

CHAPTER 2

THE IMPORTANCE OF SMART CITIES AS A MODERN URBAN SETTLEMENT SOLUTION

Olja Munitlak Ivanović  <https://orcid.org/0000-0002-4323-3678>¹
Tatjana Špoljarić  <https://orcid.org/0000-0002-6229-1486>²

¹Faculty of Sciences, Department of Geography, Tourism and Hotel Management,
University of Novi Sad, Serbia, e-mail: olja.mi@dgt.uns.ac.rs

²Faculty of Tourism and Hospitality Management, University of Rijeka, Croatia, e-mail:
tatjanas@fthm.hr

The concept of smart cities gives the option for residents of urban areas where life is increasingly complicated to function more easily, better, healthier, more efficiently and rationally. This possibility is provided thanks to mass use and with the help of advanced technologies. The intention is to include in all or as many city services as possible technology that improves the lives of city dwellers, whose number is increasing uncontrollably. At the heart of the concept of a smart city is the saving of time for each resident, and thus the possibility for him to use that time more healthily and wisely. The concept of smart cities is based on the implementation of IoT (Internet of Things) and ICT (Information and communication technologies) devices. This refers to various sensors, LED lighting, data collection and analysis devices, utility services and all services that can be simplified and accelerated by the mass use of technology. In measuring the achieved concept of a smart city and ranking them against each other, an index will be used that measures 77 indicators on the basis of which the ranking is done. This is not the only index, but it is one of the most frequently used and has been in use since 2019. Recently, the term Society 5.0 has been increasingly used for today's society. Society 5.0 is the idea of the Japanese government with the intention of balancing economic progress with solving social problems in society. The development of smart cities should be accompanied by a similar kind of attention and innovation related to the development of smart villages to reduce population migration from villages to cities, leading to a healthier society with equal development of all regions.

Keywords: *smart city, Internet of Things (IoT), Information Communication Technologies (ICT), index of smart cities, smart villages, Society 5.0*

INTRODUCTION

In 2015, the United Nations General Assembly established 17 interlinked global goals that provide a roadmap for promoting a more equitable and sustainable future for humanity (UN, 2015). These goals, known as the Millennium Development Goals (SDGs) serve as a guiding framework for nations worldwide (Munitlak Ivanović, 2018). Within this framework, cities are recognized as key players in achieving these goals by 2030. In this capacity, cities are committed to cultivating a sustainable ecosystem by harnessing smart technologies to address both social and environmental challenges (Alberti, Senese, 2020).

In practice, it is of utmost importance to establish a solid link between the concept of smart cities and the achievement of the Millennium Sustainable Development Goals (SDGs), examining the feasibility of integrating sustainable development goals into the framework of smart sustainable cities. This linkage becomes particularly important for the wise management of vital resources such as water and energy, the improvement of governance structures and the cultivation of various forms of grassroots cooperation. While overarching concepts such as sustainability, waste management, citizen participation and innovation serve as common goals, they are interpreted and strategically implemented differently in different urban landscapes. Each city masters its challenges in these areas in its own context with customized approaches tailored to its specific needs and circumstances (De Guimarães et al., 2020).

The concept of smart cities represents a compelling opportunity for urban centers to improve their functionality, efficiency and rationality through the use of cutting-edge technologies integrated into basic urban services. This advancement aims to improve the quality of life for residents, which is a particularly pressing concern given the exponentially growing urban population. At its core, this concept is about optimizing individuals' time. It is considered "wiser" to invest in a streamlined urban life facilitated by advanced infrastructure rather than dealing with the complexity of traditional urban structures (Stojkov Pavlović, 2023). Indeed, it is widely recognized that smart cities are the blueprint for the future, which has prompted numerous metropolises around the world to embark on the journey of adopting and implementing this transformative paradigm.

Smart cities are harnessing the power of IoT (Internet of Things) and ICT (Information and Communication Technologies) devices, including sensors, LED lights and data collection and analysis tools, to revolutionize infrastructure, municipal services and more. By leveraging data obtained through these devices, cities can streamline operations, improve organization, simplify processes, increase flexibility, strengthen security measures and reduce costs, ultimately improving the overall quality of life for citizens (Munitlak Ivanović, 2020). The proliferation of smart devices and their unstoppable evolution have immensely favored the concept of connecting different objects via existing internet networks. The Internet of Things (IoT) is the culmination of this progress, which has been made possible by the development of conventional networks connecting millions of interconnected devices. Technological advances in ubiquitous computing (UC), wireless sensor networks (WSN) and machine-to-machine (M2M) communications have further solidified the foundations of the IoT (Silva et al., 2018). Central to the IoT paradigm is the principle of enabling UC through uniquely identifiable smart devices, thereby minimizing human interaction and maximizing efficiency (Nathali et al., 2017). A smart city therefore inherently embodies the principles of IoT and adopts its fundamental operating mechanisms. It is widely recognized that the IoT provides the essential components for building smart cities, including data generation, data management and application handling.

In everyday parlance, a smart city is an urban environment that utilizes ICT (Information and Communication Technologies) and other related technologies to improve the efficiency of regular city operations and the quality of services provided to citizens. In a formal sense, experts have defined a smart city by considering different aspects and perspectives of urban development.

A widely used definition emphasizes the idea that a smart city combines physical, social, business and ICT infrastructures to increase the "intelligence" of the urban environment (Pereira et al., 2018). In contrast, another view characterizes a smart city as a modernized urban center that uses ICT and related technologies to improve the quality of life, strengthen competitiveness and increase the operational efficiency of urban services. At the same time, it strives to ensure the sustainable availability of resources for present and future generations, taking into account economic, social and environmental aspects (Mahmood, 2018). Originally, the main objective of early smart city initiatives was to improve the quality of life of city residents by reducing the inequalities between supply and demand in various functional areas (Zanella et al., 2014). Today's smart cities are evolving in parallel with the changing needs of city dwellers and aim to

provide sustainable and efficient solutions for energy management, transportation, healthcare, administration and beyond to meet the demands of growing urbanization (Ejaz et al., 2017).

United Nations forecasts predict that around 66% of the world's population will live in urban areas by 2050 (UNECE, 2020a). In the global economic landscape, megacities consume a significant proportion of the world's resources. According to current estimates, these urban giants account for 75% of global energy consumption (Mohanti et al., 2016). This pattern of energy consumption in cities is responsible for almost 80% of greenhouse gas emissions and has a profound negative impact on the environment (Gil-Garcia, Pardo, Nam, 2016). In light of these challenges, industry and academic experts agree that smart cities are an optimal solution to the multiple challenges posed by rapid urbanization, population growth and environmental degradation from energy-related pollution and other factors. However, it is crucial to recognize that not all smart cities are homogeneous, as they have different needs, contributions, components and characteristics inherent to modern urban centers. Given this diversity, the International Organization for Standardization (ISO) plays a central role in providing globally harmonized standards to ensure the quality, safety and performance of a wide range of smart city initiatives. Adherence to these standards not only facilitates the implementation and management of smart cities, but also real-time performance monitoring, thereby promoting the efficiency and effectiveness of urban governance (The British Standard Institution, 2014).

Even the philosophers of antiquity reflected on the organization of the ancient polis and advocated a symbiotic relationship between residents and their urban habitat to promote a higher quality of life. This ancient wisdom is in line with today's concept of smart governance, where the well-being of citizens is closely linked to the sustainable management of resources and infrastructure. The observations of the philosopher Hippocrates further emphasize this interconnectedness by highlighting the profound influence of environmental factors such as water quality, soil fertility and climatic conditions on human health and overall quality of life (Silva et al., 2018).

MATERIALS AND METHODS

The research primarily based on the analysis and use of secondary data sources, in particular the review and examination of previously published research in this area, as well as case studies of various national and international organizations. In addition, the study looks at national and

global strategies for the development of smart cities, combined with an analysis of the practical implementation of IoT (Internet of Things) and ICT (Information and Communication Technologies) in selected smart cities, which also include elements of sustainability. Through the predominant method of secondary data analysis, the study dissects and determines the concepts of IoT, ICT, smart cities and advanced technologies underlying the development of smart cities.

To effectively illustrate the findings, the study uses schematic, tabular and graphical representations, including bar charts, to show the ranking of cities or their success in implementing smart city concepts. In particular, the Smart City Index (SCI) serves as a key tool that provides insights into each city's performance from 2019 to 2023.

In order to draw conclusions and summarize perspectives, the synthesis method is applied, allowing the integration of different viewpoints on the implementation of exemplary practices and approaches in the field of smart mobility and public safety. This synthesis is complemented by a comparative analysis that contrasts practices from national and global contexts. Furthermore, the inductive-deductive method is applied, which includes processes of generalization and specialization to derive insights from specific examples and extrapolate broader implications. Through these methodological approaches, the research aims to provide a comprehensive understanding of smart city development and its implications for urban governance and sustainability.

RESULTS AND DISCUSSION

Components and characteristics of a smart city

The slogan of the 2010 Shanghai World Expo, "Better City, Better Life", reflected the increasing recognition of the crucial role of local authorities in creating a living and working environment in which their citizens can thrive (De Jong et al., 2020). The Shanghai Declaration (dated October 31, 2010) summarizes the aspirations to create "harmonious cities", which are considered urban environments where people live in harmony with nature, society and themselves, as well as in harmony between generations (UN, 2011). This also includes respecting nature, promoting the use of renewable energy sources, building low-carbon eco-cities, striving for inclusive and balanced growth and preserving an optimal balance between social equity and economic efficiency. The declaration contains a whole series of proposals aimed at improving the quality of life in urban environments, such as implementing scientific and technological

innovations, building a smart and accessible information society, creating livable communities and promoting balanced urban-rural development (Shanghai Manual - A Guide for Sustainable Urban Development in the 21st Century).

In addition to the declaration, megalopolises are the subject of numerous initiatives aimed at improving urban infrastructure and services in order to create better environmental, social and economic conditions and increase the attractiveness and competitiveness of cities (Guandalini, 2022; Bibri et al., 2024; Blasi et al., 2022). This development is reflected in a large number of new categories of cities that have entered the political discourse: "sustainable cities", "green cities", "liveable cities", "digital cities", "intelligent cities", "smart cities", "knowledge cities", "information cities", "resilient cities", "eco-cities", "low-carbon cities" and even combinations such as "low-carbon eco-cities" and "ubiquitous eco-cities". Essentially, they all represent the pursuit of smart cities as defined in this paper. In addition, the proliferation of smart city initiatives has led to a renaissance in urban planning and governance, triggering a re-evaluation of traditional approaches and paradigms. As cities grapple with growing populations, resource scarcity and the demands of climate change, the imperative to innovate and adapt has never been more urgent. The emergence of new types of cities such as "knowledge cities", "information cities" and "resilient cities" underlines the dynamic nature of urban development and the need to embrace change in all its forms. This development represents a paradigm shift in the way cities conceptualize and realize their future by transcending conventional boundaries and taking a holistic, integrated approach to urban development.

Figure 1 illustrates several different components that make up a smart city. Smart community, smart energy, smart transportation and smart healthcare are some of these key components. However, in practice, the components of a smart city vary from one smart city to another, depending on the areas of interest of the local community or opportunities. For example, a particular smart city's administration may consider incorporating disaster management systems into the smart community, while another city's administration may plan to integrate waste management systems, and a third may implement smart lighting that focuses on energy sustainability and maximum capacity utilization (i.e., transitioning from conventional to LED street lighting).

Below is a schematic representation of a smart city that some authors consider essential, namely the 6 components that make a city "smart":

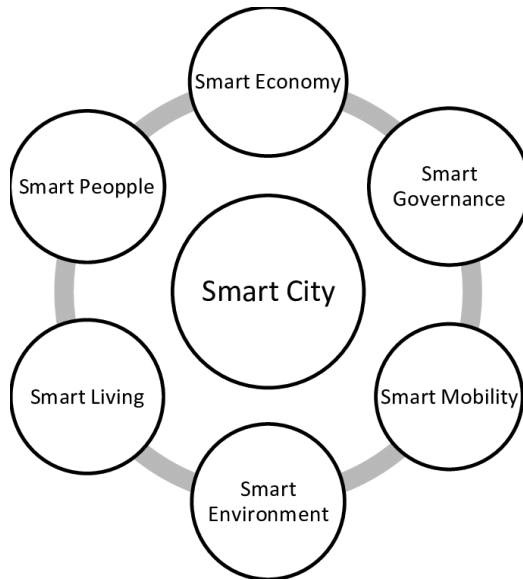


Figure 1: Schematic representation of the 6 necessary smart cities categories

Source: <https://www.researchgate.net/figure/Six-characteristics-of-smart-city-adopted-from-Giffinger-et-a>

This presentation is the result of research by author Giffinger and his colleagues from the Vienna University of Technology in a book that served as a starting point for further analysis and research related to the needs of medium-sized smart cities (Giffinger et al., 2007).

Over time, the criteria that determine and define the degree of applied "smartness" of cities have been refined, changed, and finely tuned. All of this has resulted in a greater number of methods and more ways to measure the success of smart city functioning in practice (Pérez et al., 2020). Some methods even consider 77 indicators to measure the success of the implementation of the smart city concept (IMD Smart City Index Report 2023).

According to the European Commission, a smart city is more than just the use of information and communication technologies (ICT) and aims to make better use of resources and reduce harmful emissions. This means smarter urban transport networks, better water supply, more efficient waste management facilities and more efficient ways of lighting and heating buildings. It also means more interactive and accountable city governance, safer public spaces and addressing the needs of the elderly population ([europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en](https://europea.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en)).

The idea of smart cities is based on creating and connecting human capital, social capital and information and communication technology (ICT) infrastructure to create more meaningful and sustainable economic development and a better quality of life (Hood, Wilson, 2001; Broadus, 1987; Ramaprasad et al., 2017).

The concept of a smart city evolves with the progress and refinement of various technologies, mainly information and communication technologies. People are taking advantage of the convergence of these technologies to improve their quality of life.

This progress in high technology implies a shift in the term from the so-called "city" to the term "smart city".

Significance of indicators: smart cities index (SCI)

Moreover, the assessment of smart cities includes a wealth of indicators, each of which offers unique insights into different facets of urban intelligence. Depending on the indicators chosen, their scope and the categories they encompass, smart cities can be classified in different ways. It is widely recognized that the development and use of smart city infrastructures not only improves the competitiveness of these cities, but also contributes to their sustainability and resilience in the midst of current global challenges (Azevedo et al., 2018). In response to the growing need for comprehensive assessments of cities, initiatives such as the City Index have emerged that aim to evaluate urban environments based on a variety of indicators. The City Index, for example, examines 77 indicators across 10 major categories of urban life and provides a nuanced understanding of the dynamics and performance of cities (Sharifi et al., 2021).

In addition, the development of smart city assessments has led to the development of specialized indices, such as the Smart City Index, which IMD has been offering since 2019. This index takes a balanced approach, focusing not only on the economic and technological dimensions of smart cities, but also incorporating the "human dimensions", which include aspects such as quality of life, environmental sustainability and inclusivity (IMD Smart City Index Report 2023). Such indices provide valuable insights into the multi-layered nature of smart cities and facilitate informed decision-making and policy formulation to promote sustainable urban development.

The categories that are subject to measurement and on the basis of which the ranking is compiled are 1. economy, 2. technology, 3. human capital, 4. social cohesion, 5. international influence, 6. environment, 7.

mobility and transportation, 8. urban planning, 9. public governance and 10. management (Barletta et al., 2020).

Table 1: Ranking of cities according to the value of the Smart Cities Index (SCI) in the period 2019-2023, year

City	Rank in 2023	Rank in 2021	Rank in 2020	Rank in 2019
Zurich	1	1	1	1
Oslo	2	2	2	2
Canberra	3	-	-	-
Copenhagen	4	5	3	4
Lausanne	5	4	-	-
London	6	3	10	3
Singapore	7	7	7	10
Helsinki	8	9	5	6
Geneva	9	6	8	7
Stockholm	10	11	9	6
Hamburg	11	8	6	-
Beijing	12	17	22	30
Abu Dhabi	13	12	14	16
Prague	14	10	4	8
Amsterdam	15	13	11	11
Seoul	16	18	20	23
Dubai	17	14	19	23
Sydney	18	29	32	22
Hong Kong	19	33	34	38
Munich	20	34	35	40

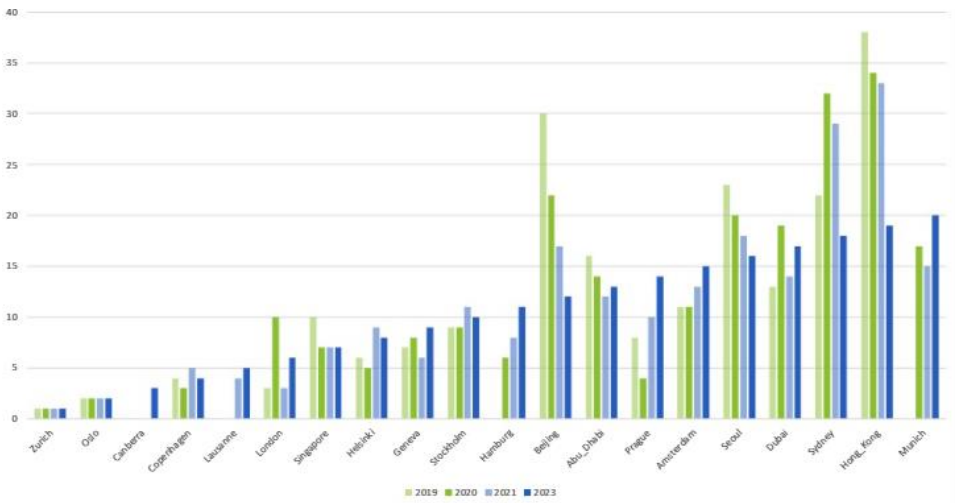
Source: IMD Smart City Index Report 2023

The table above shows that the first two places are occupied by the same cities during the observed period. Zurich and Oslo have held first and second place respectively since the beginning of measuring and ranking smart cities based on the index values, starting from 2019. Canberra was in third place last year (2023), although no index values were measured in previous years. It is interesting to note that from sixth place in 2023, where London is positioned, there are significant fluctuations in the index values in previous years. For example, London, which ranked sixth in the previous year (2023) according to the SCI index, showed drastic deviations in the previous measurement years (2021, 2020 and 2019). London's SCI score was so high in 2021 that the city was in a high third place! However, in 2020, London only ranked tenth based on the SCI index value, whereas a year earlier (2019) it was in a high third place. There are similar fluctuations for other cities below London, which ranked 6th in 2023 and whose SCI Index scores fluctuate significantly from one year to the next.

In 2023, the SCI Index made progress in all three dimensions (economic, technological and human). As mentioned above, the coverage of cities by the SCI Index and the number of cities measured by the Index increased by almost 20 percent, bringing the total number of smart cities to 141. The IMD Business School focused on the use of city-specific data to determine the index (IMD Smart City Index Report 2023; Guo et al., 2019).

Specifically, the Smart City Index (SCI) will be conducted by the IMD World Competitiveness Center in Singapore every year from 2019. According to the SCI methodology, a smart city is defined as an urban environment that uses technology to enhance urban advantages and mitigate the disadvantages of urbanization for residents.

Below is a graphical representation of the data, including the year 2022, which is not included in Table 1, but the values for 2019, 2020 and 2023 remain the same for all cities.



Graph 1. Presentation of the position of smart cities based on the values of the Smart Cities Index (SCI) in the period 2019-2023. year
Source: <https://imd.cld.bz/IMD-Smart-City-Index-Report-20231/8/>

Table 2: Ranking of cities according to the value of the Smart Cities Index (SCI) in the 2023. year

Introduction	03	Auckland	44	Canberra	67	Ho Chi Minh City	90
Table of Contents	10	Bangkok	45	Cape Town	68	Hong Kong	91
The IMD World Competitiveness Center	12	Barcelona	46	Cardiff	69	Hyderabad	92
City Performance Overview	13	Beijing	47	Chengdu	70	Islamabad	93
In 2023 City Ranking Order with	14	Beirut	48	Chicago	71	Istanbul	94
HDI Context and 2019-2023		Belfast	49	Chongqing	72	Jakarta	95
Ranking Comparison		Bengaluru	50	Copenhagen	73	Jeddah	96
In Alphabetical Order By City	17	Berlin	51	Doha	74	Kat	97
with 2023 Deep Dive and		Bilbao	52	Denver	75	Krakow	98
2021 Comparison		Birmingham	53	Doha	76	Kuala Lumpur	99
In Alphabetical Order by City with	22	Bogota	54	Dubai	77	Lagos	100
HDI Context and 2019-2023		Bogota	55	Dublin	78	Lausanne	101
Rankings	26	Bordeaux	56	Düsseldorf	79	Leeds	102
A User's Guide	30	Boston	57	Geneva	80	Lille	103
Methodology	33	Brazilia	58	Glasgow	81	Lima	104
City Profiles	35	Braşov	59	Göteborg	82	Lisbon	105
Abu Dhabi	36	Brisbane	60	Guangzhou	83	Ljubljana	106
Abuja	37	Buenos Aires	61	Guatemala City	84	London	107
Accra	38	Bucharest	62	Hamburg	85	Los Angeles	108
Algiers	39	Budapest	63	Hangzhou	86	Luxembourg	109
Amman	40	Busan	64	Hanoi	87	Lyon	110
Amsterdam	41	Busan	65	Hanover	88	Madrid	111
Ankara	42	Cairo	66	Helsinki	89	Makassar	112
Athens	43						

Manchester	113	Philadelphia	136	Taipei City	159
Manila	114	Phoenix	137	Tallinn	160
Marseille	115	Prague	138	Tel Aviv	161
Mecca	116	Rabat	139	The Hague	162
Mexico	117	Reykjavik	140	Tianjin	163
Medan	118	Riga	141	Tokyo	164
Medellin	119	Rio de Janeiro	142	Toronto	165
Medina	120	Riyadh	143	Tunis	166
Melbourne	121	Rome	144	Vancouver	167
Mexico City	122	Rotterdam	145	Vienna	168
Milan	123	San Francisco	146	Vilnius	169
Montreal	124	San Jose	147	Warsaw	170
Mumbai	125	Sana'a	148	Washington D.C.	171
Munich	126	Santiago	149	Wellington	172
Muscat	127	Sao Paulo	150	Zagreb	173
Nairobi	128	Seattle	151	Zaragoza	174
Nanjing	129	Seoul	152	Zhuhai	175
New York	130	Shanghai	153	Zurich	176
Newcastle	131	Shenzhen	154		
Nicosia	132	Singapore	155		
Osaka	133	Sofia	156		
Oslo	134	Stockholm	157		
Ottawa	135	Sydney	158		
Paris					

Source: <https://imd.cld.bz/IMD-Smart-City-Index-Report-20231/8/>

The previous table, Table 2, shows all the countries shown. They are arranged in alphabetical order and the rank next to them is the rank based on the Smart Cities Index. Only the previous year 2023 was observed.

Transformation of smart cities: from smart cities to smart society

According to the latest predictions, 70% of the world's population will live in urban areas by 2050. Cities make up only 2% of the earth's surface, but are responsible for 2/3 of greenhouse gas emissions. This also means that traffic congestion and energy consumption will increase in populated cities if the right measures are not taken in time. The problem of most cities in Serbia, even in the metropolises of the world, is the size of the cities that have "outgrown" themselves". They are not designed for such growth and population influx and cannot adapt to the rapid changes in society. Adapting cities to accelerated growth requires expanding water and wastewater infrastructure, improving the urban linear underground and surface transport network and increasing the number of car parks without destroying green spaces.

For example, if you look on Google Maps to see how long it takes to get from one place to another, you will realise that it does not take much time. But if you actually try to get from one place to another, the time required is much higher than Google Maps predicts. However, the problem is not with Google Maps or any other application you are using. The problem lies in the way cities are designed. The reason for the increase in journey time is because the person in the vehicle is "stuck in traffic" or looking for a parking space, and this has a significant impact on the growth of time spent in traffic.

This simple example shows that in most cases, cities are not as optimised as they could be and are not designed in an intelligent way. Today's social challenges require a holistic approach to solving problems, i.e. putting people at the centre of innovation, connecting everything and giving all members of the community equal access to the benefits (Azbil report).

A positive example of progress has happened in our neighbourhood, in Sarajevo, in Bosnia and Herzegovina. Smart projects from developing countries are more beneficial for the local community than in highly developed countries. This is a particularly interesting example because Bosnia and Herzegovina had significantly fewer smart projects compared to Croatia and Serbia. Not only that, Bosnia and Herzegovina did not even appear in the top lists in terms of the number of smart projects after 2012.

Contrary to popular belief, smart projects are not necessarily complicated or difficult to understand. Their benefits are usually easy to demonstrate, precisely because they are visible, practical and effective. In Sarajevo, for example, a European project was carried out to make street lighting more efficient in line with the smart city system. In just three days, the intelligent lighting reduced energy consumption by 72%. This raises the question of how it works: The smart lighting was located in the pedestrian zone, i.e. near the bus station. The lighting was dimmable, i.e. when there were no pedestrians present, the lighting only used 20% of the electricity, while the lighting was turned up to 100% when people passed by.

In addition, the intelligent lighting system is designed to save up to 80% energy with LED lamps and optimise maintenance by reducing operating costs by up to 42%. In addition, this lighting increases the quality of the lighting service in the long term, saves money, increases safety and reduces carbon dioxide emissions. Importantly, some of the products installed were manufactured in the country.

Industry 5.0 and Society 5.0

Relatively recently, we talked about the fourth industrial revolution, its consequences on society and the characteristics of that society. From a new perspective, we can say that this is Society 4.0 (Munitlak Ivanovic, 2020).

The term Society 5.0 originates from the intention to create a fifth new society through the optimal use of digital transformation and artificial intelligence, after society has passed through the previous stages, such as the hunting society (Society 1.0), the agricultural society (Society 2.0), the industrial society (Society 3.0) and the information society (Society 4.0) (Munitlak Ivanović et al., 2024a).

In short, the characteristics of previous societies would be:

- Society 1.0 (Hunter Society): Hunter-gatherer society is an anthropological concept that characterises the way of life of a society that relies on hunting and gathering wild animals and plants to sustain itself. It is assumed that all human societies up until the advent of agriculture in the Neolithic period led a hunter-gatherer lifestyle.

- Society 2.0 (Agricultural Society): An agrarian society is a social structure in which the economy is primarily based on agriculture, also known as the first agricultural revolution that took place during the Neolithic or Stone Age. These societies have existed for thousands of years in different parts of the world right up to the present day. This makes them the most widespread form of social and economic organization in the

history of human organizational work in pre-industrial times (Munitlak Ivanović et al., 2024b).

- Society 3.0 (Industrial Society): An industrial society is a society that has made significant progress in industrialization. In many cases, the industrial societies follow the previous phase, which was characterized by the agrarian society, including the extensive use of technology in various areas for a human-centered society.

- Society 4.0 (Information Society): The information society is a society in which activities related to the use, generation, dissemination and integration of information are of great importance. The main catalysts for this phenomenon are information and communication technologies (ICT), which have led to the rapid development of automated machines and robots.

Recently, as artificial intelligence (AI) is entering all areas of society, futuristic industry and society, i.e. Industry 5.0 and Society 5.0, are attracting more and more attention. The European Commission announces Industry 5.0 to create a sustainable, human and resilient European industry.

Society 5.0 is proposed by the Japanese government to harmonize economic progress with solving social problems in Japanese society. In general, industrial and social revolutions have been closely interrelated since the first industrial revolution.

The coexistence of Industry 5.0 and Society 5.0 could lead to the need to clarify various confusions and answer a number of questions. In short, Society 5.0 is characterized by these three elements:

- Comfort - An advanced fusion of cyberspace and physical space.

- High quality of life - A balance between economic progress and solving social problems.

- Vitality - Freedom from complicated work and efficient use of time that benefits everyone, regardless of the age of the members of society.

As a result, cities also adapt and become even "smarter" or more sprawling, i.e. more massive. Both smart cities and smart villages are seen as one of the solutions to the increasing impact of climate change in developing countries. Smart cities are viewed as service systems that align with the principles of logic, sustainable development goals, and the theories of service science. There are more and more initiatives related to increasing the number of smart cities and smart cities are seen as the only means to improve the economy through urbanization models, development issues and urban planning. For cities, technologies are the only means to achieve resilient and adaptable smart cities that are focused on practical approaches to achieving a sustainable ecosystem (Kasinathan et al., 2022).

The logical continuation of the organization of smart cities is the organization of smart villages. Smart villages are an effective tool to improve life in rural areas and counteract the trend of migration to urban regions. With the introduction of smart villages, the services provided by sustainable energy are improved, with the intention that the increase in the quality of these services will have an impact on better healthcare and education (Munitlak Ivanović et al. 2023).

The development of smart cities should be accompanied by the same kind of attention and innovation that applies to the development of smart villages. When it comes to regional and local development, it is crucial to consider the development of rural and village areas as well as other related agricultural activities. In this case, the development of a low-carbon economy is primarily meant. This important aspect is necessary because the share of agriculture in total greenhouse gas emissions is high. However, rural areas have the potential to utilize their resources to improve carbon emissions, reduce GHG emissions, contribute to climate change mitigation and use agricultural activity to develop renewable energy sources. In relation to rural areas, sustainable development and the Millennium Development Goals are two important concepts, as the natural environment plays a prominent role in the realization of the production functions and strategic development goals of these areas.

CONCLUSION

The emergence of the smart city concept has been driven primarily by the widespread adoption of Internet of Things (IoT) applications in urban environments. Among the myriad of urban management strategies that utilize Information and Communication Technologies (ICT), such as the digital city, the green city and the sustainable city, the smart city stands out for its comprehensive approach. This article takes an in-depth look at the basic characteristics and various methods of the smart city, including definitions, standards and implications. It also provides detailed visual representations of the core elements that make up the smart city concept, as well as comprehensive methods for evaluating its implementation.

One of the most important contributions to the smart city discourse is the Smart City Index (SCI) introduced by the IMD World Competitiveness Center. This index provides a synthetic benchmark for cities labeled as smart cities and is based on metrics that have been developed and refined since 2019. However, given the relatively short observation period from 2019 to 2023, it is difficult to derive long-term trends from the data. This limitation underscores the continued need for widespread

availability and affordability of IoT and ICT technologies, which are essential for the successful implementation of smart city initiatives.

As technology advances, there is a growing expectation that younger generations will increasingly engage with and contribute to the smart city concept. This engagement will drive further innovation and progress in creating sustainable, liveable and attractive urban environments. The vision of the smart city goes beyond mere efficiency gains. It encompasses a holistic approach to urban development that aims to improve the quality of life for all residents.

Although some cities such as Zurich and Oslo are leading the way in implementing smart cities, it is important to recognize that the concept is still in its infancy. Most cities are still struggling with the complexities of integrating smart technologies into their urban fabric, with many prioritizing efficiency improvements over fully integrating the Sustainable Development Goals (SDGs). Nonetheless, the momentum towards smart and sustainable city development is palpable, driven by a shared commitment to tackle pressing urban challenges and strive for a more equitable and resilient future.

This paper serves as a comprehensive resource for policy makers and academics alike, offering insights into the achievements and shortcomings of smart and sustainable cities initiatives. By highlighting key milestones and challenges, it aims to support decision-making processes and promote dialog on the future development of cities. It also highlights the interconnectedness of different stakeholders - government agencies, the private sector, academia and civil society - in the realization of smart and sustainable cities.

The concept of the smart city is inherently dynamic and continues to evolve in response to changing societal needs, technological advances and environmental pressures. Therefore, continuous research and collaboration are essential to keep pace with developments and ensure that smart city initiatives remain responsive and inclusive. By fostering interdisciplinary dialog and knowledge sharing, this paper aims to contribute to the collective effort to create smarter and more sustainable cities for future generations.

ACKNOWLEDGMENT

The authors acknowledge financial support of the Ministry of Education, Science and Technological Development of the Republic of Serbia (Grant No. 451-03-68/2022-14/200125).

REFERENCES

1. Alberti, A., Senese, M. (2020). Developing capacities for inclusive and innovative urban governance. *Governance for urban services: Access, participation, accountability, and transparency*, 127-152.
2. Azevedo Guedes, A. L., Carvalho Alvarenga, J., Dos Santos Sgarbi Goulart, M., Rodriguez y Rodriguez, M. V., Pereira Soares, C. A. (2018). Smart cities: The main drivers for increasing the intelligence of cities. *Sustainability*, 10(9), 3121.
3. A Frost&Sullivan White Paper (2020). Smart Society, Building a Better Future for Citizen with Smart Technologies. Azbil report. https://www.azbil.com/top/pickup/whitepaper/pdf/Azbil_Smart_Society_WP_12022020.pdf
4. Barletta, V. S., Caivano, D., Dimauro, G., Nannavecchia, A., Scalera, M. (2020). Managing a smart city integrated model through smart program management. *Applied Sciences*, 10(2), 714.
5. Bibri, S. E., Krogstie, J., Kaboli, A., Alahi, A. (2024). Smarter eco-cities and their leading-edge artificial intelligence of things solutions for environmental sustainability: A comprehensive systematic review. *Environmental Science and Ecotechnology*, 19, 100330.
6. Blasi, S., Ganzaroli, A., De Noni, I. (2022). Smartening sustainable development in cities: Strengthening the theoretical linkage between smart cities and SDGs. *Sustainable Cities and Society*, 80, 103793.
7. British Standard Institution, 2014. <https://www.bsigroup.com/Documents/about-bsi/financial-performance/2014/The-British-Standards-Institution-Annual-report-and-financial-statements.pdf>
8. Broadus, R.N. Toward a definition of bibliometrics. *Scientometrics* 1987, 12, 373-379.
9. De Guimarães, J. C. F., Severo, E. A., Júnior, L. A. F., Da Costa, W. P. L. B., Salmoria, F. T. (2020). Governance and quality of life in smart cities: Towards sustainable development goals. *Journal of Cleaner Production*, 253, 119926.
10. De Jong, M., Joss, S., Schraven, D., Zhan, C., Weijnen, M. (2020). Sustainable-smart-resilient-low carbon-eco-knowledge cities; making sense of a multitude of concepts promoting

- sustainable urbanization. *Journal of Cleaner production*, 109, 25-38.
11. Ejaz, W., Naeem, M., Shahid, A., Anpalagan, A., Jo, M. (2017). Efficient energy management for the internet of things in smart cities. *IEEE Communications magazine*, 55(1), 84-91.
 12. Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N., Meijers, E. J. (2007). Smart cities. Ranking of European medium-sized cities. Final Report.
 13. Gil-Garcia, J. R., Pardo, T. A., Nam, T. (2016). A comprehensive view of the 21st century city: Smartness as technologies and innovation in urban contexts. *Smarter as the new urban agenda: A comprehensive view of the 21st century city*, 1-19.
 14. Guandalini, I. (2022). Sustainability through digital transformation: A systematic literature review for research guidance. *Journal of Business Research*, 148, 456-471.
 15. Guo, Y. M., Huang, Z. L., Guo, J., Li, H., Guo, X. R., Nkeli, M. J. (2019). Bibliometric analysis on smart cities research. *Sustainability*, 11(13), 3606.
 16. Hood, W. W., Wilson, C. S. (2001). The literature of bibliometrics, scientometrics, and informetrics. *Scientometrics*, 52, 291-314.
 17. IMD Smart City Index Report 2023, <https://imd.cld.bz/IMD-Smart-City-Index-Report-20231/8/>
 18. Kasinathan, P., Pugazhendhi, R., Elavarasan, R. M., Ramachandaramurthy, V. K., Ramanathan, V., Subramanian, S., Alsharif, M. H. (2022). Realization of sustainable development goals with disruptive technologies by integrating industry 5.0, society 5.0, smart cities and villages. *Sustainability*, 14(22), 15258.
 19. Mahmood, Z. (ed.), (2018). *Smart Cities: Development and Governance Frameworks*. Cham: Springer International Publ. AG.
 20. Mohanty, S. P., Choppali, U., Kougianos, E. (2016). Everything you wanted to know about smart cities: The Internet of things is the backbone. *IEEE consumer electronics magazine*, 5(3), 60-70.
 21. Munitlak Ivanović, O., Implementacija ciljeva održivog razvoja primenom milenijumskih ciljeva, Monografija, Institut ekonomskih nauka, Beograd, 2018.
 22. Munitlak Ivanović, O. (2020) Razvoj pametnih gradova - primer četvrte industrijske revolucije, *Ecologica*, 27(97), 15-21.

23. Munitlak Ivanović, O., Zadel, Z., Špoljarić, T. (2024a). The importacne of green hotels in eco tourism and the green economy. International Scientific Conference: Green Economy and Adaptation of Industry to climate Changes, 22-24 April 2024, Belgrade, Serbia; Scientific and Professional Society „Ecologica“, Book of Abstracts, 91-92
24. Munitlak Ivanović, O., Zadel. Z., Špoljarić, T. (2024b). Zeleni hoteli kao deo ekoturizma i način realizacije zelene, ekonomije, Ecologica, 31 (113), 17-24.
25. Munitlak Ivanović, O., Nadić, D., Vujić, M. (2023). Ekoturizam i održivi turizam: način rasta zelene ekonomije. Ecologica, 30(110), 189-194.
26. Pereira, G. V., Parycek, P., Falco, E., Kleinhans, R. (2018). Smart governance in the context of smart cities: A literature review. Information Polity, 23(2), 143-162.
27. Pérez, L. M., Oltra-Badenes, R., Oltra Gutiérrez, J. V., Gil-Gómez, H. (2020). A bibliometric diagnosis and analysis about smart cities. Sustainability, 12(16), 6357.
28. Ramaprasad, A., Sánchez-Ortiz, A., Syn, T. (2017). A unified definition of a smart city. In Electronic Government: 16th IFIP WG 8.5 International Conference, EGOV 2017, St. Petersburg, Russia, September 4-7, 2017, Proceedings 16 (pp. 13-24). Springer International Publishing.
29. Shanghai Manual - A Guide for Sustainable Urban Development in the 21st Century,
https://www.un.org/esa/dsd/susdevtopics/sdt_pdfs/shanghaimanual/Introduction.pdf
30. Sharifi, A., Allam, Z., Feizizadeh, B., Ghamari, H. (2021). Three decades of research on smart cities: Mapping knowledge structure and trends. Sustainability, 13(13), 7140.
31. Silva, B. N., Khan, M., Han, K. (2018). Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities. Sustainable cities and society, 38, 697-713.
32. Stojkov Pavlović, A., (2023). Perspektive razvoja pametnih gradova u Srbiji, Ecologica, 30(110), 269-277
33. UN, 2015. <https://sdgs.un.org/goals>
34. UNECE,2020.
https://unece.org/fileadmin/DAM/hlm/documents/Publications/Guidelines_for_SSC_City_Action_Plan.pdf.

35. UN, 2011.
<https://academic.oup.com/heapro/article/32/1/7/2979257>
36. UNECE, 2020a.
<https://unece.org/statistics/publications/keeping-count>
37. Zanella, A., Bui, N., Castellani, A., Vangelista, L., Zorzi, M. (2014). Internet of things for smart cities. IEEE Internet of Things journal, 1(1), 22-32.
38. <https://www.researchgate.net/figure/Six-characteristics-of-smart-city-adopted-from-Giffinger-et-al-2007>
39. <https://imd.cld.bz/IMD-Smart-City-Index-Report-20231/8/>
40. https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en