Smart City Initiatives and the Common Welfare in Modern Societies

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I. Introduction

The term *smart city* is used to describe technology-based transformations of cities (Albino/Berardi/Dangelico 2015). *Smart city initiatives* are designed to help solve a variety of technical, social, economic, and organizational problems that arise from increasing urbanization in conjunction with a growing population. Cities consume more than 75 % of the global energy demand and cause more than 80 % of greenhouse gas emissions (Lazaroiu/Roscia 2012). Furthermore, increasing urbanization leads to increased demand for infrastructure and services, which further increases emissions and resource consumption (Neirotti et al. 2014). With the use of information technology and data analytics, cities can be managed more effectively and efficiently, improving citizens' quality of life and life satisfaction and thus the common welfare in modern societies (Al Nuaimi et al. 2015). Consequently, smart city initiatives that focus on the integration of intelligent transportation systems, for example, can make traffic flows more fluid and safer and reduce emissions. Smart power grids can facilitate the integration of renewable energies (Camacho et al. 2011). Additionally, involving citizens in the planning and implementation of smart city initiatives can help ensure that their needs and interests are addressed. To shed light on the concept of smart cities and their influence on the common welfare of citizens in modern societies, the following section first defines the concept and then explains its dimensions in order to subsequently demonstrate the influence of various smart city initiatives on the common welfare.

II. The Influence of Smart City Initiatives on the Common Welfare

In the absence of a uniform definition, the term "smart city" is often used to describe the increasing networking of a city's inhabitants with the surrounding technology (Göbel/Ferrero-Calle 2017). The idea of the smart city thus encompasses advances in technology, economy and society. In this context, the full potential of the concept can be realized only in a cooperative network of connections between civil society, city management, science, business and politics (Jaekel/Bronnert 2013). *Smart technologies* can bring great benefits to cities from both an economic and an environmental perspective. Cities are using their resources more efficiently by integrating information and communication technology (ICT) into municipal services. These new urban forms that make use of cutting-edge technological applications promote commercial opportunities and position themselves as centers of scientific research. They attract both new businesses and established companies (Müller-Seitz/Seiter/Wenz 2016).

Despite the abovementioned lack of a generally applicable definition, six activity areas/dimensions for the smart city can be identified (Giffinger et al. 2007). Figure 1 presents these as *Smart Economy*, *Smart People*, *Smart Governance*, *Smart Mobility*, *Smart Environment* and *Smart Living*. These subareas are combined and interconnected to provide the basis for the emergence of smart cities. The dimensions of smart cities explained below provide a general framework for understanding the concept and its applications.

An open, transparent, and diverse economy, which is what makes a city competitive, is characterized by the *Smart Economy* dimension. In particular, a city's internationality and entrepreneurial energy, as well as its productivity and labor market flexibility, help keep it competitive. A variety of employment opportunities and flexible labor market structures that promote innovation and entrepreneurship are characteristics of the smart economy (Giffinger et al. 2007). The aim is to expand citizens' access to educational opportunities, thus improving their skills and employability. In addition, smart economy initiatives can improve the business environment (Caragliu/Del Bo/Nijkamp 2011). Smart economy initiatives can lead to the development of new business models by making data generated in the city accessible to the public. The regional labor market can be made more flexible and at the same time stabilized through the networking of companies with each other, local authorities, service providers and employees (Müller-

Seitz/Seiter/Wenz 2016). Smart cities can thus promote entrepreneurship and the expansion of companies.

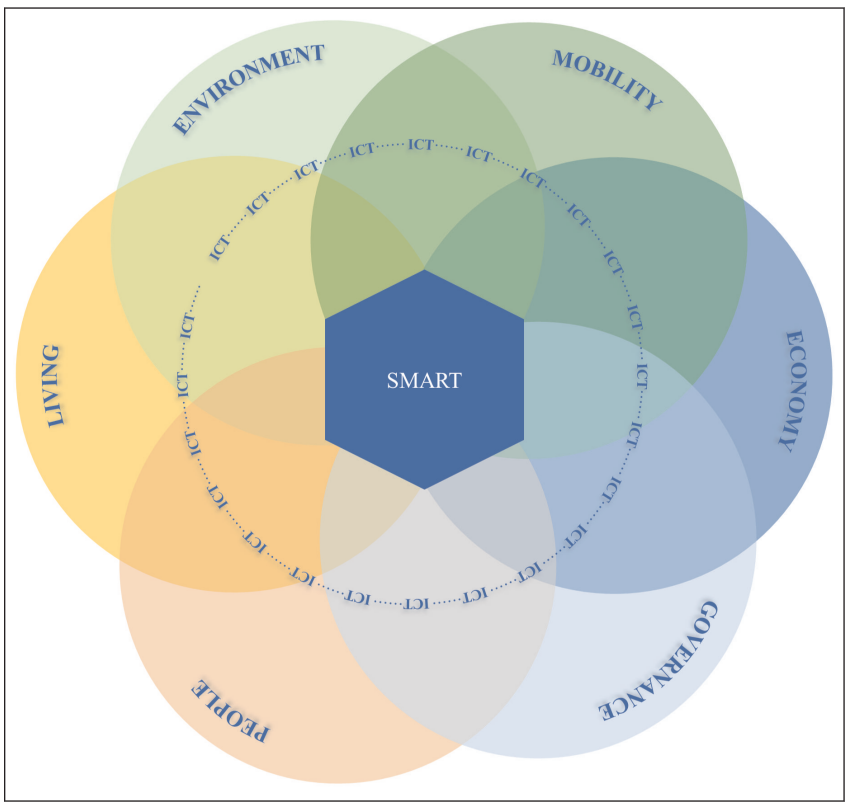

Figure 1: Smart city dimensions

Source: authors' illustration based on Sabory et al. 2021.

Another core dimension of a smart city is the *Smart People* aspect (Giffinger et al. 2007). Human and social capital are at the heart of this dimension, as a participatory civil society in which residents actively engage with public problems is what makes a smart city (Costa/Oliveira 2017). Social media and digital platforms can make it easier for citizens to connect with each other and with regional businesses, fostering a sense of neighborhood and social cohesion (Selinger/Kim 2015). Smart city initiatives can also promote citizen participation in decision-making and give residents a voice in the governance of their city (Klimovský/Pinterič/Šaparnienė 2016).

The functions and services of the city administration fall within the *Smart Governance* dimension. For example, the integration and improved accessibility of e-government services as well as the public provision of generated urban data (open data), open government and e-government can significantly improve the efficiency of public services (Govada/Spruijt/Rodgers 2017). Moreover, through e-participation, civil society can ideally exert greater influence on government decision-making. Regarding health care, for example, smart governance initiatives can establish telemedicine services with remote monitoring devices that help patients manage chronic diseases and receive treatment without having to leave their homes (Ptak 2021).

Sustainable and state-of-the-art transportation, the accessibility of cities, and the availability of information and communication technologies are just a few of the numerous factors that make up the *Smart Mobility* dimension (Giffinger et al. 2007). Public transportation and other elements of the transportation system are essential elements of smart mobility given the immense amount of traffic in cities (Govada/Spruijt/Rodgers 2017). The aim is to facilitate citizens' access to jobs and leisure activities. In doing so, intelligent transportation systems can provide real-time information about traffic patterns to help citizens make their journeys more effective. Furthermore, real-time information can be provided for public transit schedules or available parking spaces (Prakash 2020).

Initiatives for sustainable growth considering the natural environment of a city are assigned to the *Smart Environment* dimension (Govada/Spruijt/Rodgers 2017). Consequently, this dimension includes elements such as preservation of the ecosystem, reduction of air pollution, sustainable use of resources, and maintenance of a desirable environment (Giffinger et al. 2007). For example, sensors can be used to continuously monitor air quality (Gupta et al. 2020). A strong commitment to preserving, expanding, and improving existing green spaces and investing in making cities greener is another focus of the *Smart Environment* dimension (Müller-Seitz/Seiter/Wenz 2016). Green spaces provide citizens with access to recreational areas and play a critical role in improving air quality. Smart technology can be used to monitor and manage these spaces to ensure that they remain in good condition and accessible to all (Gupta et al. 2020).

Finally, the aim of the *Smart Living* dimension is to raise citizens' standard of living. The components of the dimension include social cohesion, housing quality, quality of educational facilities, health care and safety, and quality of cultural facilities (Giffinger et al. 2007). Numerous technologies

and gadgets can be integrated into smart living through smart home technologies, improving citizens' well-being and satisfaction. In addition, smart living initiatives can raise the standard of living by promoting the use of smart home technologies and sustainable building techniques (Macke et al. 2018). As a result, it may be possible to build homes that not only are more energy efficient but also can improve citizens' quality of life.

III. A Smart City Initiative in Freiburg im Breisgau, Germany

A current example of smart city initiatives is the subprojects within the Freiburg *"Modellprojekt Smart-City"*. The city of Freiburg has set the goal of improving the common welfare of Freiburg's citizens by providing groundbreaking answers to the issues of digitalization, climate change and social integration. In doing so, the city relies on close collaboration with citizens, scientists, businesses, and other partners. Freiburg competed against 86 other German cities with its model project and received funding of approximately 8.3 million euros from the German Federal Ministry of the Interior and Home Affairs (Digital.Freiburg 2020).

In December 2019, Freiburg adopted a digital strategy to be used as a framework for all digital projects in the city (Digital.Freiburg 2023). Part of this strategy is the smart city initiative *"Daten:Raum:Freiburg"*. Running from January 2021 to December 2025, the project aims to have a functional and scalable data infrastructure in place by 2025 that Freiburg can benefit from in the medium to long term and that can be transferred to other German cities. The overall "*Daten:Raum:Freiburg*" project is divided into five smaller smart city initiatives:

- City Simulation
- Connected Participation
- Platform Architecture
- Data Governance
- Mobility Control & Traffic Safety

Part of the *City Simulation* involves building a digital twin of a neighborhood that will be used by urban planners to model and optimize different scenarios for infrastructure design, resource management, and growth of the new neighborhood. This can lead to more cost-effective resource use, better planning decisions, and a more sustainable environment that meets citizens' accessibility, transportation, and environmental needs. The devel-

opment of this platform will allow citizens to view proposed development and construction plans and express their opinions about them. This promotes openness, responsibility, and diversity while ensuring that the new neighborhood meets citizens' needs and aims. Furthermore, the digital twin can be used to model and optimize the environmental performance of the new district, from energy consumption to waste disposal to the creation of green spaces. As a result, the district's CO2 consumption can be reduced and the city's sustainability increased, making the ecosystem healthier and more livable for residents.

The *Connected Participation* initiative involves the future-oriented integration of citizens into urban development. The mission is to realize the initiative through participation formats that build trust and acceptance and ultimately increase citizen participation. This is achieved by designing with and for citizens and enabling broad participation and codesign through effective communication and participation processes. Furthermore, the *Platform Architecture* initiative is designed to develop and implement a platform architecture that will enable better integration of the city's data infrastructure. Platform architecture refers to the implementation of a distributed network of data as well as applications. The creation of this network goes beyond ubiquitous, simple, and unified access and also focuses on semantic linking of data, services, and applications. The architecture acts as a data hub for collecting and consuming distributed data sources and applications. As part of the *Data Governance* initiative, a data infrastructure will be established that will enable decision-makers to effectively manage information.

Finally, a *Mobility Control and Traffic Safety* system will be developed for the city. This system will create real-time representations of people densities, people flow, and traffic movements. For this purpose, infrared cameras will be used to record trajectories as well as a 3D measurement of vehicles so that the system can also identify heavy traffic. The generated data will then be integrated into a 3D model of the city. Furthermore, traffic safety must be continuously improved. For this reason, traffic-relevant data will be collected using deficiency detectors to identify problem routes for emergency services. This information will improve the traffic light priority system and thus increase traffic safety. In addition, the data will be used to evaluate the ecological impact of new mobility concepts (Smart-City-Dialog 2023).

IV. Conclusion

Smart city is a concept that is currently being pursued by many cities around the world and aims to use technology and innovation to improve the lives of citizens. In contrast to other initiatives, the city of Freiburg is focusing on actively involving citizens and stakeholders in the process to enable the successful and sustainable development of a smart city. This involves not only the development of technologies but also the promotion of citizen participation and cooperation to improve citizens' quality of life and life satisfaction and thus the common welfare. Freiburg's smart city project has shown that successful implementation should not be based solely on technical solutions. Involving citizens in the development process is crucial to ensure the successful adaptation of the smart city initiative.

In addition, the "*Daten:Raum:Freiburg*" project has made it clear that a comprehensive data governance strategy is of great importance. Such a strategy makes it possible to control the citywide data space and to define responsibilities, decision-making frameworks, and rules for data management. This project can also serve as an example and guide for other cities and municipalities to establish a contemporary, effective, and efficient information management system and thus to promote the sustainable development of a city.

In summary, smart city initiatives are becoming increasingly popular in research and practice. Although the research conducted thus far has yielded important insights, there are still many challenges that need to be addressed in the future. These include issues such as the long-term viability of smart city solutions and the security of data and infrastructure. Therefore, there is an urgent need for research to explore these and similar key topics more intensively.

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