significant improvements, whereas the other areas remained at the same level. This can mostly be explained by COVID-19 restrictions and many forces to use digital tools in this period. More recent data are required to evaluate the consequences of the pandemic on digital development and its potential drawbacks.

The International Telecommunication Union (ITU) is a United Nations specialized agency researching ICTs. Compared to DESI it includes 193 Member States as well as around 900 companies, universities, and international and regional organizations. ITU aims to facilitate international connectivity. Individual country profiles were available through Digital Development Dashboards. The data presented on a dashboard are a summary of the three latest ITU datasets, including values for selected indicators. The current report uses the information collected before December 2022. The report has three dimensions: Infrastructure & Access, Internet Use and Enables & Barriers. Some of the indicators are missing data: Mobile Phone Ownership, rural and urban households with Internet access, and share of 75+ and <15 years old who use the Internet. Overall, the country shows very good performance in terms of network coverage, ICT access, and % of the population using the Internet. Austria has very low ICT prices (as a % of GNI per capita) compared with other countries. It is also among the top countries for people who have standard or advanced ICT skills. In terms of digital skills, ITU reports have similar results to those of DESI.

Each of the four presented methodologies uses a different set of indicators that target various aspects of digitalization. Overall, they can be categorized into two groups: 1) local indicators of the specific needs and activities of the city. 2) generalized indicators reflecting trends and those that can be compared with other cities. Global rankings such as the SDG-Index, DESI, or ITU primarily use the second category to highlight the positive consequences of digitalization and its development. Their benchmarks were also used to provide recommendations for 'catching-up' cities and countries. Overall, the following three dimensions of the global ranking system can be identified:

- 1) ICT coverage - broadband, wifi, 5G,
- 2) Digital skills of the population - people who possess digital skills, educational programs and IT specialists.
- 3) ICT accessibility - an infrastructure able to provide digital services for individuals and enterprise(s). This includes e-Government, Big Data and ICT prices

Such indicators do not provide much information about the challenges of digital technology implementation or the methodologies of cities. The second group also does not cover the key characteristics of 2nd generation Smart Cities: sustainability and participation. Another advantage of the internal system, such as local indicators, is the availability of data. Both ITU and DESI lack data to provide a comprehensive analysis; thus, the ranking can fail to represent reality. Even though the city of Vienna acknowledges DESI as a benchmark for becoming a digital capital of Europe, it developed its own approach in addressing digitalization goals. The first group of indicators considered the specific context of a city. Thus, it becomes easier to identify problematic areas, find the root of the problem, and develop appropriate solutions. Compared with global rankings, local strategies can benefit from using qualitative indicators. For example, having an established set of rules controlling digitalization is crucial for successful implementation and robustness. Security and data protection remain vital for the local evaluation of Smart City strategies but are not mentioned by ITU or DESI. Despite these differences, both approaches focus on ICT coverage, accessible infrastructure, and the digitalization of governmental services. For Vienna, an accessible infrastructure also includes the availability of alternative analog services, which, based on collected materials, are quite rare. To understand the digitalization path of a Smart City, different perspectives and approaches are needed. It is important to compare data over time not only to measure the effectiveness of implemented solutions and evaluate decisions, but also to understand the impact of potential risks or disasters, such as COVID. Digitalization occurs simultaneously at all governance levels; thus, a holistic view is needed. This is applicable to the Smart City paradigm, which attempts to cover all dimensions of the city. Digitalization makes it possible to grasp all of these small and large shifts occurring in the city and make them visible to everyone: citizens, city planners, researchers, government, etc. This chapter didn't include smart city rankings provided by private companies and research institutions. The main reason is that there is no evidence that cities actually use this information and it is impactful for

their development. Outside rankings are mostly associated with Smart City as a brand (see p. 12), thus allowing a city to 'show off' on a global arena. Private and global ranking also do not reflect the contextual issues of a particular city. Yet, if we compare Viennas' preliminary indicators with those of SDG, DESI or ITU they are very similar and most importantly the majority of the indicators can be applied not only to a regional, but also to the city level as well. This implies that a good smart city indicators model can be used to reflect the state of cities and also to summarize the overall impact on a scale of a country. As discussed in the theory chapter a Smart City is both a local and a global actor, thus the evaluation of both areas is needed for an appropriate conceptualisation of smart city phenomena.

6. Discussion and Findings

The integration of digital technologies in urban spaces has become a defining characteristic of modern smart cities. This chapter explores a comprehensive model designed to analyze the multifaceted dimensions of this integration. Following the methodology suggested by Mayring (2014), the collected material from content analysis and interviews was used to establish the main interactions which link digital technology and smart city urban planning. These practices include social, political and economical dimensions and actors who are involved in them. The discussion provides an interpretation of findings for each subcategory, supported by the argument from the cities experts.

Main Category	Sub Category
Design	Citizen-centric Approach
	Co-Creation
	Urban Challenges
	Transparency
Integration	Infrastructure
	Sustainability
	Adoption
	Participation
Utilization	Surveillance
	Data Collection / Security
	Trust
	Technology Readiness

Table 4: Analysis model of technology implementation in a Smart City. Source: self elaboration based on conducted analysis.

The implementation of the digital technology process is divided into three interconnected dimensions that represent the main categories of Design, Integration and Utilization. *Design* forms the foundational pillar, encompassing the intentional planning and conceptualization of smart city digital initiatives. It can follow two distinct approaches. First, new technology requires the redesign of already established practices. Second, a new technology establishes a completely new one. Design phase simultaneously occurs on various levels. It can involve political actors who outline the project's goals and aims. Lawmakers who analyze how integration might affect stakeholders' rights and suggest new regulations if needed. Market analysis in which the offered tools are examined. Private sector with an economic interest in a project. Citizens who can provide their knowledge and unique understanding of a particular topic (E.g. Fitzgerald et al., 2016; Strasser et al., 2019; Kasperowski & Kullenberg, 2019). The design has four subcategories that correspond to smart city principles and characteristics. In a sociological context, the adoption of a *citizen-centric approach* in the design of smart city initiatives raises questions regarding inclusivity and representation. This emphasizes the potential impact of technology on the reinforcement of existing inequalities. As shown in the 5th chapter Vienna prioritizes the well-being of its citizens, and its strategy should be aimed at mitigating or solving social challenges. Acknowledging that effective solutions arise from collaborative efforts, the *co-creation* subcategory explored the dynamics of community involvement. The focus can be made here on power imbalances, ensuring that technological decisions are made collectively and inclusively. Citizens here are not perceived as end-users or passive actors but are expected to play an active role and contribute to the process in a SC. Sociology has a long history of research on *urban challenges*. As discussed in Chapter 3.1 the concept of urbanity has undergone significant changes over time and still carries unsolved questions. Smart City is a valuable resource that can help address these questions empirically. This category aimed to explore the challenges acknowledged by the city of Vienna and what can be revealed through empirical research. *Transparency* analysis examines how openness in digital decision-making processes contributes to or detracts from democratic governance (Goodman, 2020). This subcategory ensures that transparency is not merely a buzzword, but a mechanism for accountability and citizen empowerment.

The second main category *Integration* involves the incorporation of digital technologies into the fabric of urban infrastructure. During this stage, the design of a digital technology or project is practically implemented. Integration can target all stakeholders in a city; thus, it can be oriented to the private sector, city administration, or individuals. This category stresses a city's capability to achieve smart city goals, and explores the methodology developed in Vienna. Integration always causes shifts in the infrastructure of cities. Such changes can occur on a digital level, such as an online platform for managing fines, or on a physical level, such as self-driven buses and trains. The main challenge is that both are too interwoven and cannot be reduced to a singular digital or physical dimension. Taking the two mentioned examples, having an opportunity to manage your fines online removes the necessity of personal interaction with the city administration, and having a self-driven train requires sensors and digital tools for real-life monitoring. This subcategory can help explore how technological advancements affect accessibility and potentially create a digital divide. Examining the societal consequences of upgraded infrastructure is crucial to understanding its impact on diverse urban communities. *Sustainability* is the main pillar of Vinnas' Smart City Strategy. Its goals are to achieve resource-efficient consumption and to benefit from renewables. In the long run, this should help achieve climate neutrality. This category explored the distributional consequences of green technologies and environmentally friendly practices. Sustainability also can be translated into sustainable behavior. The question is what impact can a city and its citizens realistically achieve with the help of digital tools. Third subcategory here is *Adoption*, which illustrates how a city delivers digital technology. Beyond technological considerations, adoption explores cultural and social dynamics. It addresses the questions of agency, resistance, and the potential consequences of technological adoption on different social groups. *Participation*, the final subcategory, represents the city's main decision-making approach. Citizens should have the opportunity to be involved in the development of the city, and the city's goal is to empower such intentions. This subcategory explores the nature of civic engagement in smart-city projects. Examining who participates and who is excluded helps to reveal power dynamics, ensuring that the benefits of technological integration are equally distributed.

All digital projects generate data that can be *utilized* in different ways. The last category summarizes how and what data is collected by the government, and what information is provided by citizens. During this phase, the consequences of digital technology implementation can be observed and analyzed. A city makes a final evaluation and determines whether a practice is successful. In the case of failed implementation, the entire process needs to be reflected to understand the issues and what particular decisions had led to undesired outcomes. In the case of success, the project enters a state of maintenance. Its activity is further supported, but owing to the rapidly developing nature of digital technology, significant changes may occur. This can lead to an overall redesign of some functions or practices. *Surveillance* is one of the most criticized aspects of the first smart cities (Trencher, 2019). Markedly driven by a pressure of pure effectiveness, such cities followed the same principles as commercial companies. In most cases, to use digital technology, a city would have to rely on market solutions. Surveillance raises concerns regarding civil liberties and discriminatory practices. This subcategory navigates the delicate balance between security and individual freedoms, emphasizing the societal implications of constant monitoring. The correlated subcategory *Data Collection and Security* delves into questions of control, protection, and potential commodification of personal information, ensuring that privacy concerns are adequately addressed. Compared to surveillance, the aim here is to explore the methods used to collect data and analyze security measures. This subcategory includes political regulations and organizational changes in political institutions caused by digital technology. The last two subcategories reflect citizens' perspectives. *Trust* is a key factor in the acceptance of digital technologies. Understanding the social dynamics that contribute to or erode trust is essential for fostering positive relationships between citizens and technologies that shape their urban experiences. The main challenge here is that people's trust is not only influenced by the city and its administration, but also by technology. Digital technology, in turn, involves a variety of external actors that shape it. The changes might not always be required at the level of technology, but from people as well. *Technology readiness* addresses the preparedness of individuals and communities to embrace technological advancement. Readiness is dependent on social factors, such as age and education, and TR can also be used to investigate actual technology usage (Blut & Wang, 2020).

The model is circular meaning the ‘utilization’ could influence the redesign of already existing projects or shape the future ones. Challenges in integration can lead to the same consequences, for example, if a desired design is technically not possible or yet achievable. This can happen for various reasons, such as lack of AI regulations, high ICT prices, failed adoptance, and resistance from citizens. The categories are also deeply interconnected between each other. Thus, the citizen-centric approach is reflected in the adoption process. Co-creation is related to participation and technological readiness. Urban challenges refer to sustainability, surveillance, and security occurring in the process of implementation. Transparency in design should explain people's trust in government actions and digital technology itself. Assignment to a particular category follows two rules: 1) the text passage should explicitly refer to one of the concepts. 2) It should be bound by one of the three dimensions represented by the main categories. For example: ...“This key component (referring to excellent digital infrastructure) of digitalisation is a prerequisite for ensuring that the interconnection of the many data points can be achieved sustainably, with the different requirements for bandwidth, response time, scalability, availability, security and energy supply needing to be given due consideration”... (Digital Agenda, 2025., p. 58) is assigned to the “Sustainability” category. The interpretation is that digital infrastructure allows for better and more efficient interconnection of various cities' physical bodies, thus saving resources and contributing to sustainability. It explains how the city of Vienna understands sustainability through the lens of digitalization. On the other hand, assignments can refer to many categories simultaneously. In this example, it touches on physical, digital, and sustainability categories. In such cases, the decision is made based on direct reference to one of the sub-categories, otherwise a particular case. Another example is when text refers to the different dimensions: “The security hub aims to develop sustainable structures to establish Vienna's top rank in the IT security environment.” (ibid., p. 24) Here “Sustainability” and “Security” are mentioned together. In this case, the decision is made based on the context or an additional broader context analysis (Mayring, 2014, p.88-89). The text discusses the security action field of the Digital Agenda 2025 and explains the Security Hub Wien project. The topic of sustainability is not disclosed here; thus, it is assigned to the “Data Protection/Security”.

Overall, the subcategories provide a general overview of the direction the city currently has, and they help explore the fundamentals of the Smart City approach in the domain of digital technologies.

6.1 Overview: Smart Climate Strategy

In total, 56 text passages from Smart Climate City Strategy Vienna were assigned to the categories of the technology implementation model. The first two dimensions each have approximately 40% of all the codes, whereas the utilization dimension is only 20%. This can be explained due to the last four categories having an overarching importance on all digitalization practices. They also represent the challenges that digitalization can cause; thus, such statements could potentially be negatively perceived by the general public. If challenges are acknowledged, they also require a solution, which makes a strategy to offer something. If the plans are not ready, are under planning, or are in the design phase, such as AI regulations, it makes sense to take a neutral stance and not to deepen into digitalization issues such as trust or data protection. Data protection is also a very technical aspect that cannot be easily communicated to the general public or fundamentally explained in an overview document such as Vienna's Smart Strategy. At the same time, there is still enough data to provide an analysis and interpretation of the development of the city. The categories with the most points of discovery are citizen-centric approach and sustainability. Since the establishment of the Smart City strategy in 2014, Vienna has had an exact vision that it should be based on citizens' needs. This approach has not changed until today, and the city still tries to explore the opportunities that digitalization can provide to strengthen its people-oriented principles. This also implies that Vienna can be considered a second-generation smart city from the beginning, but that question will be discussed and answered later. Sustainability is closely related to the climate issues that Vienna recognized as pivotal for its current development, and even included the word 'Climate' in the strategy name. The categories with the least number of examples are 'Adoption' and 'Trust.' However, both are connected to other categories: adoption with technology readiness and participation, trust with security and transparency. Adoption is related to specific digital technology or services; thus, it can be different in each particular case. Trust is a complex issue involving multiple practices and social spheres. In this context, it refers to trust in digital

services or how people's trust can be strengthened through digitalization. Both categories in this document reflect the common approach of the city targeting these issues, and thus are only mentioned a few times. All other categories are quite even among each other. This indicates that the document tried to equally cover all relevant aspects of digitalisation in Vienna. A more specific description is provided in other related documents such as Digital Agenda 2025, STEP 2025 and others. The following section provides a summary of the results for each category, including the interpretation and references to other empirical studies and theories introduced previously.

Dimension	Category	Points of discovery	Count	
Design	Citizen-centric Approach	p. 38, 38, 44, 45, 96, 102, 102	7	22
	Co-Creation	p. 23, 38, 108, 111, 111	5	
	Urban Challenges	p. 16, 22, 38, 96, 108, 112	6	
	Transparency	p. 38, 44, 110, 112	4	
Integration	Infrastructure	p. 108, 110, 110, 111	4	21
	Sustainability	p. 7, 38, 38, 45, 45, 54, 57, 64, 108	9	
	Adoption	p. 106, 111	2	
	Participation	p. 38, 104, 111, 114, 116, 126	6	
Utilization	Surveillance	p. 38, 45, 108, 111	4	13
	Data Collection / Security	p. 16, 112, 129	3	
	Trust	p. 108, 126	2	
	Technology Readiness	p. 45, 102, 112, 112	4	
			56	

Table 5: Categories occurrence in Smart Climate City Strategy Vienna. Source: self elaboration based on Smart Climate City Strategy Vienna, 2022.

Citizen-centric Approach

Vienna's Smart City strategy places human needs at the forefront of digitalization. Its fundamental principle is that technology must serve people, address their needs, and enhance their experiences. (p.38). This is one of the main differences in implementing technologies in cities compared to the capitalist nature of IT companies and the design of first-generation smart cities. One distinctive facet of Vienna's approach is its comprehensive and inclusive digital education programme. The principle of social inclusion harmoniously extends into the realm of digital inclusion. (p. 96, 100). Vienna recognizes that digital transformation must encompass those who currently have limited interaction with emerging technologies in their daily routines. At the same time it does not neglect the analog channels for communication as an alternative. Inclusion is also seen as an opportunity to participate in decision-making processes available through digital platforms. The ultimate goal of the city is to create a digital environment available to all social groups by digitalizing all relevant public services (p.38, 45). To keep them inclusive, the city promises to provide digital education programs to the current generation but also lays the groundwork for a future where digital literacy is universal and integral to societal progress (p. 38, 44). Overall, digital technology is presented here as a tool that allows better communication and interaction between cities and citizens. A digital solution is supposed to have a needs-based design, which puts certain limitations on its functions; it can be further limited by data protection measures. Compared to customer orientation, the citizen-centric approach seeks to find the right technology to enhance current practices, but does not necessarily pursue the most possible efficiency. Similarly, technology is presented as a solution to a problem caused by the technology itself. In this case, inclusion (mostly digital) should be achieved through digital participation and education. To provide equal opportunities, everyone should use digital services, and it is not clear if this would eventually be the only option. Thus, digital technology is supposed to solve the issue it created. What makes it more complicated is that the design can change significantly depending on new technology features. Examples include the integration of AI, blockchain, or real-time monitoring. In this case, either the population should always be agile and ready for change or the city

itself would have to adjust the design throughout the implementation process and subsequent maintenance. Either way, there are many varieties and possibilities. Similarly, the evaluation process is rather difficult compared with other profit- and efficiency-oriented approaches, where success can always be quantified.

Co-Creation

Co-creation is another core principle of modern Smart Cities. It suggests that actors should collaborate and mutually contribute to the city's future. This includes citizens, educational institutions, businesses, city governments, and a variety of private and public bodies outside of the city. Digitalisation, again, is a tool which allows all the actors to connect and establish a common area of interaction. (p. 38). In Vienna's Smart City strategy, most of the attention is given to citizens, whose participation is required for the sustainable future of the city (p. 23). To achieve this, the city provides different participation channels based on the required services and their localities (p. 108, 111). Co-creation means that different groups are getting involved not at the final stage of a project but already during its design phase. As shown in STS discussions, the public is a significant knowledge-group (Kasperowski & Kullenberg 2019; Strasser et al. 2019; Felt & Davies, 2020;). However, co-creation is not a purely bottom-up approach. The ideas and needs of citizens are collected and then translated by experts into potential projects or solutions based on the cities' capabilities. A perfect example from Vienna is the Mitgestalten platform. Everyone who lives in Vienna is eligible to submit their ideas through the mitgestalten.wien.gv.at/. Projects themselves follow five stages: 1) submission of ideas 2) ideas selection by the city experts 3) projects draft design with citizens and experts 4) citizens jury votes for projects in accordance to the available budget 5) city takes the responsibility for the implementation of a project. People can like, dislike and discuss the ideas on the platform. Experts provide feedback for each idea if it was rejected. The selected ones later are being collectively redesigned and voted again before final implementation. In Vienna's case, co-creation represents a certain middleground, where citizens' ideas, needs, and knowledge are being collected, and top-down and bottom-up approaches meet together. This significantly differs from the surveillance capitalism mode, in which citizens play only a passive role. The role of digital technology is twofold. On one hand, it provides tools for communication and a convenient place for sharing. On the other, it can empower people to participate. The

empowerment can be enforced - a service only available online, or voluntary - like a Mitgestalten platform. The benefit of such an approach is the higher level of transparency of governmental actions. It also reduces the surveillance potential of a smart city, thus increasing trust of other actors.

Urban Challenges

As shown in previous categories, digitalization can generate new or amplify existing urban challenges. Vienna acknowledges that it can also have negative impacts regarding data protection, digital ethics and digital equal opportunities. (p.16, p. 96). The main issue the city sees is the 'digital divide'—the gap between people who actively use digital services, and those who have limited access to modern ICTs (p.112). Vienna expects digitalization to be a solution for future urban issues (p. 16, 22). The strategy does not specify what challenges a smart city might face in the future (despite one mentioned above) and how digital technology would help in solving them. DT is presented here from a positive side with a huge potential (p. 108). To stabilize and balance development, a city integrates digital solutions only if the benefits are higher than the costs (p. 38). The costs are mostly associated with energy consumption and resources but not with potential risks to the social sphere. In cases where digitalization will not solve the issues it creates, damage control methods have not yet been considered.

Transparency

Transparency in Vienna's Smart City Plan is a characteristic ascribed to digital solutions, contrary to the surveillance capitalism of IT companies, where data utilization is hidden behind secured algorithms. Vienna presents digital participation as a method of increasing transparency in citizen-city interactions (p. 38, 44). This affects the design of applications or platforms that must be user-friendly (p.110). Compared to physical practices, digital ones always have data processing on the back-end. This has become a major security question. Here, transparency refers mostly to the initial inputs and consequential outputs, rather than the process itself.

Infrastructure

Digitalization affects both the digital and physical infrastructure. Physical infrastructure is the IoT - a network of physical devices, sensors, servers, and so on. Digital platforms are mostly apps and platforms. As illustrated by Van Dijck's platformization tree (2021), most of the physical infrastructure is owned by the big five. This also applies to cloud services, which are digital spaces in which data can be shared. It places a city in a situation where the government has to choose whether to use third-party services or try to establish its own local ecosystem, which can result in high costs and lower efficiency. This opens up a variety of questions regarding security and privacy. If the city decided to use external services, it would have to share certain data with private companies. Therefore, the city currently does not use any cloud services to store or transfer citizen information. As shown in the DESI and ITU reports, Austria overall already has good mobile coverage. Fixed high-speed broadband is still one of the challenges that the city has to deal with (p. 108, 110).

Sustainability

The sustainable development of the city is the main strategy for achieving Vienna's goals of climate neutrality. As it is a long-term goal, changes should be made as soon as possible. It was acknowledged in the interviews, reaching climate neutrality by 2030 is rather optimistic, but the first steps have to be made as soon as possible. Vienna expects digitalization to be the key to transforming how the city manages and uses resources (p. 38). In order to achieve sustainable development the city has to provide resource-efficient infrastructure and empower citizens for responsible behavior (p. 7, 38, 45, 45, 108). The contribution of digitalization to sustainability occurs at several levels. At the governance level, digitalization should help to better manage city activities and improve logistics (p. 57). One of the interviews revealed that digitalization made public management more complicated and difficult to organize. This is due to the significant increase in actors and stakeholders, while regulations can impose significant restrictions on public administration actions. For example, even within the same department, citizens' personal data cannot be shared. Vienna expects that the management capabilities of digital services will also improve how the city uses resources, which would allow more effective distribution and reduce overuse and waste (p.64). Finally, digital management should help to establish sustainable behavior practices of citizens

(p.54). People would learn more about sustainable methods of consumption or transportation. On a global scale, however, the effect of such 'digital sustainability' within a single city is very minor and almost non-existent (E.g. IQAir, 2022). Overall digitalization should improve the management of resources, but it does not offer alternative ways of consumption or production, which is the task of non-digital innovations and technology, for example solar energy or recycling methods.

Adoption

The goal of this category was to investigate how the City of Vienna prepares technology for integration into society. The Smart Climate Agenda is not rich in terms of methods of adoption. The city's approach is to create a test environment in which future innovation can be tested and adjusted before the final release (p.111). Collectively, using the co-creation approach, the length of this process can be reduced substantially. Vienna established the so-called Living Labs, where future technologies can be piloted (p. 106). This also occurs throughout the development of digital apps and platforms. An expert who worked on the 'WienBot' app shared that involving people into the development process right at the beginning significantly improves the quality of the final product and makes the adoption process way easier. The problem is that such an approach is very time-consuming, quite limited to the number of participants (because you have to concur with all opinions), and not applicable to all digital solutions the city works on. Vienna has also established a test community project in which people can participate in the development of applications and platforms and provide feedback. It creates a pool of citizens interested in testing and participating in future projects. The issue is that the pool itself can be very homogenized, as represented by innovators or early adopters.

Participation

Digital platforms and apps provide new opportunities for everyone to participate in the decision-making processes. Currently, Vienna sees society as highly digitalized (p. 104). Participatory platforms can also increase engagement (p. 38, 126). This is achieved through user-friendly design (p. 114). Another attraction strategy is to offer commonly used services in a digital environment, thus making them easier and faster for the user. This also involves automation, like passport renewal or fines payment. Digitalization opens new opportunities for initiative people or communities, who

previously did not have an adequate or easy way to get involved (p.116). At the same time Vienna is a very diverse city, where around 30% of the population does not have voting rights. This puts a significant limitation on the whole idea of a participatory concept. A dilemma is that everyone should have the right to participate in city development activities, or only citizens or people with resident permits. In any case, digitalization can provide the necessary infrastructure to successfully integrate new participatory services.

Surveillance

Surveillance is an inherent characteristic of digitalization, and thus, smart cities. This can be explained by the pursuit of effectiveness and forecasting possibilities. In the case of the private sector, both will generate higher profits, while for cities, this can mean higher security and better-designed future services. Instead of overarching monitoring, second-generation smart cities such as Vienna follow a co-creative approach, sacrificing potential efficiency. Simultaneously, the city acknowledges the need for better-designed data management (p. 38). This is required for sustainability goals. Additionally, the city provides an open data platform that would become impractical without a significant data pool (p. 45). Another issue is the installation of sensors and monitoring tools that usually remain hidden to the naked eye (p.111). Whether people's awareness would solve this issue remains an open question. One way or another the cities are restricted by the variety of internal and external regulations. On Viennas example, the city tries to design its digital services in a transparent way by involving different actors, providing open data and open source software.

Data Collection / Security

Digitalization has enormous potential for data collection and utilization. This comes hand-in-hand with data protection issues (p. 16). Vienna has a strong focus on the design of new regulations for digital data protection (p. 112). In Vienna, everything related to healthcare has different regulations and management bodies. For example, digitalization in public administration and the health sector is regulated by different city departments. Data security also puts a certain restriction on how data can travel between governmental institutions. As previously mentioned, in some cases, it is

prohibited even within the same department. Contrary to the Big 5, the City of Vienna does not aim to collect all possible data, but only the data necessary for the smart city goals and maintenance of already existing services.

Trust

To successfully implement digital technologies, people have to trust not only the technology itself, but the government as well. With current regulations such as the GDPR and Austria's attention to data privacy, people should always retain full sovereignty over their personal data (p. 108). All other strategies, such as transparency in actions and fostering of participatory practices, should also strengthen people's trust (p.126). At the same time trust is a complex social construct and is structured through a variety of factors (Cook & Santana, 2020); for example, trust in digital technologies can be significantly influenced by social media actions or IT companies. This leads us back to the issue of surveillance, in which people might believe that a city wants to establish more control mechanisms. This is precisely what happened in Vienna during the COVID-19 pandemic when the city introduced the Stopp-Corona app (Steinkogler, 2021). It was intended to inform people about areas with a high risk of infection. Contrary to the cities' expectations, people saw it as an intrusion in private life, and violation of personal rights.

Technology Readiness

Trust in digital technologies also depends on people's readiness and knowledge of how they work, and the ways in which data are collected and utilized. Compared to Adoption, this category explores how people are being prepared for technology integration. The city of Vienna has two approaches: first, providing an intuitively understandable infrastructure; and second, establishing new educational programs for city inhabitants and promoting digital skills on various levels (p. 102, 112, 112). Vienna prioritizes human digital literacy over the pure effectiveness of digital technologies, as shown in previous categories (p. 45). Technology readiness significantly affects the success of the implementation and provides more opportunities for the city to monitor its progress. Readiness, however, does not imply that a person will use a particular technology on a daily or constant basis.

6.2 Overview: Digital Agenda 2025

While analyzing Digital Agenda 2025, the final 96 codes were assigned to the categories. This document can be divided into two parts. The first part, until page 23, provides an overview and explains the foundation as well as the core principles of digitalization in Vienna. The second part includes seven thematic chapters that were summarized earlier. Each chapter has a variety that are correlated with the action field and projects. The projects are further divided into: currently ongoing, under development, and under consideration/review. As these action fields have many in common, the same or very similar anchor samples were reduced to one, where the first appearance was assigned to a category. Overall, the agenda table is balanced with a variety of examples for each category. Compared to the Smart City strategy Sustainability here was not discussed that often. Instead, co-creation, urban challenges, infrastructural changes, and people's technology readiness have received more attention. This could be explained by the practical orientation of the document, where the successful implementation of all the mentioned projects, to a certain degree, involves all four categories. For the same reason Adoption of digital technologies is more relevant to the Agenda. Little attention has been paid to the surveillance prospects of digital technologies and trust-related practices. Both topics are deeply integrated into the political dimension, which is not discussed here; thus, the technical aspects of each topic are highlighted. At the same time, because of the high correlation between the categories within the same dimension, prevention practices are prioritized. Thus, Data protection addresses the issues of surveillance, while people's technology readiness will build up their trust along the way. In the Digital Agenda the City is presented as a 'service' platform (p. 5). In this context, digitalization allows this service to function and fulfill city goals. If exposed to any risks or outside interference, the entire governance system could fail. Therefore, an analysis of the implementation process is required to understand how Smart Cities can prepare for the digital future. The following section concludes the category interpretation and highlights the most important practices anchored in these categories.

Dimension	Category	Points of discovery	Count	
Design	Citizen-centric Approach	p. 5, 9, 10, 15, 26, 27, 44, 53	8	37
	Co-Creation	p. 8, 9, 12, 13, 13, 27, 31, 38, 39, 53b	10	
	Urban Challenges	p. 4, 9, 10, 14, 14, 15, 23, 25, 32, 44, 48	11	
	Transparency	p. 9, 16, 17, 18, 19, 21, 50, 54	8	
Integration	Infrastructure	p. 7, 11, 23, 26, 30, 37, 40, 51, 58, 60	10	32
	Sustainability	p. 7, 11, 18, 18, 36, 37, 58	7	
	Adoption	p. 30, 31, 31, 38, 57, 58, 58, 67	8	
	Participation	p. 5, 12, 13, 18, 38, 44, 48	7	
Utilization	Surveillance	p. 15, 25, 29, 48, 51	5	27
	Data Collection / Security	p. 23, 25, 26, 28, 33, 50, 53, 59	8	
	Trust	p. 23, 23, 24, 48	4	
	Technology Readiness	p. 24, 31, 34, 38, 38, 39, 40, 45, 48, 49	10	
			96	

Table 6: Categories occurrence in Digital Agenda 2025. Source: self elaboration based on Digital Agenda 2025, 2019.

Citizen-centric Approach

As in the Smart City Strategy, citizens are central to the Digital Agenda (p.9). Following this principle, technology should be designed to serve people, and in Vienna, it is used mainly to empower their participation (p.5, 15). For the city to be smart, it mainly translates to the citizen-centric approach (p. 10). This poses a significant challenge for the city, where it should provide everyone with equal opportunities for participation and access to digital technologies (p. 27, 44). The selection of technologies to be implemented is based on the current needs of citizens (p. 53). At the same time, turning the city into a 'digital platform' allows it to transfer the responsibilities to the digital tools and eventually users themselves. Thus, the citizen-centric approach could be used not only to organize urban planning based on people's needs but also to redistribute the responsibilities between a variety of actors, including digital entities. The search for digital solutions intensifies cities to collaborate with the private sector and empower public entrepreneurialism, which aligns with the neo-liberal rationale of modern urban planning. High competition in the digital market can always provide a more effective solution to a city, even under regulatory limitations. Considering this tendency, a citizen-centric approach can create a new class - a smart citizen, which, owing to its capital and technological knowledge, would benefit the most and take advantage of digital tools available on the market. As the solutions are provided by the digital market, this could create an even bigger gap for those who do not have access to it. This can be applied not only to the individual, such as marginalized groups, but also to cities that cannot afford certain technologies, again providing more power for big or global cities, simultaneously making those more attractive for capital investment.

Co-Creation

Digitalization caused Vienna to reconsider its traditional top-down approach to urban planning (p.12, 13). The current design of city projects aims to involve everyone through digital participation (p.8, 9, 31). Vienna associates the success of digitalization with the availability of actors to cooperate and provide feedback (p. 27, 39). As a collective actor, a smart city is supposed to create a common environment and workplace for everyone who can be involved (p. 48, 53b). Co-creation yet is rather an ideological principle that

does not suggest a well-designed methodology. Involvement can vary depending on the city's vision and power given to digital technology. This is also a matter of whose interests do the contributors represent. As discussed in the interviews, it is currently unrealistic to involve everyone in the production process. Digital technology can potentially represent the entire city owing to its analytical capabilities. However, this requires high levels of surveillance, a practice that the city of Vienna tries to avoid.

Urban Challenges

The Agenda addressed a broad spectrum of urban challenges. This includes: 1) current challenges and redesign of city practices by technology integration and 2) future risks associated with digitalization. It is not a question that digital technologies will only become more important and decisive in managing a city (p. 4, 9). As in the Smart City Strategy, the biggest challenge that digitalization evokes is the digital divide (p.10). Social inclusion through digital participation should reduce the risk of increasing inequalities (p.15). Another area that has become more problematic is crisis management (p. 25). ICT allows different city departments to connect, but at the same time information sharing is limited by Vienna's rules and regulations. Crisis situations can require exceptions, which again leads to the redesign or actualization of laws. There are also latent or unpredictable risks inherent to digital technology (p.14). Similar to the concept of *unknowns* in STS (Nielsen et al., 2017), designers cannot always predict how a particular technology might be used or what extra functions it can acquire (e.g., the 'affordance concept'). The labor market will also be altered, and Vienna expects new digital jobs to require highly qualified people, whereas simple jobs will be automated (p. 48). On the positive side, digitalization helps improve housing in the city by providing services for facility management and swift communication (p. 32). Real-time tracking and predictive models can make a city safer, which mostly refers to mobility in the city (p.23). It is difficult to evaluate whether digitalization provides more solutions than challenges. Keeping in mind that digital technology constantly evolves and changes, the city has to limit and control its functions. The downside of such an approach is that cities are unable to fully control the integration that is happening outside of their jurisdiction. For this reason, much effort has been put into designing global regulations such as the GDPR or AI Act.

Transparency

Digitalization had made Vienna shift from its closed bureaucratic model of governing to open and participatory design (p. 9, 18). Transparency in digital governance is mostly granted by clear regulation and user-friendly design of digital technologies (p. 16, 17, 54). Another major difference from private IT companies is the disclosure of algorithms used by the city (p. 19). Vienna is actively searching for new technologies that can guarantee safe and transparent data transactions (p. 21). One such technology is blockchain, which is currently only integrated into the Kultur-Token application. As the city promises to make its services transparent, it has to develop its own software or come up with new ways of using the market without negative consequences, such as data sharing (p. 57). The reason is that market solutions do not have an Open Source Software (OSS) design and keep their algorithms private.

Infrastructure

ICT is presented as a 'nervous system' of Vienna which can supply the citizens with all kinds of information and services (p. 7, 11). Its integration resulted in the redesign of cities' activities, as ICT became the foundation for Viennas' capacity to act and communicate (p. 23, 26). Opportunities to share, analyze, and generate information are the cornerstones of a Smart City. All can only be provided by well-established digital infrastructure (p.51, 58). Infrastructural changes will affect mobility by providing barrier-free access to public transport (p. 37), education with high-speed Internet and digital teaching materials (p. 40), and the speed of information transposition between the city's businesses. The future of public governance is also expected to shift towards digital platforms, leaving face-to-face interaction behind (p. 30).

Sustainability

To achieve sustainability, Vienna prioritizes the sharing economy, an approach where resources and products are shared between actors, a car sharing for example. Digitalization is supposed to help deal with ecological problems by encouraging responsible behavior by educating people about environmental issues and empowering people to use alternative ways of transportation (p. 18, 36, 37). The sustainable use of resources remains the city's duty (p. 11, 58). As explained in the Smart City Strategy analysis, digitalization offers circumstantial improvements for sustainability. Its greatest

advantage remains fast communication and highly effective monitoring, accompanied by the possibility of increasing people's awareness of climate issues.

Adoption

Vienna's strategy to adopt digital technologies adheres to the principle that technology should adapt to people, and not vice versa (p. 48). This includes constant support and potential changes in apps and platforms. (p. 31). As discussed in the interviews, unprepared integration will always fail and people will be unhappy with what they are offered. This became clear after experimenting with the co-creation of a WienBot app, in which a small group of 10 participants provided constant feedback for each step during development. As a result, many changes in steaming from citizens were applied before the final release. Because it is not possible to involve everyone in the actual development process, the city has two stages of adoption. The first stage is the testing community, which is designed for citizens (p.31), and digitalization showrooms, where technological applications can be studied and tested (p. 57). Showrooms are oriented on citie's employees and other interested parties like universities as well. The first stage should help the city identify the changes needed for digital technologies and plan their future use in the city (p. 67). The second stage examines the visual design and intuitive use of the offered services (p. 30, 58). It also involves simplifying the process of information access and connections to the city's authorities (p. 48). It is not clear how the city will characterize different groups to adjust services. It most likely will be based on the test community, which can be misrepresented. Yet, interviewed experts believe that an increasing number of people are getting used to digital services and feel more comfortable in the digital environment.

Participation

Participation in Vienna is a principle of digital democracy, where citizens can constantly provide feedback and interchange with the city (p. 12). The feedback is still considered to be an 'outside view, meaning that the final decision remains in the hands of the city experts (p.5). Like in the Mitgestalten platform. Digital platforms are the main way citizens can cause changes within a city (p. 38). The biggest challenge for the city is to achieve equitable participation, independent of social attributes or gender (p. 18, 44). This should also solve the 'digital divide' risk (p. 48). Currently, the city has a common

digitalization budget, which allows each district to implement the required solutions and thus invokes participation. The success evaluation of participation is not well defined. From a quantitative perspective, Vienna does not have a certain range for how many people should participate in city planning. The expert from UIV expects this number will be set to approximately 40% of the residents in the future. Preliminary indicators are also mainly focused on the number of services provided, such as digital platforms, apps or established city labs (see pp. 78-80).

Surveillance

Vienna's approach to reducing surveillance practices is to make digital algorithms more acceptable (p. 15). This implies that human rights should be of economic or commercial interest. As discussed earlier, the profitability of digital tools is mostly associated with their effectiveness and prediction capabilities (see p. 30), meaning that those characteristics should be limited in order to reduce surveillance. This is a dilemma in which the city has to take advantage of digital tools at the same time, minimizing the risks for the government and the people (p. 25, 48). As Vienna follows the principle of open data and OSS, information is available to everyone, for example, through dashboards (p. 29). Commercially driven companies can use this information. Combined with the data, the capacity for surveillance increases. Vienna acknowledges that ICT has become the leading force in all sectors; thus, its influence will only grow (p. 51).

Data Collection / Security

Data protection is one of the main pillars of Vienna's Digital Agenda. Secured data directly affects the performance of a city's services (p. 23). Sharing economy principles is limited if they negatively affect the interests of citizens (p. 53). Thus, Vienna follows the strategy of data minimization and disclosure of personal information, even within the city's administration (p. 33). The controlling options and regulations are in a constant city's review, managing the interactions between platforms and citizens. (p. 50). Compared to a commercially driven enterprise, a Smart City must always take ethical and moral principles into consideration (p. 53). To enhance security, Vienna plans to implement cryptographic measures, which showed very high standards within blockchain technology (p. 26). The plan is also to create a place where people can

safely store all administrative data. (p. 28). As the city needs the allowance to utilize the data only once, such an approach can significantly enhance the response time that Vienna needs to make a decision. This can be decided in crisis situations like COVID.

Trust

As mentioned earlier, people's trust in digital technology also depends on external factors such as social media, trust in the government, and actions of global IT companies. This information can be misused and the data can be manipulated. The challenge for a Smart City is that it has to deal with not only internal but also external sources that can affect the trust of the people. If we do not consider machine learning and real artificial intelligence, all digital technologies follow strict rules represented by the algorithms, meaning that the same input will always result in the same output. Digitalization as the future governance model of Smart Cities requires people to trust its services (p. 23m). Vienna's goal is to increase awareness of how digital technologies work (p. 24). This can be achieved by reducing technology skepticism and establishing trust in the digital world itself (p. 23b, 48). The main tools currently used by Vienna are educational programmes and initiatives that prepare people for digital participation.

Technology Readiness

People's knowledge of digitalization is the foundation of the participatory regime that Vienna tries to achieve. (p. 31). Central to the vision of the strategy is the empowerment of residents through knowledge acquisition. Digital literacy is presented as a fourth cultural skill that should be achieved through education (p. 38). The city tries to involve younger generations, as well as all senior citizens, to participate in digital activities (p. 34, 39). Vienna plans to invest in universities to equip them with digital tools and to develop digital programs for all educational institutions (p. 40, 45). By fostering a populace well versed in digital concepts, the city aims to leverage its collective intelligence for informed decision-making and cohesive development. The strategy extends beyond institutional settings and aims to bolster private initiatives that promote technology acceptance and research enthusiasm (p. 48). Not only the citizens, but also the city's administration has to go through professional development in the area of digitalization (p. 24, 49). Readiness to use technology also refers to assimilation in a Smart City. This leads us to the question of who smart citizens actually are.

6.3 The notion of a Smart Citizen

The significant discussion which has been left out up until now is the idea of a *smart citizen* and how does the city frame its 'users.' Citizen-centric emphasis on the role of citizens became highly popular after significant criticism of the neoliberal logic of modern smart cities (Townsend, 2013; Grossi & Pianezzi, 2017; Cardullo and Kitchin, 2019). This also aligns with the transition to second-generation SC with redistribution of power, where market-oriented goals should be replaced by citizens' needs (Trencher, 2019). In a generalized view, a smart citizen is an individual living in a smart city. Thus, establishing a Smart Environment in a city should eventually adapt its inhabitants to changes. If one looks in Google the most popular definition is: "A digitally literate person that takes advantage of technology in order to engage in a Smart City environment, address local issues and take part in decision-making"⁴. However, as the idea and definition of a Smart City are fuzzy and diverse, the same applies to smart citizens. Instead of providing another context-oriented definition, the main characteristics of such individuals should be identified. Summarizing the articles mentioned in this thesis and recent studies on the topic of being a citizen in a smart city, the following characteristics can be identified: 1) civic engagement, 2) digital literacy, 3) technological proficiency, and 4) environmental consciousness.

Civic engagement is currently the main milestone of any Smart City strategy, regardless of the region. Engagement itself, however, is understood and, most importantly, measured very differently. In Vienna, participation in urban development occurs via test communities or through a Mitgestalten platform. Digital technology is the main medium that allows people to participate in decision making. However, opportunities for participation are quite limited. As discussed in the interviews, only around ten people can be invited to the development process of the city series in its current state, but already with that small amount, the process changes significantly due to the feedback of the citizens. Another reason is the current organization of public administration in Vienna, which was said to be not agile enough to create services at a faster pace and include not only test communities, but also a variety of stakeholders from the city

⁴ IGI Global Dictionary:
<https://www.igi-global.com/dictionary/smart-city--smart-citizen--smart-economy/87777>
 Retrieved November, 2023

simultaneously. In order to do so, the public administration needs to guide all of those stakeholders and also empower them. At the same time the experts acknowledge that public administration has been identified by the Big Five and other tech companies as very financially interesting, due to the data a city and its citizens produce. Thus, the city has to limit its services and participatory options to protect its data and remain, to a certain extent, independent of global IT companies. Referring to one of the interviews, more than 30% of the people in Vienna do not have the right to vote at the local level. In summary, the experts agreed that to empower citizens to engage and participate, first, certain changes should be made at the administrative level, which would establish civic engagement as a standard and provide a toolbox for Vienna administrations with participatory options for everyone. This has not yet been achieved. As all four characteristics are interconnected, engagement is highly dependent on people's *digital literacy* and *technological proficiency*.

The corresponding challenge to *digital literacy* is the *digital divide* addressed by the Digital Agenda. Such literacy is the skill to navigate and process the enormous amount of information available today. This includes critical thinking and the ability to discern between credible sources and misinformation. Such a quality is usually attributed to educated people. As illustrated earlier, Vienna tries to make digital literacy a part of the educational program and provide the elderly population with pertinent options. As the expert with a very long experience in city administration stated, digital technology makes the process even more complex as an increasing number of stakeholders and players become involved. A city not only has to choose what services are needed for citizens but also to keep its data protected from the market. This is the same tendency where the first step has to be made by the city and then the citizens can get involved, wherever it is an educational project or participatory service. The problem is that emerging technology, especially digital services, changes, shifts, and appears constantly. In many cases, people would experience a service or technology offered by a private company, and only later by a city. Agility in public administration should tackle these specific features of technologies, which would make it easier for people to accept them. The question remains open as to how to do that or with what technology such a state can be achieved. As discussed in the interviews, something like a blockchain could potentially be an answer—a platform that would provide users with full authority

over their personal data. Interestingly, the blockchain itself has not found any significant use cases for the city of Vienna and is currently only used in the upcoming Kultur-Token application. *Technological proficiency* is a corresponding skill that a smart citizen should acquire, which helps people understand the basics of emerging technologies, such as Blockchain, AI or Cloud services. This will help people adapt to changing digital landscapes. From the perspective of Innovation Diffusion Theory, such people would be a small group of early adopters. People who have sufficient knowledge and resources to obtain and test new technologies. The challenge for a Smart City is to establish its own environment of service provision, where these steps of adoption could be neglected; thus, an innovation, technology, or service would equitably be available to everyone. This is also currently the biggest difference between European and Asian models of a Smart City, which later relies on the full digitalization of the services. On the other hand, an expert opined that citizens do not realize the transformation, as it does not happen instantly. The evolution occurs at all levels of the city, and as a Smart City like Vienna does not pursue economic profits, but prioritizes digital humanism, the gap between people; otherwise, the digital divide could be reduced to a minimum. As of now, this discussion exists only on a theoretical planning level, as the results are not yet available, the services have not been implemented, goals have not been achieved, and so on. Information is lacking in order to answer which approach or what generation of a Smart City is actually better. This brings us to another milestone of the current Smart Cities - sustainability.

Environmental consciousness is a characteristic that can be translated as people's awareness of environmental issues and the resulting sustainable behavior. In Vienna, it has gained the highest priority even when changing the strategy title to *Smart Climate Vienna*. As previously analyzed, the sustainability practices rooted in the smart city plan are more efficient allocation of resources, easier administrative processes, better management, and responsible citizen behavior. Vienna implemented interesting ideas to empower people to make sustainable decisions. For example, while building a new 22 district, the planning department first established public transport channels for people, such as bus and metro lines, before the first buildings. The idea was that people might reduce their need to buy or own a car after moving to a new district because it already has easy and fast access to the city center and surroundings. The Kultur-Token app has

a similar intent, through gamification, to encourage people to engage in environmentally friendly behavior by providing certain benefits a city can offer. Sustainable consumption will be taught in schools and other educational institutions, increasing public awareness of waste management, recycling, and the use of renewable resources. From a city perspective, this situation is highly complicated. To achieve substantial changes, significant restructuring of the city is required. From the experts perspective, the current organization of public administration in Vienna relies on citizens' wished mindset or wished behavior. For example, Vienna removes parking spaces from the city center to make people do what is wished by the administration - to use public transport. Eventually sustainability is not only a technological question, but also a social and a political question. Nevertheless, the experts agreed that these first steps had to be made as soon as possible to educate future generations, while the climate goals would require significant restructuring of social systems as well as new (not yet existing) technological intervention.

All four characteristics are very demanding and require a person to have significant knowledge about current issues that occur in the city and beyond, such as environmental concerns. Additionally, smart citizens should be capable of distinguishing between real and fake information by utilizing various digital services to make rational decisions. Such people are a lot more alert towards too much digital comfort and remain vigilant about their online privacy and data protection. In certain cases, this can lead to people boycotting city services as it was with the Stop-Corona app in Vienna (Steinkogler, 2021). In the current discussions, smart citizens are presented as an ideal, a unit that fits the idea of a perfect smart city; people consciously participate in city development and contribute to real changes. Current smart city policies are far from ideal (Shelton & Lodato, 2019). An expert shared that even in countries that are pursuing full digitalization like Estonia, such common issues as interoperability of city systems and services are present and remain unsolved. Van Twist et al. (2023) analyzed the growing concern among scholars regarding citizen discontent in smart cities and identified two perspectives: active and passive discontent. Active discontent involves citizens expressing dissatisfaction with smart city technology, democratic processes, or societal impacts through various behaviors, either individually or collectively. Passive discontent, on the other hand, stems from citizens' lack of

awareness or skills as well as the invisibility of smart technologies. In each corresponding case, appropriate governmental actions are needed to embrace critical citizenship (ibid., p. 10). Overall, it is an open question whether smart citizens are an idea of the future or an example of existing citizens. Independent of the direction a particular smart city chooses, the first significant changes should be made at the organizational level, transitioning step-by-step to the inclusive city with participatory options for different groups and actors. At the same time, digital technology is an undoubted leader when it comes to achieving such goals, even if in the short term, it can lead to further fragmentation of society and cause new challenges, which currently seems to be inevitable. Vienna's approach is to slowly find the right use cases for a variety of digital technologies, thus engaging and involving different social groups in its smart city environment. Even though Vienna was among the first cities to introduce its smart city strategy, experts agree that smart city goals will not be achieved immediately; it is a continuous path with constant changes on the way. This includes: organizational changes of the public administration making it reactive and more agile, citizens empowerment through education and befitting services, faster pace and building of an extensive foundation of technology skills. Summarizing, the vision of a smart citizen is in its early stage and has a long way to go.

7. Conclusion

This research thesis aimed to explore the influence of digital technologies on modern urban development planning. This interplay was analyzed through the emerging concept of smart cities, which has become the main approach for the majority of cities. The aim was to identify what social practices were influenced by the integration of digital technologies and what practices emerged within the Smart City paradigm, and to build a foundation for future sociologically focused research. The perception of digital technology's role in SC has shifted from being a fundamental element to a supportive tool in addressing the different dimensions of a smart city and correlated urban challenges. This step can be reflected as a transition from the first to the second generation of smart cities, where people-centered design became the main driving force (Trencher, 2019). The case analysis of Vienna helped to establish the current state of a 'balanced' smart city and, based on the technology integration model, identified a variety of challenges. Understanding Vienna's strategy is crucial in the context of modern urban development to address the pressing issue of harnessing digital technologies for sustainable and inclusive city growth.

The results of this thesis indicate that the concept of a smart city has become a global trend for addressing existing and new urban challenges. The initial idea of a smart city as an analytical and comparative model for medium-sized cities in Europe expanded beyond the original trajectory proposed by Giffinger et al. (2007). On a global scale, the smart city model is still used as a metric with a variety of indicators to rank and compare cities worldwide. Two international ranking systems, DESI and ITU, show limited capability to grasp the essence of a modern smart city because they focus on comparable superficial data. Despite this, metrics are still a popular tool. Smart City is a perfect field where Mau's '*quantification of social*' (2018) can be observed. While the frameworks and strategies might propose a certain approach it is important to investigate how the practical execution actually happens. To achieve a more in-depth understanding of urban changes stemming from the smart city concept, the analysis must focus on specific cases or clusters of similar cities. Vienna was selected as the major competitor in the smart arena. The results of the document analysis revealed that Vienna's emphasis on civic engagement represents a departure from the traditional

top-down urban planning. However, the city grapples with balancing citizen participation to safeguard individual privacy, reflecting the global dilemma of data protection in the digital age. The adoption process doesn't have a clear approach, but is structured around a variety of methods. The biggest disadvantage is that potential resistance is not considered, rather social groups who might have interest in a service. Even though the citizen-centric approach is primarily focused on social needs, the emphasis on technology remains relevant. It shifted to the back-end discussion and can be easily observed on practical examples. The model has proven that the majority of challenges and issues can not be addressed by the current methodology and suggested indicators. Smart City still remains an issue for empirical assessment (Ependi et al., 2022). Digital technology remains the main driving force behind achieving global smart city goals. In certain areas, such as participation, it creates unrivaled opportunities for citizen engagement, whereas in others, such as sustainability, digital technology shows very limited capabilities. Overall, in the current state of digital technologies, Vienna is in an early stage. The opportunities that digital technology provides come with the corresponding challenges of digital divide, sustainability, surveillance, adoption, and trust, which have yet to be overcome. At the same time, the smart city concept does not address all urban challenges, and major issues such as gentrification receive little to no attention here. Co-creation approach helps to reach more desirable design (as it was with WienBot) but it doesn't reveal the hidden processes behind technology acceptance and does not provide a methodology for future services. The presented cases are not enough to evaluate the effectiveness and accessibility of co-creative practices. The doubts if a concept of Smart City can truly address social needs still remain relevant (Townsend, 2013; Cardullo & Kitchin, 2019; Prado et al., 2016; Streitz & Riedmann-Streitz, 2022).

This case study contributes to the ongoing conceptualization of smart cities within Europe and provides useful information for future analysis and comparison of digital agendas for cities all over the world. It identifies the challenges Vienna faced during the implementation of its strategy and provides an overview of the solution that the city's government is planning to implement. Unlike smart city indexes, the results of this study provide some insights into how digital technologies can be implemented to achieve smart city goals and what milestones others will need to reach in the process.

Additionally, newly established challenges of digital urbanism should be addressed by policy makers and lawyers to successfully implement smart solutions in the future. Learning from others in the main agenda of this thesis, which is inherent in the concept of smart cities. Additional research could investigate the dependencies of digitalization on other dimensions of a smart city. The results imply that a new methodology is needed to comprehensively understand and implement various digital solutions that can be utilized in a city. Digitalization is a continuous process that requires constant monitoring and reflection. Viennas' citizen-centric approach points towards potential areas for improvement in existing smart city frameworks pursuing co-creation and civic participation as the future of urban development. As smart cities became the dominant way of communicating with citizens, it is necessary to reconsider some outdated practical and theoretical considerations about the concept to achieve the common vision of the smart paradigm. The digital dimension of a smart city is deeply rooted with such social challenges as: digital divide and inclusion, responsible and sustainable behavior, democratic participation, surveillance (ethical dimensions of technology), and automation. Each particular field can benefit a lot from a dedicated sociological analysis, identifying relevant actors, practices and interactions. The implementation of smart city agenda can significantly change the way cities communicate and interact with the citizens. The new emerging class addressed as a 'smart citizen' has a potential to become a main actor in decision-making, thus causing power diffusion and societal shift towards digital and technologically literate people.

The study relied on document analysis and expert interviews, lacking actual data or results, which will be crucial for a comprehensive analysis in future studies. The interviews with experienced city experts provided valuable qualitative insights but were limited by their subjective nature. Incorporating quantitative data and longitudinal studies would offer a more comprehensive understanding of smart-city dynamics. Moreover, this study primarily focused on the digital dimension of smart cities, neglecting other dimensions and correlated urban challenges. The thesis focused on the organizational level; thus, the citizens' perspective is not included in the final interpretations, and residents' interviews must be conducted in the future. Political and economical dimensions should be explored in the upcoming studies establishing a finalized model for smart city analysis. Until then the comparison of different smart cities

would remain only on a superficial level. Data-driven analysis will be possible after the city of Vienna provides up-to-date reports. Reports should be compared with previous results and initial planning shared with the Smart Climate Strategy and the Digital Agenda. The thesis provides no explanation to how cities decide to enter the Smart City path and what makes SC different from others. Also the question about rural areas and if 'Smart' is applicable only to urban centers remains open. Another area that requires further analysis are the smart indicators suggested by the city, with emphasis on qualitative indicators. They would help to establish more accurate metrics, thus helping to identify or prevent potential challenges. More attention should be given to the practical differences between the first and second generations of smart cities and the influence of big tech companies on the city's administration decisions on the implementation of digital technologies. An interesting question is how a smart city can empower citizens for responsible and sustainable behavior with the help of digital technology. In the case of Vienna, the city plans to achieve it through educational programs, which could be put under the scope of sociological research. Trust and responsible behavior are deeply rooted in the ongoing digitalization of smart cities. Both areas require dedicated research and appropriate methodologies, such as technology acceptance models. Technology acceptance theories and models can contribute to understanding citizens' intentions in regard to smart technologies, thus finding solutions for such issues as digital divide and exclusion from participatory practices (Abdulrahman et al., 2020).

This study provides an opportunity for urban sociology to engage with the evolving landscape of cities in the digital era. It argues that cities again became an important unit for sociological analysis. Smart City as a result of ongoing globalization offers an exploration field of the new urbanism driven by technological solutions. The thesis underscores the digitalization of human activities and life, shedding light on the importance of Science and Technology Studies in understanding technology both as a medium and as a societal challenge. STS offers a unique perspective on citizen science, ignorance, and co-creation practices, which are core to human-centered Smart Cities (Jasanoff, 2004; Adams et al., 2009; Böschén et al., 2010) . This study also highlights the intersection of smart city initiatives with broader sociological theories, emphasizing the need for cities to navigate the complexities of growing digital

inequalities and cultural differences within the framework of digital urban development. The complexity of a modern city involves actors outside its borders and recently emerged virtual practices, such as surveillance capitalism, which significantly influence the implementation process of digital technology and its acceptance by individuals. A smart City is a transdisciplinary field that requires a coordinated approach; thus, it cannot be compromised by a single discipline. Without a common comprehensive view, a smart city remains a fuzzy concept that generates different perspectives and loses the opportunity to be used as a model for grasping and comparing cities.

In navigating the twisted landscape of smart cities, it is evident that the digital future holds immense promise, yet carries profound risks and challenges to society. The forward path can shift in different directions, which can lead to connectivity establishing desired participation, increased efficiency, sustainability, and innovation, making cities more inclusive. An alternative method can disrupt the balance between the potential for extensive surveillance, both by city authorities and tech giants, and the imperative of securing citizens' trust and authority over personal data. As we advance into this digital frontier, the ethical dimensions of technology and surveillance, social inclusion and digital equality, democratic participation and cultivation of public trust must remain at the forefront. The evolution of smart cities underscores not just a technological revolution but also a societal transformation that demands careful navigation, critical reflection, and a steadfast commitment to shaping a future where technology serves humanity rather than controlling it.

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