Building Collaboration for a Smart and Green Regional Ecosystem: Insights from the Slovak Republic

Ondrej Mital'(✉), Silvia Ručinská, Michaela Lukačínová, and Miroslav Fečko

Department of Public Policy and Theory of Public Administration, Faculty of Public Administration, Pavol Jozef Šafárik University in Košice, 04011 Košice, Slovak Republic
{ondrej.mital,silvia.rucinska,miroslav.fecko}@upjs.sk, michaela.lukacinova@student.upjs.sk

Abstract. The study investigates planned collaboration between local and regional stakeholders in the Slovak Republic, which we see as an essential base for smart and green regional ecosystem. The study uses case studies to examine the impact of the implemented solutions on the wider regional ecosystem and how stakeholders collaborate to achieve their goals. The authors argue that systematic and planned collaboration between stakeholders is essential for smart, green, and sustainable development of the region's ecosystem. The study analyzes six cases between 2020 and 2023 and discusses the relationship between stakeholders, the characteristics of stakeholders, and the innovative solutions adopted to solve certain smart and green challenges in the region. The results show that collaboration between local and regional government, higher educational institutions, business, citizens and other stakeholders involved in the Smart city structure has resulted in the implementation of innovative solutions that promote sustainable and environmentally friendly practices, with positive impacts on both entities and the public. The study concludes that smart and green policies operate together and emphasizes the need for planned collaboration between regional stakeholders to address smart and green challenges in the territory.

Keywords: smart city · stakeholder collaboration · regional ecosystem · innovation ecosystem · smart and green public policies · Slovak Republic

1 Introduction

The emergence of Smart cities as a popular approach to address the complex challenges faced by urban areas has captured the attention of academics, policymakers, and practitioners worldwide. As the concept of smart cities gains momentum around the world, it becomes increasingly important to understand the components that make up these innovative urban areas. The growth of urban areas and the associated environmental challenges have spurred the development of Smart city technologies, which aim to mitigate the negative impacts of urbanization. Simultaneously, various practitioners and

© The Author(s), under exclusive license to Springer Nature Switzerland AG 2023
O. Gervasi et al. (Eds.): ICCSA 2023 Workshops, LNCS 14105, pp. 598–612, 2023.
https://doi.org/10.1007/978-3-031-37108-0_38

politicians indicate that Smart city approach can help urban areas in tackling contemporary ongoing environmental climate change. Smart city approach affects not only the city itself but also citizens and various local stakeholders in the wider territory. In this regard, we perceive Smart city as concept that also includes mutual relations not just between local government and citizens, but also complex mutual relationship within the regional ecosystem [9, 45, 53]. For the purpose of this article, we define regional ecosystem as a platform for any mutual relationship between local or regional stakeholders that is associated with positive impact on local challenges and local public policies in the region surrounding a city.

The study has an ambition to realize preliminary research and investigate mutual collaboration between stakeholders of regional innovation ecosystem in the Slovak Republic, which we see as an essential base for smart and green ecosystem. In this sense, the study examines the activities of different stakeholders in the city that aims to answer smart and green challenges, focusing on the relationship between stakeholders and synergic effect of the implemented solutions on regional ecosystem. More precisely, the study examines, with the use of case study method, green and smart solutions adopted by different stakeholders, their impact on mutual relations and synergic effect on regional ecosystem challenges. Focusing on the conditions of the Slovak Republic, altogether 6 cases between 2020 and 2023 were analysed. We perceive regional ecosystem as a term that unifies different approaches to collaboration between stakeholders in the territory, such as innovation ecosystem, regional ecosystem or quadruple helix model [46].

We presume that solutions adopted within the planned collaboration between regional stakeholders have potential to solve both smart and green issues in the territory. Put differently, contemporary smart and green policies operate together, but not as random concurrent activities. They supplement each other, and their interlinking should be seen as welcomed and expected. Smart solutions bring also positive environmental impacts, and green solutions contribute to better and more sophisticated use of smart technologies. In this regard, systematic and planned collaboration of stakeholders in facing smart and green challenges can be seen as approach that contributes to smart, green and sustainable development of regional ecosystem.

2 Sustainable Smart City

As the world population continues to grow and urbanize, cities are facing unprecedented environmental challenges. Currently, more than half of the global population reside in urban areas, and this number is anticipated to rise to 68% by 2050 [55]. It is anticipated that the urban population will increase by more than double its present size by 2050, reaching a point where nearly 70% of the world's population will reside in urban centers [49]. With the rapid growth of urbanization, cities have become focal points for the creation of innovative technological solutions that improve the quality of life for their citizens while simultaneously addressing pressing environmental and socio-economic challenges.

2.1 Perspectives and Components of the Smart City Concept

Smart cities have emerged as a widely popular and fashionable approach to urban development in the present era. Cities worldwide increasingly claim to possess varying degrees of intelligence, with a primary focus on Information and communication technology and infrastructure [4, 15]. In this regard, Smart cities utilize digital technologies to enhance the well-being and quality of life of their residents, thus policymakers tend to initialize the technology-led growth process and allocated municipal budgets towards investments that enable Smart city development [16, 29, 50]. Put differently, Smart cities works through the development of information and communication technologies and the increasing hybridisation of electronic content with the physical world that is often described as augmented reality [40]. Smart city approach should leverage existing urban infrastructure rather than constructing new facilities, thus is expected to result in a safer and more livable urban environment, with improved accessibility to city services and governance [14].

According to the OECD, Smart cities can be defined as initiatives or approaches that increase digitalization to boost well-being and deliver more efficient, sustainable and inclusive services and environments as part of a collaborative, multi-stakeholder process [38]. Accurate assessment and measurement methods are essential for evaluating the effectiveness of a Smart city. The ISO 37120:2014 standard for the sustainable development of communities provides a framework for measuring and reporting the success of Smart city initiatives. Furthermore, the ISO 37120:2014 standard is based on a comprehensive set of 100 performance indicators, divided into 17 categories that encompass various aspects of urban life, such as the environment, economy, energy, education, finance, health, governance, emergency response, safety, recreation, transportation, innovation, solid waste, wastewater, urban planning, water and sanitation, and shelter [20].

Smart cities encompass a range of interdependent elements, including Smart environment, Smart living, Smart mobility, Smart governance, Smart people, and Smart economy, all of which contribute to the creation of a sustainable and livable urban environment [46].

Smart cities refer to the use of mentioned components to improve the quality of life of its citizens, increase the competitiveness of cities, and enhance sustainable development. The interaction between them is the key to the essence of a Smart city as a dynamic system, in which the city and all actors respond and adapt to changes [45]. Additionally, researchers are motivated to develop solutions for Smart cities, taking into account both socio-economic and technical perspectives [48]. The success of the Smart city is based not only on sophisticated digital and smart infrastructure but also on interconnectedness of Smart city components and collaboration of involved stakeholders.

To understand interconnected areas, it is crucial to consider the stakeholders who are part of them and represent them A range of stakeholders, including planners, governments, businesses, citizens, and universities, play a crucial role in the development and functioning of a Smart city. Thus, it is crucial to regularly assess and evaluate the status of these stakeholders in order to achieve the desired outcomes. Additionally, inter-stakeholder interactions are necessary for achieving the objectives of the Smart city. For example, monitoring population growth or economic burdens is critical for ensuring the

well-being of citizens, whereas ensuring a high quality of life for urban populations is an essential consideration for planners. The smart city phenomenon has direct implications for enterprises and businesses, necessitating the development of intelligent infrastructure and the implementation of Smart solutions by real estate developers, system integrators, and technology providers. The success of a Smart city largely depends on the government's ability to formulate policies that promote its sustainability. Higher educational institutions, such as universities, have a significant role to play in the planning and operation of Smart cities.

2.2 Evolving Environment and Smart City Concept

The world has a unique opportunity to steer the course of urban development. Despite this, most of the individuals residing in cities lack adequate transportation and housing, and they are plagued by unsanitary conditions, poor waste management, and air quality that fails to meet generally accepted standards. Scholars and policymakers have expressed apprehensions regarding the adverse impacts of higher levels of urbanization on the environmental aspects, such as higher levels of air pollution and CO2 emissions [13, 47], negative effect on biodiversity [30, 58], public health issues [28, 31, 34]. In this regard, cities contribute to environmental degradation through various factors, including energy and water consumption, mobility, and waste production. Cities have a significant impact on the environment and are therefore key players in the fight against climate change. Based on abovementioned one of the crucial objectives of the Smart city is to prioritize sustainable development, especially in matters related to the environment. The Smart city concept indicate that green aspirations and undertakings are incorporated in almost all of the six Smart city components, its goals (social sustainability, economic sustainability, and environmental sustainability), intelligent initiatives (smart houses, smart energy, smart parking, smart health, etc.) and building blocks in Smart city (smart traffic, smart Sustainability, e-governance, smart technology, smart data, etc.) [48].

As digital transformation consolidates, the Smart City concept helps local government in tackling digital and green challenges. Smart cities present significant opportunities for promoting environmental sustainability, which is critical given the potential negative impact of urbanization on the environment [55]. In response to abovementioned environmental challenges, many economies and cities are turning to the concept of Smart Cities to improve sustainability and livability [23, 45]. Thus, it can be argued that understanding the link between green technological innovation and Smart city development is crucial for promoting sustainable urbanization [56]. Regarding the connection between Smart city and the environment, on average, larger municipalities exhibit a greater degree of ecological awareness, what may be attributed to the emphasis placed on environmental quality by policy makers, urban planners, as well as citizens and communities in Smart cities [4]. Regarding the interconnectedness of smart and green policies, the benefits of co-existing smart city and climate change adaptation explore opportunities as well as reduce the harmful risks of contemporary challenges [8, 19, 42].

The intimate and incontrovertible connection between the Smart City and the environment is reinforced by the European Commission's definition of a smart city, which extends beyond the deployment of digital technologies to achieve enhanced resource

utilization and reduced emissions. This encompasses the establishment of more intelligent urban transport networks, upgraded waste disposal facilities and water supply, and more efficient lighting and heating systems for buildings, thus it is explicitly stated that the smart city concept endeavors to attain the European Union's energy and climate objectives [11].

2.3 Stakeholders' Collaboration in Regional Ecosystem

Smart and green challenges have exceeded barriers between the sectors of our society. Both types of challenges affect different types of stakeholders, mainly local governments, business, higher educational institutions and citizens. Put differently, stakeholders of regional ecosystem do not have the capacity to face contemporary ongoing smart and green challenges independently.

Environment with good collaboration of involved stakeholders can lead to various benefits that will emerge in given region or territory, such as the strengthening of cost effectiveness and environmental performance [18, 41, 44], higher identification with cross-sectional and fragmented societal goals [5, 7], as well as general sustainable development of certain environment [17, 24, 27].

However, collaboration between the regional stakeholders cannot be automatically connected to universal success. Collaboration between stakeholders is a complex phenomenon that is determined by several variables, such as the quality of social capital [43, 44], socio-political framework [6], context of city and local government typology [9], as well as involvement of actors in policymaking and relations between stakeholders [22].

Based on abovementioned, collaboration of stakeholders within the region or territory should not be perceived as fortuitous situation that generates new solutions. Collaboration in the case of regional development must be realized under the long-term collaboration. We argue that such collaboration must be also materialized in local government strategies. As it was stated by many scholars, strategic approach in stakeholder collaboration in regional ecosystem can lead to higher intensity of collaboration and mutual benefits for involved stakeholders [10, 21, 37, 53].

In this regard, important precondition of smart and green regional ecosystem is a systematic approach in stakeholder collaboration and involvement of relevant stakeholders in policymaking. Stakeholders' collaboration allow local governments to be more facile in the way they develop infrastructure to meet the needs of its citizens, by removing barriers to innovation [54]. Smart and green challenges represent fragmented and cross-sectional issues of contemporary democratic governance, which can only be solved or mitigated with the mutually beneficial collaboration of stakeholders. We also argue that higher performance of mentioned regional ecosystem leads to higher quality of life, what is also the main aim of local government in contemporary democratic governance.

3 Methods

The study has an ambition to realize preliminary research and investigate mutual collaboration between stakeholders of regional innovation ecosystem in the Slovak Republic, which we see as an essential base for smart and green ecosystem. In this sense, the study

examines the activities of different stakeholders in the city that aims to answer smart and green challenges, focusing on the relationship between stakeholders and synergic effect of the implemented solutions on regional ecosystem. More precisely, the study examines, with the use of case study method, green and smart solutions adopted by different stakeholders, their impact on mutual relations and synergic effect on regional ecosystem challenges. Focusing on the conditions of the Slovak Republic, altogether 6 cases between 2020 and 2023 were analysed. Regarding the conditions of the Slovak Republic, each case study focuses on good practice example in the city of regional significance. The selection of cities was determined by the fragmentation of local self-government and the significance of these cities in public service delivery both in the city and in the region surrounding a city.

The case studies represent the appropriate tool, which was used to demonstrate how planned collaboration between stakeholders helps to create smart and green regional ecosystem. Each of six case studies include the description of relationship between stakeholders, character of stakeholders, description of innovative solution adopted to solve certain smart and green challenge in the region, as well as impact on smart and green agenda in the region. Analysed cases of collaboration between stakeholders were selected intentionally.

Theoretical analysis was used to analyse contemporary state of research in the sphere of smart and green agenda. Content analysis was used to analyse the content of strategies adopted by different regional stakeholders, emphasizing selected methodology. Abstraction was used in the context of filtering those aspects of selected cases, which were relevant for our research and smart and green regional ecosystem framework. The method of synthesis was used to systematize new ideas based on our research, as well as to draw conclusions resulting from the analysis.

4 Results

The importance of digital and green challenges is highlighted by the competences assigned to state administration authorities. The Ministry of Environment of the Slovak Republic is the central state authority and the supreme inspection authority in environmental affairs. The central coordination role in digitalization from the central government's perspective is performed by the Ministry of Investments, Regional Development and Informatization of the Slovak Republic. Both state authorities create, with the help of other stakeholders at regional and local levels, basic frameworks that results to policies and strategies.

The Greener Slovakia – Strategy of the Environmental Policy of the Slovak Republic until 2030 is a main national environmental strategy that identifies priorities and basic directions for future environmental and cross-sectional policy goals, mainly sustainable use and effective protection of natural resources, adaptation and mitigation to climate change and air protection, fostering green economy. Envirostrategy 2030 has many ambitious goals, such as reducing individual car traffic and support public transport, including bicycle transport, building green infrastructure in cities, promoting data-based decisions, and fostering inclusion of adaptation measures in strategic documents of cities in general [32]. The 2030 Digital Transformation Strategy for Slovakia is a nationwide strategy of

the Slovak Republic that defines policies and priorities of the digital transformation of the society and economy that describes Smart City as the way to a modern and smart territorial development. In addition to digitization, the strategy also underlines the need for green solutions, mainly supporting smart public transport and integrated public transport, preferring emission-free public transport, using of digital technologies to foster communication and participative decision-making at local level, as well as improving collaboration between private, academic and public sector in order to improve quality of life [33].

Framework and priorities defined by the state authorities must be also implemented by the cities. Based on abovementioned, smart and green challenges influence each other. Thus, we presume that local stakeholders naturally develop initiatives that helps cities to improve the quality of live in regional ecosystem. Following case studies demonstrate planned collaboration of regional stakeholders in the Slovak Republic. Simultaneously, case studies concentrate attention on smart and green solutions that we perceive as preconditions for smart and green regional ecosystem.

4.1 Smart Mobility Towards Sustainable Mobility

Collaboration between local government and business has resulted in development of shared transport services and public transport in the city of Košice. This intention of the city of Košice to cooperate with business in the sphere of public transport is declared in recent strategies [25, 26]. This mutual effect was created as an outcome of green and smart solutions. Shared transport services were originally provided by the local business Antik Telecom, mainly bike sharing, e-bike sharing and scooter sharing. Services were available to the public thanks to the mobile app (Antik SmartWay). However, the close collaboration with the city of Košice leads to creation of innovative solutions with positive impacts on both entities, as well as public. Virtual travel tickets for public transport provided by Košice public transport company were added to Antik SmartWay app. In October 2021, both services and information systems were linked, while the application Antik SmartWay can be used to purchase a ticket for public transport and shared transport [26]. Simultaneously, the city of Košice coordinated the construction of the charging stations for electric vehicles with the company. In this regard, the most of them were build next to public transport stops. Summing it up, collaboration was mutually beneficial for each other. This case of smart and green solutions is also contribution to aim Increase the share of sustainable types of mobility and improve traffic service in the city, which is part of priority called Sustainable mobility [25]. Positive impacts of smart and green solutions generate behaviour that motivate citizens to use public transport, shared electric vehicles, as well as creates storage boxes for shared electric vehicles solving one of the biggest problems of shared electronic mobility.

4.2 Smart Solutions Help Reduce Emissions

Higher educational institutions as very specific stakeholders are situated mainly in bigger local self-government units. Universities are also seen as facilitators of sustainable regional development, mainly thanks to their research activities and personal capacities. Collaboration between the city of Košice and Pavol Jozef Šafárik University in Košice

play important role in the development of wider territory, as it is also declared in Economic and social development plan 2022–2027 [25]. Planned collaboration between both stakeholders have led to elaboration of document Basic emission balance of the city of Košice, that analyses current state and includes suggestion for more resilient city in the case of climate and energy change. University experts have helped the city to prepare very important document, which is necessary for signatories of Covenant of Mayors, the commitment of local governments to implementing EU climate and energy objectives [12]. Basic emission balance of the city of Košice describes the current level of CO2 emissions and describe potential smart solutions in various spheres, such as emissions for buildings, emissions for public lighting, emissions in transport, emissions from waste, as well as greenery in the city [39]. This collaboration demonstrates the importance of the higher educational institutions for regional development, also in the spheres of smart and green solutions.

4.3 Green Housing Estates Thanks to Smart Participation Process

Innovative approach to citizens' participation in urban development was applied in the case of Banská Bystrica. This case is based on collaboration between the local government and non-governmental organization that facilitated participation of citizens. Collaboration of mentioned stakeholders is declared to be one of the priorities in the Economic and social development plan 2015–2023 [1]. The aim of the city was to implement citizen friendly environmental solutions in their housing estate. Personal capacities and know-how of non-governmental organization Dialogue Centre were used during participation process. In this regard, data collection process and evaluation of obtained data were carried out exclusively electronically. As a result of this collaboration, the criteria for selecting a processor of project documentation are set with an emphasis on suggestion presented during participation process, explicitly 70% fulfilment of suggestions and 30% economic efficiency [3]. Collaboration between the local government and non-governmental sector have created a space for emphasizing the green demands of citizens. The intention of the city to satisfy the demands of citizens is also expressed in the different strategies, mainly developing the principle of neighbourhood partnerships, which will contribute to the rebuilding of the residential environment housing estate [2] and ensuring the development of green infrastructure and adaptation of the city to the climate changes [1]. Smart and digital solution that helped to obtain data in easier and quicker way have initiated policymaking underlining green and sustainable solutions.

4.4 Innovative Bike Storing as a Support of Cycling Mobility

Another collaboration that combines benefits of green and smart solutions was established in the city of Trnava couple of years ago. Intensive use of bike transport in the city leads to unique solutions, the construct of bike tower. This very specific facility was constructed in the collaboration with BIKETOWER that have already constructed bike towers in 20 cities. Collaboration of the city with the different stakeholders is perceived as very important in the case of public transport and public mobility [51]. Intensive collaboration with the company includes not only the basic annual service works, but also digital services for the citizens. Bike tower is fully automatized. In this regard,

citizens can detect the tower's filling status with the use of internet. Besides, Bike tower in Trnava is situated near the train station that encourage citizens to use the combination of public transport and bike rather than the use of own car. This ideal state is in accordance with goals included in the strategies of the Trnava, mainly partial goal Addition of supporting elements for cycle transport [52] and measurement called Development of non-motorized transport, mainly cycling transport [51]. Mentioned combination of green and digital solutions supports green sustainability in the city, as well as helps to mitigate traffic jams and reduce air pollution near the city centre.

4.5 Smart Public Lighting as Part of Mitigating the Impacts of Climate Change

Next case of innovative approach to green and smart solutions in local self-government is based on the collaboration between city and business. Personal capacities of local self-government units are limited, what means that sophisticated analysis and audits must be outsourced. Collaboration with private sector is also reflected as one of the priorities in Program of economic development and social development of the City of Nitra 2015–2023 [35]. The same decision was made by the city of Nitra in the case of public lightning audit. However, this collaboration does not lead to direct impacts on green and smart agenda in the city, audit itself brings innovative green and smart solutions for the city, their citizens and wider region. Energy audit report of the public lighting system elaborated by Arnea Company suggest various smart solutions with positive impacts on environment, such as connection of new smart lightings in the overall integrated smart system of the city, configuration of new smart lightings and control sensors with conditions resulting from climate change, automatization of smart lights in the case of rain, fog and concentrating of citizens [36]. Presented solutions creates smart and green friendly solutions that have potential to minimize negative impacts of public lightning on environment and public finances, but also secure the highest possible safety for citizens. Outcomes of these future solutions comply with the aims of development in the Economic and social development plan 2015–2023, mainly aims increasing the protection of city residents and their property and increasing the energy efficiency of public buildings and city facilities with an emphasis on building and facilities owned by the municipality [35].

4.6 Plant Your Tree Thanks to Your PC or Smartphone

Collaboration between citizens and local self-government units is also very important in the case of smart and green agenda. Involving of citizens in policymaking is defined as one of the priorities in Economic and social development plan 2015–2023 [35]. Web page Green city, created by the city of Nitra and Nitrian Community Foundation gives citizens the opportunity to plant the tree. What's more, citizens can decide where the tree will be planted, and which type of tree will grow in the selected location. Green city initiative is the responsive web application that allows you to participate in the planting of greenery in the city in a simple, modern way [57]. Smart web page solution based on map view can be used to pick the place randomly or intentionally next to the citizen's house. Web page also offers information about every demand of citizens in last years, its evaluation status and an overview of trees planted based on a citizen's request. This case

demonstrates how easily cities can encourage their citizens to participate in activities for a greener city, because it is as easy as using PC or smartphone. Presented simple smart solution can help citizens to be more reliable for their environment and be more involved in green, smart and sustainable development of their city.

5 Discussion

As digital transformation and impacts of climate change blurs, cities are being forced to readjust routine activities in policymaking and governance. Smart and green challenges have wider societal impact on local self-government units and their territory. Selected case studies demonstrated that collaboration between other key stakeholders can help cities to mitigate negative impact of digital transformation and climate change. Figure 1 includes comprehensive summarization of the analysed case studies.

	Stakeholders involved	Innovative solutions		Strategy based	
		Smart oriented	Green oriented	Stakeholders cooperation	Compliance with smart and green goals
Case 1	local government, business			yes	yes
Case 2	local government, higher educational institution			yes	yes
Case 3	local government, citizens, non-governmental organization			yes	yes
Case 4	local government, business			yes	yes
Case 5	local government, business			yes	yes
Case 6	local government, citizens			yes	no

Fig. 1. Comprehensive summarization of smart and green case studies. Source: authors

Focusing on the key elements of case studies, important findings should be discussed. As we presumed, solutions adopted within the planned collaboration between local and regional stakeholders have initiated solutions with positive impact on smart and green issues. However, selected cases had different impact on smart and green agenda, because some prioritize green solutions and other were primarily based on smart measures. Smart public lightning initiative from the City of Nitra and Smart mobility case from the city of Košice can be perceived as highly smart oriented, thus these activities need sophisticated digital and smart technologies to be successful. In contrary, collaboration between local government and universities in Košice, as presented in Case 2, has significant impact on green agenda, but also need smart technologies application. Case 2 and Case 3 are mainly green oriented, but outcomes of local governments' activities were amplified thanks to use of smart solutions. Figure 1 also demonstrates the intensity of innovative solutions use. However, case studies with lower intensity also can be perceived as an example of good practice, mainly thanks to collaboration of stakeholders and combination of impacts on digital and green agenda at regional ecosystem.

Selected cases also confirmed, that presented innovative solutions have resulted from intended collaboration between stakeholders, which is also declared by adopted strategies. In this regard, collaboration in demonstrated that smart and green regional ecosystems is not random, and it is far from an ad hoc collaboration. Simultaneously, five out of six cases also confirmed that implemented solutions contribute to aims and priorities included in local government strategies. Put differently, involvement of stakeholders into policymaking also facilitates environment where stakeholders follow initiatives of local and regional governments to increase the performance of local and regional ecosystem. Analysed case studies correspond not only with priorities of local governments' strategies, but also reflect long-term priorities included in national strategies.

Summing it up, we argue that systematic collaboration between the stakeholders contributes to smart, green and sustainable development of a wider region. Smart and green regional ecosystem can be based on abovementioned described as an approach that secures complex sustainable development. However, local and also regional governments can be perceived as the main actor and architect of this ecosystem. Contrary, local government without involved stakeholders is not able to solve contemporary ongoing digital transformation, climate and energy change. Citizens, businesses, nongovernmental organizations and higher educational institutions, as well as relations inside the ecosystem will affect the success of smart and green policies.

6 Conclusion

In conclusion, the concept of smart cities is gaining momentum around the world as a popular approach to address the complex challenges faced by urban areas. The growth of urban areas and the associated environmental challenges have spurred the development of smart city technologies, which aim to mitigate the negative impacts of urbanization and promote sustainable development. The study conducted in the Slovak Republic aimed to investigate the mutual relations between stakeholders in the region to create a smart and green regional ecosystem.

Through the case studies analyzed in this study, it is evident that planned collaboration between regional stakeholders, concentrating mainly on local self-government in the Slovak Republic, can create a smart and green regional ecosystem. The six cases analyzed were intentionally selected to demonstrate how planned collaboration between stakeholders helps to create a smart and green regional ecosystem. Each case study included the description of the relationship between stakeholders, the character of stakeholders, the description of the innovative solution adopted to solve certain smart and green challenges in the region, as well as the impact on the smart and green agenda in the region.

Despite the benefits of the study, there are still limitations to be addressed in further studies. First, our research was based on intentional selection of case studies. Nevertheless, we consider their information value that helped us to demonstrate importance of planned collaboration within local and regional environment. Another limit is based on statement, that smart and green challenges are complex phenomena, thus many other variables affect smart and green agenda. Our research can be further extended

from the following aspects, mainly broadening the empirical evidence, further analysis of stakeholders' strategies, as well as interconnectedness to national and European strategies.

In summary, this study has demonstrated the potential for planned collaboration between stakeholders in the Slovak Republic to create a smart and green regional ecosystem. The six cases analyzed show that the solutions adopted within the planned collaboration between regional stakeholders have the potential to solve both smart and green issues in the territory. Smart solutions bring positive environmental impacts, and green solutions also contribute to better and more sophisticated use of smart technologies. Systematic and planned collaboration of stakeholders in answering smart and green challenges can be seen as an approach that contributes to smart, green, and sustainable development of a wider regional ecosystem. Therefore, policymakers and practitioners worldwide should take into consideration the importance of planned collaboration between stakeholders in the development of smart and green solutions in their respective regions. In conclusion, the concept of smart cities is gaining momentum around the world as a popular approach to address the complex challenges faced by urban areas.

Acknowledgments. The article is created as a result of a project supported by the Scientific grant agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences, Grant no: 1/0734/22.

References

1. Banská Bystrica. Economic and social development plan 2015–2023 (Plán hospodárskeho a sociálneho rozvoja 2015–2023) (2015). https://cdn.banskabystrica.sk/Dokumenty-mesta/phsr_mesta_banska_bystrica_2015-2023.pdf. Accessed 11 Apr 2023
2. Banská Bystrica: Housing development program the city of Banská Bystrica for the years 2015–2020 (Program rozvoja bývania mesta Banská Bystrica na roky 2015–2020) (2015). https://cdn.banskabystrica.sk/2020/05/Program-rozvoja-bývania-mesta-B.Bystrica_2015-2020_textová-cast.pdf. Accessed 11 Apr 2023
3. Banská Bystrica. Green Housing Estates (Zelené sídliská) (2022). https://www.banskabystrica.sk/zelenesidliska/. Accessed 11 Apr 2023
4. Borsekova, K., Korony, S., Vaňová, A., Vitálišová, K.: Functionality between the size and indicators of smart cities: a research challenge with policy implications. Cities **78**, 17–26 (2018). https://doi.org/10.1016/j.cities.2018.03.010
5. Bridoux, F., Stoelhorst, J.W.: Stakeholder relationships and social welfare: a behavioral theory of contributions to joint value creation. Acad. Manag. Rev. **41**(2), 229–251 (2016). https://doi.org/10.5465/amr.2013.0475
6. Burns, P.: Tourism, political discourse and post-colonialism. Tour. Hosp. Plann. Dev. **6**(1), 61–73 (2008). https://doi.org/10.1080/14790530801936502
7. Chirico, F., Nucera, G., Szarpak, L., Zaffina, S.: The cooperation between occupational and public health stakeholders and its decisive role in the battle against the COVID-19 pandemic. Disast. Med. Public Health Preparedness **17**(e100), 1–2 (2021). https://doi.org/10.1017/dmp.2021.375
8. Chu, Z., Cheng, M., Yu, N.N.: A smart city is a less polluted city. Technol. Forecast. Soc. Chang. **172**, 121037 (2021). https://doi.org/10.1016/j.techfore.2021.121037

9. Clement, J., Manjon, M., Crutzen, N.: Factors for collaboration amongst smart city stakeholders: a local government perspective. Gov. Inf. Q. **39**(4), 101746 (2022). https://doi.org/10.1016/j.giq.2022.101746
10. Corrêa Gomes, R.: Who are the relevant stakeholders to the local government context? Empirical evidences on environmental influences in the decision-making process of English local authorities. Braz. Adm. Rev. **1**(1), 34–52 (2004). https://doi.org/10.1590/S1807-76922004000100004
11. European Commission. Smart cities (2023). https://commission.europa.eu/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en. Accessed 01 Apr 2023
12. European Commission. Why a Covenant of Mayors? (2023). https://eu-mayors.ec.europa.eu/en/about. Accessed 10 Apr 2023
13. Frick, S.A., Rodríguez-Pose, A.: Average city size and economic growth. Camb. J. Reg. Econ. Soc. **9**(2), 301–318 (2016). https://doi.org/10.1093/cjres/rsw013
14. Giffinger, R.: European smart cities: the need for a place related understanding. Creating smart cities, Napier University, Edinburgh (2011)
15. Gil-Garcia, J.R., Pardo, T.A., Nam, T.: What makes a city smart? Identifying core components and proposing an integrative and comprehensive conceptualization. Inf. Polity **20**(1), 61–87 (2015). https://doi.org/10.3233/IP-150354
16. Glasmeier, A., Christopherson, S.: Thinking about smart cities. Camb. J. Reg. Econ. Soc. **8**(1), 3–12 (2015). https://doi.org/10.1093/cjres/rsu034
17. Harangozó, G., Zilahy, G.: Cooperation between business and non-governmental organizations to promote sustainable development. J. Clean. Prod. **89**, 18–31 (2015). https://doi.org/10.1016/j.jclepro.2014.10.092
18. Hodge, I., McNally, S.: Wetland restoration, collective action and the role of water management institutions. Ecol. Econ. **35**(1), 107–118 (2000). https://doi.org/10.1016/S0921-8009(00)00171-3
19. Huang-Lachmann, J.T.: Systematic review of smart cities and climate change adaptation. Sustain. Account. Manage. Policy J. **10**(4), 745–772 (2019). https://doi.org/10.1108/SAMPJ-03-2018-0052
20. International Organization for Standardization. ISO 37120:2018(en) sustainable cities and communities (2018). www.iso.org/obp/ui#iso:std:iso:37120:ed-2:v1:en. Accessed 01 Apr 2023
21. Jung, T.H., Lee, J., Yap, M.H.T., Ineson, E.M.: The role of stakeholder collaboration in culture-led urban regeneration: a case study of the Gwangju project, Korea. Cities **44**, 29–39 (2015). https://doi.org/10.1016/j.cities.2014.12.003
22. Kijewska, K., Jedliński, M., Stanisław, I.: Ecological utility of FQP projects in the stakeholders' opinion in the light of empirical studies based on the example of the city of Szczecin. Sustain. Cities Soc. **74**, 103171 (2021). https://doi.org/10.1016/j.scs.2021.103171
23. Kitchin, R.: Making sense of smart cities: addressing present shortcomings. Camb. J. Reg. Econ. Soc. **8**(1), 131–136 (2014). https://doi.org/10.1093/cjres/rsu027
24. Komninos, N., Kakderi, C., Panori, A., Tsarchopoulos, P.: Smart city planning from an evolutionary perspective. J. Urban Technol. **26**(2), 3–20 (2019). https://doi.org/10.1080/10630732.2018.1485368
25. Košice: Economic and social development plan of the City of Košice and its functional area 2022–2027 (Plán hospodárskeho a sociálneho rozvoja Mesta Košice a jeho funkčnej oblasti 2022–2027) (2021). https://static.kosice.sk/files/manual/phsr/PHRSR_mesta_Kosice_a_jeho_funkcnej_oblasti_2022-2027.pdf. Accessed 10 Apr 2023
26. Košice: Strategy for the development of transport and transport structures of the city of Košice: Document update (Stratégia rozvoja dopravy a dopravných stavieb mesta Košice:

Aktualizácia dokumentu) (2022). https://static.kosice.sk/pages/F3Z5l1YQVXbTrWNA3U9/srd_kosice_aktualizacia.pdf. Accessed 10 Apr 2023
27. Krce Miočić, B., Razović, M., Klarin, T.: Management of sustainable tourism destination through stakeholder cooperation. Manage. J. Contemp. Manage. Issues **21**(2), 99–120 (2016)
28. Kuddus, M.A., Tynan, E., McBryde, E.: Urbanization: a problem for the rich and the poor? Public Health Rev. **41**(1), 1–4 (2020). https://doi.org/10.1186/s40985-019-0116-0
29. Lara, A.P., Da Costa, E.M., Furlani, T.Z., Yigitcanlar, T.: Smartness that matters: towards a comprehensive and human-centred characterisation of smart cities. J. Open Innov.: Technol. Mark. Complexity **2**(2), 1–13 (2016). https://doi.org/10.1186/s40852-016-0034-z
30. Liang, L., Wang, Z., Li, J.: The effect of urbanization on environmental pollution in rapidly developing urban agglomerations. J. Clean. Prod. **234**, 117649 (2019). https://doi.org/10.1016/j.jclepro.2019.117649
31. McMichael, A.J.: The urban environment and health in a world of increasing globalization: issues for developing countries. Bull. World Health Organ. **78**(9), 1117–1126 (2000)
32. Ministry of Environment of the Slovak Republic. Greener Slovakia: Strategy of the Environmental Policy of the Slovak Republic until 2030 (2019). https://www.minzp.sk/files/iep/greener_slovakia-strategy_of_the_environmental_policy_of_the_slovak_republic_until_2030.pdf. Accessed 07 Apr 2023
33. Ministry of Investments, Regional Development and Informatization of the Slovak Republic. Ministry of 2030 Digital Transformation Strategy for Slovakia (2019). https://www.mirri.gov.sk/wp-content/uploads/2019/10/SDT-English-Version-FINAL.pdf
34. Neiderud, C.J.: How urbanization affects the epidemiology of emerging infectious diseases. Infect. Ecol. Epidemiol. **5**(1), 27060 (2015). https://doi.org/10.3402/iee.v5.27060
35. Nitra. Program of economic development and social development of the City of Nitra 2015–2023 (Program hospodárskeho rozvoja a sociálneho rozvoja Mesta Nitry 2015–2023) (2016). Accessed 07 Apr 2023
36. Nitra. Processing of documents for the written report "Energy audit public lighting systems in the city of Nitra" (Spracovanie podkladov pre písomnú správu "Energetický audit sústavy verejného osvetlenia v meste Nitra") (2022). https://nitra.sk/wp-content/uploads/2023/02/Spracovanie-podkladov-pre-pisomnu-spravu-„Energeticky-audit-sustavy-verejneho-osvetlenia-v-meste-Nitra.pdf. Accessed 07 Apr 2023
37. O'Donnell, O.: Strategic collaboration in local government. A review of international examples of strategic collaboration in local government. Local Govern. Res. Ser. **2**, 1–46 (2012)
38. OECD. Enhancing the contribution of digitalization to the Smart Cities of the Future (2019). https://www.oecd.org/cfe/regionaldevelopment/Smart-Cities-FINAL.pdf
39. Pavol Jozef Šafárik University in Košice. Basic emission balance of the city of Košice (2020). https://josephine.proebiz.com/cs/tender/11797/summary/download/89289. Accessed 10 Apr 2023
40. Picon, A.: Smart Cities: A Spatialised Intelligence. Wiley, Chichester (2015)
41. Plaza-Úbeda, J.A., Burgos-Jiménez, J., Vazquez, D.A., Liston-Heyes, C.: The 'win–win' paradigm and stakeholder integration. Bus. Strateg. Environ. **18**, 487–499 (2009). https://doi.org/10.1002/bse.593
42. Polzonetti, A., Sagratella, M.: Smart city and green development. In: Al-Sharhan, S.A., et al. (eds.) I3E 2018. LNCS, vol. 11195, pp. 191–204. Springer, Cham (2018). https://doi.org/10.1007/978-3-030-02131-3_18
43. Pretty, J.: Social capital and the collective management of resources. Science **302**(5652), 1912–1914 (2003). https://doi.org/10.1126/science.109084

44. Robson, M., Kant, S.: The development of government agency and stakeholder cooperation: a comparative study of two Local Citizens Committees' (LCCs) participation in forest management in Ontario. Canada. Economics **9**(8), 1113–1133 (2007). https://doi.org/10.1016/j.forpol.2006.12.002
45. Ručinská, S., Fečko, M.: The use of innovations for smart cities. Transf. inovácií **38**, 81–84 (2018)
46. Ručinská, S.: "Smart city" – conception for local development?, In: CEE e/Dem and e/Gov Days 2015: proceedings of the Central and Eastern European e/Dem and e/Gov Days 2015, pp. 191–205. Austrian Computer Society, Wien (2015)
47. Sadorsky, P.: The effect of urbanization on CO2 emissions in emerging economies. Energy Economics **41**, 147–153 (2014). https://doi.org/10.1016/j.eneco.2013.11.007
48. Shamsuzzoha, A., Nieminen, J., Piya, S., Rutledge, K.: Smart city for sustainable environment: a comparison of participatory strategies from Helsinki, Singapore and London. Cities **114**, 103194 (2021). https://doi.org/10.1016/j.cities.2021.103194
49. The World Bank. Urban Development (2022). https://www.worldbank.org/en/topic/urbandevelopment/overview. Accessed 01 Apr 2023
50. Trencher, G., Karvonen, A.: Stretching "smart": advancing health and well-being through the smart city agenda. Local Environ. **24**(7), 610–627 (2017). https://doi.org/10.1080/13549839.2017.1360264
51. Trnava. Economic development program and social development of the city of Trnava for the years 2014–2023 with an outlook until 2030 (Program hospodárskeho rozvoja a sociálneho rozvoja mesta Trnava na roky 2014–2023 s výhľadom do roku 2030) (2020). https://www.trnava.sk/userfiles/file/Aktualizacia%20PHSR_na%20web.pdf. Accessed 11 Apr 2023
52. Trnava. Plan of sustainable mobility of the regional city of Trnava and its functional territory (Plán udržateľnej mobility krajského mesta Trnava a jeho funkčného územia) (2021). https://www.trnava.sk/sk/clanok/pum. Accessed 11 Apr 2023
53. Vitálišová, K., Murray-Svidroňová, M., Jakuš-Muthová, N.: Stakeholder participation in local governance as a key to local strategic development. Cities **118**, 103363 (2021). https://doi.org/10.1016/j.cities.2021.103363
54. Williams, S.: The responsive city: the city of the future re-imagined from the bottom up. In: Haas, T., Olsson, K. (eds.) Emergent Urbanism: Urban Planning & Design in Times of Structural and Systemic Change, pp. 147–158. Ashgate, Farnham (2014)
55. World Health Organization. Urban health (2023). https://www.who.int/health-topics/urban-health#tab=tab_2. Accessed 01 Apr 2023
56. Yan, Z., Sun, Z., Shi, R., Zhao, M.: Smart city and green development: empirical evidence from the perspective of green technological innovation. Technol. Forecast. Soc. Change **191**, 122507 (2023). https://doi.org/10.1016/j.techfore.2023.122507
57. Zelenemestonitra. Green City (Zelené mesto) (2023). https://zelenemestonitra.sk/mapa. Accessed 07 Apr 2023
58. Zhang, L., et al.: Direct and indirect impacts of urbanization on vegetation growth across the world's cities. Sci. Adv. **8**(27), 1–10 (2022). https://doi.org/10.1126/sciadv.abo0095