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► **To cite this version:**

Kristina Nagode, Anton Manfreda. IT Diffusion in the Society: The Expansion of Smart Cities and Their Impact on the Sustainable Development. International Working Conference on Transfer and Diffusion of IT (TDIT), Jun 2022, Maynooth, Ireland. pp.177-187, 10.1007/978-3-031-17968-6_14 . hal-04666785

HAL Id: hal-04666785

<https://inria.hal.science/hal-04666785v1>

Submitted on 2 Aug 2024

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IT diffusion in the society: The expansion of smart cities and their impact on the sustainable development

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Abstract. The spread of information technology is now visible at every turn, considering organizations, individuals, and society as a whole. Organizations, aside from the current problems associated with the Covid-19 pandemic, highlight digitalization as one of their main priorities. However, technology and digitalization do not only apply to organizations, but also to the lives of individuals and communities. After all, many places today are faced with major challenges arising from global environmental shifts, rapid urbanization, and ageing infrastructure. On the other hand, digitalization may bring new opportunities and is already establishing the concept of smart cities and communities. At the organizational level, the goals of digitalization are more or less clear, however, the question arises about the goals at the level of society. Climate changes are certainly one of the areas that society cannot ignore. Smart cities and communities can make a significant contribution in this area; however, goals must be set appropriately. Many studies focus on the importance of smart city development, but there is a lack of research linking smart city development (including society as a whole) with quality of life, sustainable development, and a green future. At the same time, adopting digital solutions is becoming increasingly difficult due to rapidly evolving innovations and the difficulty of managing the complexity of intertwining technologies. Therefore, the purpose of this paper is to shed light on the intertwining of these aspects and highlight the factors that can ensure sustainable development in smart communities.

Keywords: Smart Cities, Smart Society, Digitalization, Sustainability

1 Introduction

Digitalization and the spread of information technology (IT) are affecting many areas. Organizations are focusing on digitalization as one of their priority activities. However, digitalization is not relevant for organizations only. The affordability of IT and consequently its diffusion in society has an impact on the lives of individuals and communities.

In recent years, many places have been facing problems and challenges that are arising from rapid urbanization and ageing infrastructure that is not able to cope with these challenges. By the predictions, the proportion of people living in urban environments will rise to up to 70 % by 2050 [1], making (newly) urbanized regions very impactful

on a global level. That said, it is crucial for them to develop in a sustainable manner, to ensure that the natural and social resources are preserved, while at the same time encouraging economic growth and providing a good quality of life for their residents [2].

Digitalization and IT diffusion in society have presented new opportunities and solutions for these issues, resulting in several smart cities and smart community-related initiatives. They are providing digital solutions for efficiently managing mobility, living, environment, citizens, government, economy, architecture, and technology in urban environments [3]. A smart city must be co-integrated into the local community [4], providing good economic, and social living conditions for its residents [5]. The primary understanding of the smart city concept was focused only on the technological perspective, claiming a city smart, depending on the level of integrated IT into its system, whereas the focus nowadays is for a smart city to be sustainable. Digitalization serves merely as a tool to achieve a better life for its residents and achieve sustainable development [6].

However, the question arises whether the goals in several smart cities and communities are properly set. Smart cities and communities can make a significant contribution to climate change and sustainable development; however, these challenges and priorities are often only on the paper agenda of decision-makers. Conceptualization of smart cities has already been well and systematically researched [7, 8]; however, it is still under researched how the use of digital technologies can help in achieving greater sustainability of the smart city concept. Therefore, the purpose of this research is to explore the effects of IT diffusion in smart cities and communities on their sustainability; to identify and examine factors important for the development of smart cities, smart communities, and smart society as a whole, that provide adequate quality of life for individuals, while ensuring sustainable development and green future.

2 Literature Review

2.1 Digitalization And Its Impact on Society

The digitization initiatives started many years ago; yet, it became more predominant in the last years and will also have a significant effect in the future [9]. Digitalization is not influencing organizations merely, but also individuals, organizations, communities, and many other areas. The concept of digitalization is currently used daily and is defined as the use of digital technology to significantly improve organizational performance [10] by integrating digital technologies and business processes inside the organization [11]. Therefore, digital transformation refers to implementing significant changes in the key organizational areas, such as business processes, business models, strategy, and organizational structures [12].

Digitalization is also associated with the usage of modern digital technology that is enabling important business improvements and is influencing consumer lifestyle as well [13]. It is important to add that both, business models and consumer lifestyles as well, are going through substantial changes that are different from the established behaviors in the past [14].

Modern and affordable technologies are thus affecting organizations; yet, at the same time, it is claimed that digital transformation is mostly a “buzzword hinting at the change in the scope and direction of digital government,” while “researchers aim to understand how and why these initiatives succeed or fail” [15]. Buzzword or not, it is impossible to neglect the initiatives in the organizations. Nevertheless, digital technologies are presenting a massive potential for innovation and improving performance in organizations and everyday life [16].

2.2 The smart city concept

A Smart City is a complex phenomenon, that has been previously defined by many researchers, but does not have a unified definition yet. Taking in account a few aspects from the Informational Systems perspective, it can be described as a city, developed by utilizing a set of advanced IT [17] to manage city’s resources efficiently [17], while improving economic, and social living conditions for its residents [5]. While technology is a promising and helpful tool for making a city smart, merely its implementation is not sufficient to bring its benefits to society. According to the best practices from around the world, a Smart City must be co-integrated into the local community [4]. Furthermore, investment in IT infrastructure, as well as human and social capital with a wise management of natural resources through participatory governance in a Smart City fuel sustainable economic growth and a high quality of life [18].

The existing research on the topic can be divided into the following themes: Smart Mobility, Smart Living, Smart Environment, Smart Citizens, Smart Government, Smart Economy, and Smart Architecture and Technologies [3]. Smart environment theme refers to taking care of natural and cultural resources by using IT [19], considering air pollution, forest quality, water quality, green spaces, weather, emission monitoring, waste management, and energy efficiency [3]. Smart living refers to achieving a greater quality of life using IT [19], considering public safety, healthcare, smart education, smart tourism, and smart buildings [3]. Since social and environmental resources are at the center of Smart Cities, it is important to explore the role of IT in helping a Smart City become more sustainable by preserving its resources. Previous research discussing sustainability of Smart Cities has focused on energy efficiency, waste management, quality of water, green spaces, and air pollution [3]. However, there is still a lack of understanding, how the diffusion of IT in a city environment can promote sustainable development.

A Smart City consists of multiple stakeholders, that are included in the sustainable development of a Smart City, namely academia and research institutions, local and regional administrations, energy suppliers, investors, IT sector representatives, citizens, government, property developers, non-profit organizations, planners, policy makers, experts and scientists, political institutions, and media. Their engagement is important for the success of implementation of smart projects [20].

2.3 The link between sustainability and smart cities

Sustainability is denoted as quality of a system, while the idea of a sustainable development is a pragmatic and anthropocentric one, with a primary focus on the people and their well-being. The sustainability concept at the beginning mostly revolved around environmental challenges, with a focal point on the idea of limited natural resources, that need to be conserved. The main aspects considered were climate change, clean energy, sustainable transport, sustainable consumption and production, conservation and management of natural resources, and public health. Gradually, the social and economic aspects were being discussed as well, from the perspective of demography and migration, global poverty, and sustainable development challenges [21].

Since urban environments are expanding rapidly and increasingly more people are moving to cities, with half of the world's population already living in them [2], their role in making the world more sustainable is crucial [21]. In more recent definitions, Smart Cities are defined as cities that are run efficiently, intelligently and are at the same time also sustainable [22], with the aim to provide good quality of life for their residents as well as to ensure economic growth and preserve natural and social resources for future generations [2]. Digitalization should be considered as a tool to achieve sustainable development and improve the life of citizens, moreover it provides the greatest benefits when it brings useful solutions for the life of the citizens [6].

3 Research Methodology

Firstly, a bibliometric study was conducted following the approach by [23]. The aim was to present potential differences between the understanding of smart cities between different research fields information and library science field and a cluster of fields exploring sustainability (including meteorology atmospheric sciences, environmental sciences ecology, forestry, oceanography, biodiversity conservation, plant sciences, and marine freshwater biology). The intention behind the study was furthermore to present how various fields approach the sustainability concept in research and to provide a connection between them since they are supposed to follow a unified goal. Since there are no unified definitions of sustainability and smart city concepts, we decided to analyze what are the most used author keywords related to both concepts in the field of information and library science and in the field of 'sustainability.' Data was collected in January 2022 through the Web of Science by the keyword "smart city", analyzed with the VOSviewer software. The search criteria in the Web of Science included only articles with a publication date between 2017 and 2021. Keywords "smart city" and "smart cities" were excluded in the analysis since they are correlated to all the other keywords. Figure 1 includes the keywords from the information and library science area of research and the second graph from the meteorology atmospheric sciences, environmental sciences ecology, forestry, oceanography, biodiversity conservation, plant sciences, marine freshwater biology area of research.

Secondly, to test some influential factors in the interplay between the smart city, sustainability, and green future we have done some preliminary research on the pro-

posed research idea. A web-based questionnaire was prepared and randomly disseminated among different volunteers in different regions. The purpose of preliminary testing was to obtain additional insights into the view on the smart city concept together with emphasizing sustainability related issues.

The questionnaire was, composed of several items measuring the interest in modern technologies, familiarity with the smart city concept, attitude toward different control and measurement sensors, security and privacy issues related to smart cities and several environmental issues within smart cities. Moreover, the elements of smart mobility and smart healthcare were designed into even greater detail. To ensure a shared understanding of the research concepts, a short definition was provided with each indicator. All variables were measured on a 5-point Likert scale.

Data was collected between 2020 and 2021. Overall, 2,947 individuals participated; however, 1,640 responses were included in the analysis, since they responded with all the needed data. The profile of the respondents is presented in Table 1.

Table 1. Profile of the respondents

Demographic characteristics		Share (%)
Gender	male	37.0
	female	63.0
Education	primary	0.4
	secondary	54.4
	tertiary - graduate	36.8
	tertiary - PhD	8.4
Type of settlement	urban settlement	62.4
	suburban areas	19.9
	smaller compact settlement	13.2
	scattered houses	4.5
Country	Slovenia	38.7
	Croatia	46.0
	Other	15.3
Country - other	Bosnia and Herzegovina	24.9
	North Macedonia	19.2
	Portugal	8.2
	UK	6.3
	Serbia	3.8
	Other	< 2.0

Most respondents are situated in Central Europe; however, there were several respondents obtained from other regions as well, while some respondents did not provide their country of residence.

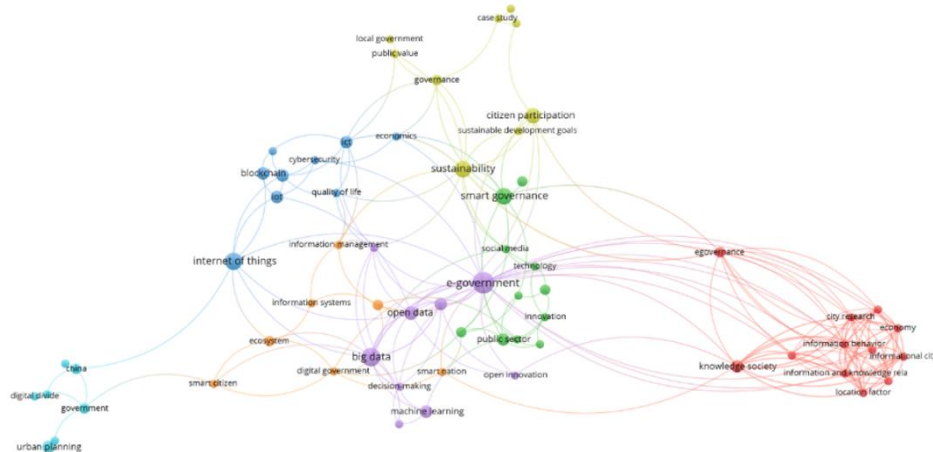
4 Preliminary results and future research opportunities

4.1 Bibliometric study of sustainability in smart cities

In information and library science, sustainability is viewed from five different perspectives, including the following clusters of keywords (see Fig. 1): (1) information and communication technology (ICT), quality of life, (2) information management, (3) e-governance, (4) social media, technology, smart governance, and (5) public value, governance, citizen participation, sustainable development goals (SDG). Quality of life in the explored research field is viewed from three perspectives: (1) privacy, ICT, (2) information management, and (3) sustainability.

Fig. 1. Bibliometric study of author keywords of smart city research in information and library research.

The keywords that are only used in the information and library research field are quality of life, information management, e-governance, social media, public value, governance, and sustainable development goals. Smart governance in sustainability re-



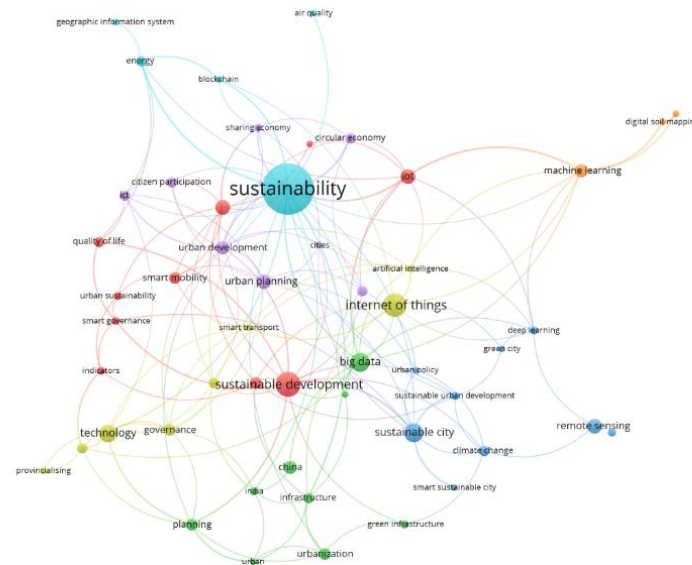
search of smart cities is indirectly correlated to sustainability through the sustainable city keyword.

In sustainability research, sustainability has been researched from a broader perspective, including the following clusters of keywords (see Fig. 2): (1) energy, blockchain, air quality, (2) citizen participation, ICT, urban development, sharing economy, circular economy, cities, (3) smart mobility, urban governance, internet of things (IoT), (4) big data, privacy, infrastructure, urbanization, India, (5) artificial intelligence (AI), innovation, technology, and (6) machine learning, and (7) sustainable city, sustainable urban development. Sustainable city in the explored research field is viewed from three aspects: (1) urban planning, cities, (2) urban privacy, sustainable urban development, cli-

mate change, smart sustainable city, and (3) smart governance, sustainable development. Sustainable urban development is viewed from two perspectives: (1) green city, climate change, sustainable city, and (2) sustainable development.

Fig. 2. Bibliometric study of author keywords of smart city research in sustainability research.

The keywords that are only used in the sustainability research field are energy, block-chain, air quality, sustainable city, sustainable urban development, urban development, sharing economy, circular economy, cities, smart mobility, urban governance, IoT, big data, privacy, infrastructure, urbanization, India, AI, innovation, and machine learning.



The only keywords that are used in all the research fields included are citizen participation, ICT, and technology. From the bibliometric study, it is evident that there are big discrepancies between the understanding of sustainability of smart cities. For a successful implementation of sustainable development goals in cities and in society, there is a need for the development of a unified model of smart sustainable communities.

4.2 The interplay between smart city and sustainability

The concept of a smart city influences individuals and their style of living. The latter is already influenced by the diffusion of technology and digitalization in society. Since individuals are generally reluctant to change, we examined the main concerns related to smart cities. We divided the sample into several groups, namely separately looking at individuals that are more enthusiastic regarding the technology, individuals that live in urban areas and individuals from rural areas only.

Table 2. Concerns related to smart cities

Concerns related to smart cities	All	Tech. enth.	Urban areas	Rural areas
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	avg.	avg.	(N)	avg.	(N)	avg.	(N)
Data privacy	4.1	4.1	(451)	4.1	(906)	4.2	(256)
Security issues	3.9	3.9	(451)	3.9	(903)	4.0	(257)
The use of preferences by other parties	3.9	3.8	(450)	3.9	(904)	3.8	(257)
Historical records of activities	3.5	3.5	(451)	3.5	(906)	3.5	(257)
Transparency and consideration of interests	3.4	3.3	(450)	3.4	(906)	3.4	(257)
Transparency of services	3.3	3.3	(451)	3.3	(904)	3.2	(256)
Complexity of services	3.3	3.1	(451)	3.3	(905)	3.3	(257)
Implementing 5G networks	3.0	2.7	(450)	3.0	(905)	3.0	(257)

As evident from Table 2, the main concerns are related to data privacy, security issues and the use of individual preferences by third parties. Surprisingly, these concerns almost do not differ between the groups.

On the other side, while looking at the potential benefits that smart cities may present, we were focusing mostly on environmental issues (see Figure 3).

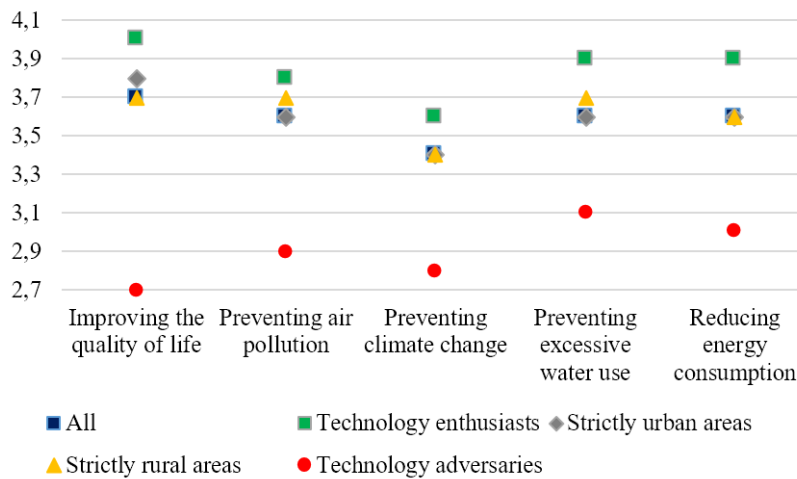


Fig. 3. Smart city environmental-related benefits as viewed by distinct groups.

The axis in Figure 3 is not fully presented to better highlight the differences. There are almost no differences between individuals living in rural or urban areas; however, there are quite significant differences between individuals that are more technology enthusiastic and individuals that are reluctant towards technology.

Lastly, we examined the view on the smart city concept between individuals that are more sustainability-oriented and once that are not. More specifically, agreement with the elements that should be included in the smart city was compared between both groups. As shown in Figure 3, individuals that live by sustainable principles perceive different smart initiatives as more important compared to others by placing smart waste disposal as the most important.

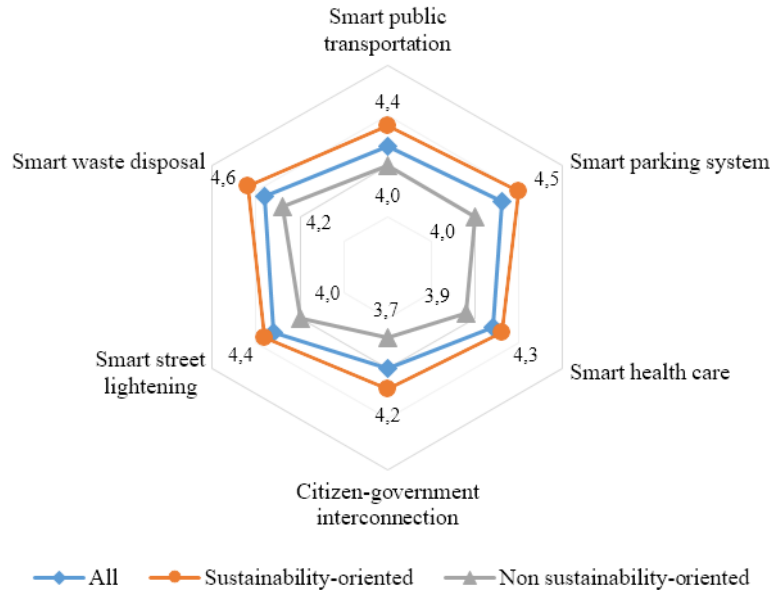


Fig. 4. Smart city elements that should be included as viewed by distinct groups.

We also found significant differences in the preparedness towards installing different sensors among sustainability-oriented individuals and others. More specifically, individuals that live by sustainable principles are more likely to use sensors in their households to monitor waste production to optimize trash collection routes (average value 3.8) and support installing noise monitoring sensors in public streets (average value 3.7) compared to non-sustainability-oriented individuals (average value 3.1 and 2.9).

The above preliminary results support the fact that future research is needed to examine factors important for the development of smart cities and smart communities concerning the adequate quality of life for individuals and ensuring sustainable development and a green future. After all, the preliminary results indicate that the concept of the smart city is perceived differently between individuals with different sustainability orientation. Different perceptions may consequently lead to a different understanding of the smart city concept. Therefore, it is vital to set properly the definition of the concept together with main goals and activities that would lead society towards a green future while maintaining a sufficient level of well-being.

4.3 Limitations and future research

A limitation of the research is that the research is constrained by the sample, which is not accurately reflecting the characteristics of the wider society. However, as stated above, the purpose of the initial phase was to receive additional insights and examine key factors related to both smart cities, well-being, and environmental issues in various regions.

The future research will focus on further development of the key factors important for the improvement of smart cities, smart communities, and smart society, that incorporate adequate quality of life, sustainable development, and a green future. Therefore, future research will examine the interplay between sustainable development and green future in relation to smart city, smart community, and smart society as viewed through the lens of key stakeholders important in this interplay. Moreover, future research should also propose proper business models that will ensure this sustainable development. Lastly, the advancement in this area will hardly be achieved without knowing the barriers and main obstacles in the society; thus, exploring opportunities and barriers of digital technologies and various technological factors for supporting sustainable development of smart society in even greater detail is also crucial.

5 Conclusion

The study showed that there are differences in understanding sustainability of smart cities between the information systems field and the sustainability related fields. The preliminary study results indicate end users are concerned about data privacy, security issues, and the use of individual preferences by third parties. The main perceived benefits of smart cities on sustainability from end users are improvement of quality of life, prevention of excessive water use and reduction in energy consumption. Moreover, individuals that live by sustainable principles perceive different smart initiatives as more important compared to others placing smart waste disposal as the most important. They are also more prepared to install and use digital technology solutions to manage the sustainability of a city.

The rapid growth of population and fast urbanization is currently affecting not only the quality of living in several urban areas but also in suburbs and in many vacated areas on the other side. Moreover, several urban areas are facing older existing infrastructure; and therefore, are not able to handle this rapid urbanization. However, modern technology, IT diffusion in society and digitalization itself may provide various solutions that can solve many problems with urbanization on one side and vacated areas on the other side.

Several studies are focusing on the importance of smart city development, but the research linking not only smart city development but also society with quality of life, sustainable development and a green future is lacking. IT and digitalization of society can significantly help in solving modern issues, yet they both can cause even additional problems if not effectively managed and implemented. Due to climate changes, which cannot be overlooked anymore, it is important to emphasize factors that are leading society towards a green future and maintaining a sufficient level of well-being at the same time. However, the latter is not as obvious as it sounds.

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