Transforming cities into smart sustainable cities

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ABSTRACT

On the one hand, the world is facing rapid urban growth—and, on the other hand, rapid technological development. The growth of cities creates many environmental, social, and economic challenges, which cities are increasingly solving with the help of various technologies. This article proceeds from the question of whether it is also possible to take into account the concept of sustainable development. On the basis of a critical analysis, it was realized that, to solve the challenges of the growth of cities, technological and sustainable development must take place simultaneously. This is the only way to ensure a high quality of life for all residents in cities, both now and in the future. Transforming cities into smart sustainable cities should therefore become the main paradigm of future global development.

Keywords: cities, urban growth, sustainable development, smart cities, quality of life

Preobrazba mest v pametna trajnostna mesta

POVZETEK

Svet se po eni strani sooča s hitro rastjo mest, po drugi pa z naglim tehnološkim razvojem. Rast mest prinaša številne okoljske, družbene in gospodarske izzive, ki pa jih mesta vse bolj rešujejo s pomočjo različnih tehnologij. V članku izhajamo iz vprašanja, ali je ob tem možno upoštevati tudi koncept trajnostnega razvoja. Na podlagi kritične analize smo prišli do spoznanja, da morata za potrebe reševanja izzivov rasti mest tehnološki in trajnosti

razvoj v njih potekati sočasno. Le tako se namreč lahko zagotovi visoka kakovost bivanja vseh prebivalcev v mestih, tako v sedanjosti kot tudi v prihodnje. Preobrazba mest v pametna trajnost mesta bo zato postala glavna paradigma prihodnjega svetovnega razvoja.

Ključne besede: mesta, rast mest, trajnostni razvoj, pametna mesta, kakovost bivanja

1. Introduction

Cities are of great importance to humanity. "The major part of economic potential and production is located in cities, they are centers of goods exchange, services and information, they are centers of power and decision-making, and centers where cultural life and social reproduction are formed." (Rebernik, 2008, p. 9) Because cities are centers of cultural, social, and political activity, they must therefore provide conditions for the wellbeing and residence of all their citizens. (Kerbler, 2011) With the rapid development of the modern information society, cities realize this commitment by transforming into smart cities. A smart city uses various technologies to improve the efficiency of its operations, services, and competitiveness, thereby raising the quality of life of its residents. (Akande et al., 2019) The transformation of cities into smart cities is even more important because modern cities face rapid growth and many challenges that growth brings. Therefore, the research question arises as to whether cities can simultaneously realize the commitments of sustainable development, as the main model of future development in the world, (United Nations, 2015) and become smart sustainable cities.

2. Growth of cities

The world's population has increased dramatically in recent decades. Today there are about eight billion people living on Earth, and in 2050 there will be around ten billion people. In 2009, for the first time, humanity crossed the line where more people live in cities than outside them. (Akande et al., 2019) Currently, 56% of the world's population lives in cities. (World Urban Population, 2022, e-source) Of these, as many as 1.7 billion people live in cit-

ies with more than one million inhabitants. (Van den Buusea & Kolk, 2018) By 2025, around 58% of the world's population, or 4.6 billion people, are expected to live in urban areas. (Mohanty et al., 2016) In the following years, the number of people living in cities is only expected to increase. According to the United Nations, the urban population is expected to increase by almost 700 million by 2030, reaching a total of 5.2 billion. This means that, by 2030, 60% of the population will live in cities. (Yigitcanlar & Kamruzzaman, 2018) It is also predicted that by 2050 approximately 6.3 billion people, or around 70% of the world's population, will live in urban areas, (Mohanty et al., 2016) and by the end of the century the share is expected to exceed 80% of the world population. Some countries have already exceeded this share; (Yigitcanlar & Kamruzzaman, 2018) for example, Argentina, the United States, Canada, Australia, Brazil, the United Kingdom, Sweden, Norway, and Spain. (The World Bank, 2022, e-source)

These data are astonishing, especially if it is realized that, in 1950, 730 million or 28.8% of people lived in cities. (Kerbler, 2011) In the last century, fewer than twenty cities had a population of one million or more, and in 2022 there were already more than 510 cities with a population of more than one million. (Infoplease, 2022, e-source) The highest level of urbanization will be achieved in North America and Latin America (namely, 90%), and it will rise the most in Africa and Asia, where the share of the urban population will increase by more than a fifth in the next forty years. Despite the high level of urbanization in developed countries, in 2050 less-developed parts of the world will have as much as five times more urban population than developed ones. (Kerbler, 2011)

Megacities (i.e., cities with more than ten million inhabitants) will also continue to grow. In 1950, there were only two megacities in the world: New York and Tokyo. The former had 12.4 and the latter 11.3 million inhabitants. (Gurjar & Lelieveld, 2005) Between 1950 and 2010, the number of megacities increased from two to twenty-one. In 2010, 9% of the world's population lived in them. (Kerbler, 2011) There are currently thirty-four cities in the world with more than ten million inhabitants. Most of the megacities are located in Asia (twenty-one cities), Latin America (six cities), and Africa (three cities). Currently the largest city in the world is the Tokyo Metropolitan Area, with 37 million inhabitants.

It is followed by Delhi (31 million) and Shanghai (28 million). According to the calculations of the United Nations, the number of megacities will increase to forty-three by 2030. At that time, Delhi will be the world's largest city, with almost 39 million inhabitants. (Statistisches Bundesamt, 2022, e-source) Although the growth and expansion of megacities has attracted a lot of attention from the public, according to the United Nations Population Fund, above all cities with fewer than five million inhabitants will grow in the future. (Kerbler, 2011)

The growth of cities is mainly related to the technological and economic development of society. Cities offer many services and at the same time opportunities. People immigrate into them on a large scale, especially many young people, due to better opportunities for obtaining an education, career development, a greater number of jobs, easier access to various services, and quality of life. (Stimmel, 2016) The desire for quality of life is universal and is shared by all people. Quality of life factors are socioeconomic status, dwelling, education, knowledge and skills, employment, balance between work and free time, family relationships, health and the health system, personal wellbeing, and social environment. All of these factors affect the quality of life, even in urban centers. The urban environment affects an individual's physical, social, and mental wellbeing, and for this reason it is important for an individual to live in a healthy and stimulating environment. People have the right to clean air, access to clean drinking water, and adequate housing. In cities, access to green areas, accessible public transport, safety, and opportunities for social interaction are particularly important. (European Environment Agency, 2009) With such rapid growth of cities and urban populations, ensuring all of this is a great challenge.

3. Challenges of urban growth

Cities are characterized by being relatively densely populated areas with many people. The growth of cities and the rapid increase in the urban population therefore places a heavy burden on urban infrastructure and services in cities and raises various questions regarding environmental protection, which affects the quality of life in cities. (Fernandez-Anez et al., 2018) There are major problems in mobility. Due to the increasing number of in-

habitants, traffic, and commuters in cities, traffic jams and ever-increasing traffic chaos are created. (Akande et al., 2019) Congestion occurs, which has a negative impact on the economy, society, and the environment, and increases fuel consumption and environmental pollution. The problem can be solved by making better use of public passenger transport, which would reduce the pressure on city centers and occupied parking lots, but people still do not use it enough. The most common reason for this is inflexibility and accessibility, as a result of which passengers spend too much time on public transport. (Pečar & Papa, 2017) However, traffic is only one of the problems that cities face. The growth of cities also affects problems in the supply of water, waste, energy, and so on. Currently, cities consume 75% of the world's resources and energy, resulting in 80% of greenhouse gases. Thus, there may be serious negative impacts on the environment in the coming decades. (Mohanty et al., 2016) Additional problems and shortcomings appear in developing cities, especially in developing countries. With the growth of these cities, the crime rate increases sharply, unemployment rises, the infrastructure ages, major problems arise in the supply of electricity and other urban infrastructure, breakdowns are common, and so on. (Kumar et al., 2020)

In general, cities are characterized by their "metabolism," consisting of the input of goods and the amount of waste, with consistent negative externalities that reinforce environmental, social, and economic problems. Cities have so far relied on too many external resources and are actually (and probably always will be) consumers of resources. (Turcu, 2013) All this presents a serious challenge for planners. The solution, however, is not to reduce the population density in cities because lower city density does not mean that there are fewer negative impacts in the city—quite the opposite. In less densely populated cities, more energy is used for electricity and transport, as evidenced by the fact that carbon dioxide emissions per inhabitant decrease as the density of urban areas increases. (Hammer et al., 2011) However, the greater concentration of population and activities in cities requires integrated solutions that cover various urban systems, such as the energy supply system, the drinking water supply system, the infrastructure system, the traffic management system, and so on. (Berardi, 2013a, 2013b) Different technologies can help cities in this.

4. The help of technologies in the growth of cities

In recent decades, the development of various technologies has advanced greatly. Many cities have already demonstrated many good practices for improving the quality and efficiency of city services, based on technologies that are increasingly present in people's private lives, business environments, and also public life, making cities and the people in them increasingly digitalized. (Kumar et al., 2020) Modern mobile devices make it possible to obtain a wide variety of information with the help of sensors. Sensors accompany us everywhere; that is, in cars, on phones and tablets, in houses, along roads, and so on.

Cities are based on systems that are essential to their functioning and development, which is reflected in city services, businesses, city administration, and so on. The effectiveness of these systems determines how a city operates and how successful it is in achieving its goals. Cities must therefore change their systems so that they are digitized, interconnected, and intelligent. With this, the systems become measurable, they can communicate with each other and exchange the data they analyze, and, based on the results of the analysis, decision-makers and various services in cities can take effective action. Therefore, the more these systems are interconnected, the better the overview of the functioning of the city as a whole. (Dirks & Keeling, 2009)

Technology therefore makes possible the continuous and comprehensive collection of a large amount of data. At the same time, these data enable the city's residents to improve their quality of life, effectively manage resources and infrastructure, reduce pollution, manage risks, and integrate planning and participation. Technologies therefore allow cities to become smart and thereby transform into smart cities. (Berrone & Ricart, 2018)

However, on the one hand, the growth of cities occurs, and, on the other, technologies are constantly developing. In this way, technologies also promote the development of smart cities, not only the challenges created by the growth of cities. However, the development of smart cities presents new challenges to city planners and managers because on the one hand the goal is economic growth, and on the other the desire for a healthy and clean living environment, which can be mutually exclusive. It is also impor-

tant that the city work in all areas of public services. This means that technologies and systems in the city are adapted to all social groups and everyone benefits from this. (Stimmel, 2016; Berrone & Ricart, 2018)

Cities around the world have begun to tackle the challenges of growth in a systematic way. Many new approaches related to urban services are increasingly based on the exploitation of technologies that help create smart cities. (Albino et al., 2015) City managers have found that it is possible to save significant resources (up to 20% of all resources spent on the management, maintenance, and planning of cities) with the help of technologies and by establishing effective control in the city. (Berrone & Ricart, 2018) However, although many cities around the world have already successfully coped with the problems caused by the urban growth with the help of technologies, it will still be necessary to invest a lot in the development of smart solutions. There are still more problems, and they arise faster than the solution. Therefore, in addition to the introduction of smart cities, it is necessary to start thinking and acting more sustainably.

5. Sustainable development of cities

In the context of sustainability, reflections on urban development are not new and have been on global agendas for several decades, anchored in global debates and forums. In response to the challenges of urban growth, the idea of the concept of sustainable development first emerged in 1972 at the United Nations Conference on the Human Environment in Stockholm. Although the term was not explicitly stated, the international community agreed that both development and the environment, which until then had been treated separately, could be managed in a mutually beneficial way. (Mensah, 2019)

With the help of the World Commission on Environment and Development, in 1987 the United Nations published the report *Our Common Future*. The commission was chaired at the time by the Norwegian politician and diplomat Gro Harlem Brundtland, and for that reason the report was also called the Brundtland report. The report took a critical view of the development model adopted by industrialized countries and reproduced by developing ones. The report emphasized that economic and social pro-

gress cannot be based on indiscriminate exploration and degradation of nature. It has also been suggested that poverty in the "Global South" and extreme consumerism in the "Global North" will be the root causes of unsustainable development and an environmental crisis. Although the report did not present simple guidelines for action, it did reveal the ideological force that established an agreement between generations that is used as a consensus definition of sustainable development; that is, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Schiavo & Magalhães, 2022)

During the Earth Summit in Rio de Janeiro in 1992 (known as Rio-92), led by the United Nations World Commission on Environment and Development, the leaders of 179 countries agreed to and signed Global Agenda 21. This was an action program that was based on a single document with forty chapters, and it is still considered today the most promising attempt to promote a new pattern of development at the planetary level. (Bac, 2008) Agenda 21 was a term used in the sense of the desired development model of the twenty-first century. It could be defined as a planning tool for building sustainable societies in different geographical locations and coordinating methods of environmental protection, social justice, and economic efficiency. During the Millennium Summit in 2000, held by the United Nations in New York, the leaders of 191 countries signed a pact for a peaceful, just, and sustainable future by 2015 and defined the Millennium Development Goals (MDGs). The agenda included eight development goals of the new millennium, defined in detail in eighteen specific goals and forty-eight indicators. Current goals—that is, Sustainable Development Goals (SDGs)—succeeded and updated the MDGs. The construction of the SDGs began in 2012 after the Rio+ 20 conference. The process was completed in 2015 during the United Nations Summit on Sustainable Development, when 193 United Nations members agreed to a proposed agenda titled Transforming Our World: The 2030 Agenda for Sustainable Development. It is also known as the 2030 Agenda and consists of seventeen SDGs, 169 specific targets, a section on means of implementation, a renewed partnership council, and an evaluation and monitoring mechanism. The seventeen SDGs guide policies and activities for international cooperation until 2030 and represent a global call to

action to end poverty, to protect the planet, and to ensure that by 2030 all people enjoy peace and prosperity. Eleven SDGs aim to make cities and communities more inclusive, safe, resilient, and sustainable. (Schiavo & Magalhães, 2022) This made it clear that current urbanization, especially in large cities, requires thoughtful strategies and innovative planning for modernization and quality urban life. (Akande et al., 2019)

6. Smart sustainable cities

Although sustainability has become the fundamental paradigm of urban development, the question arises whether sustainable cities can be smart cities at the same time. (Glasmeier et al., 2015; Albino et al., 2015) In the literature, the terms *sustainable city* and *smart city* are considered separately. The former includes a wide range of definitions that include many areas related to issues of sustainability and the viability of cities, whereas the latter is defined by the use of technologies. (Van den Buusea & Kolk, 2018) Opinions about the compatibility of the two terms differ. Those that support their compatibility defend the view that a smart city is also sustainable. In their opinion, a smart city has the same goals as a sustainable city; that is, to become more sustainable and provide better living conditions, which can be achieved by integrating high-tech solutions into the urban environment. (Mortensen et al., 2012) A smart city therefore uses technologies for better governance while providing sustainable solutions, thus making a smart city sustainable. (Silva et al., 2018) A sustainable city and a smart city should therefore not be mutually exclusive. Even more: the smart city concept is a model (or way) of sustainable city development. According to the advocates of sustainability in smart cities, it is possible that the development of sustainable cities would take longer if smart solutions were not introduced in sustainability because the development would be based on the use of traditional planning tools; that is, without high-tech solutions that are part of a smart city and can help in reducing the consumption of energy and greenhouse gases, which contributes to ensuring the sustainable development of cities. (Mortensen et al., 2012; Van den Buusea & Kolk, 2018)

However, some researchers are also critical of the term *smart cities*. Namely, there are opinions that the term is used for brand-

ing and marketing. They even believe that a city that is not sustainable cannot be smart either. Therefore, they recommend using a more precise term; for example, *smart sustainable city*, instead of the term *smart city*. They also recommend that, in addition to indicators that measure output, indicators that contribute to the final goals, such as environmental, economic, or social sustainability, should also be used. (Ahvenniemi et al., 2017)

In order to ensure the implementation of the 2030 Agenda and to help achieve the SGDs, in particular SGD 11 (i.e., to make cities and communities more inclusive, safe, resilient, and sustainable), the United Nations launched the initiative United for Smart Sustainable Cities (U4SSC) in 2016, based on the established compatibility of smart cities and sustainable cities. It is coordinated by the International Telecommunication Union (ITU), the United Nations Economic Commission for Europe (UNECE), and the United Nations Human Settlements Programme (UN-Habitat). It is a global platform for public policy advocacy, and it promotes the use of information and communication technologies (ICTs) to facilitate the transition to smart sustainable cities. (Schiavo & Magalhães, 2022)

7. Conclusion

The topic of smart cities is increasingly relevant in today's fast-developing world, and the creation of smart sustainable cities is necessary to alleviate the problems arising from the rapid growth of cities and urban populations. The new city concept—that is, a smart sustainable city—pays attention to people's needs, rational management of resources, sustainable development, and economic sustainability. A smart sustainable city provides efficient services and lower energy consumption, which should lead to a more efficient and economical city. (Girardi & Temporelli, 2017) The reasons for the emergence of such a concept must be sought in 1) the rapid development of technologies and smart urban solutions and 2) the context of an attempt to treat the concept of sustainability more comprehensively. (Huovila et al., 2019) With this, the world has recognized that the challenges of urban growth could be solved in a sustainable way, and, in this, technologies that help cities to become smart and sustainable at the same time could help. (Schiavo & Magalhães, 2022) The transformation of

cities and the official sustainability of the city will therefore become the main paradigm of future global development to achieve a high quality of life in the future.

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