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Implementation of smart city solutions from the perspective of the population in Slovakia

Ivana BUTORACOVÁ ŠINDLERYOVÁ[1], Andrea ČAJKOVÁ[2]

***Abstract*:** In the past decade, the topic of Smart City is indisputably one of the most important concepts in the development of cities and urban regions in Central and Eastern Europe, their management and planning, while innovations and innovation potential are becoming a prerequisite for functioning connections and processes within integrated local (or geographical) functional areas. The Slovak Republic is gradual, despite the difficult beginnings without system coordination, declaring an effort to implement the Smart City policy within the existing residential structure of cities and municipalities. Relying on the Action Plan for Smart Cities and Regions 2023-2025 as well as the Slovakia Program 2021-2027, at the same time the results of world studies and analyzes carried out in the conditions of the Slovak environment (while we start from the findings and follow up on the study by Kóňa et al. 2022), the authors identify in their research as the main problem the fact that the attention of the state, professional public, as well as local authorities, is aimed at supporting the creation of Functional Urban Areas in the geographical structure of individual regions with the aim of supporting the development of six defined areas, the so-called „domains", which ultimately brings about an increase in the quality of life of the population of these regions. However, given domains are ambiguous in terms of content, this variability is also reflected in the inability of participating parties to perceive their content. As part of the research, respondents were asked about six areas of smart city policy implementation, the aim of the research was to identify the content perception by the respondents according to the weight they assign to individual areas and subsequently define within individual domains the elements/characteristics perceived by the population as key to the growth of the quality of their lives in cities and regions.

Keywords: Smart City, Cities, Urban regions, Smart governance, Slovakia.

JEL: O18; O21; O31; O38

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[1] Prof. Ing., PhD, University of Ss. Cyril and Methodius, Faculty of Social Sciences, Bučianska 4/A, 917 01 Trnava, Slovak Republic, e-mail: ivana.butoracova.sindleryova@ucm.sk; ORCID: 0000-0001-8261-7490.

[2] Assoc. Prof. PhDr., PhD, University of Ss. Cyril and Methodius, Faculty of Social Sciences, Bučianska 4/A, 917 01 Trnava, Slovak Republic, e-mail: andrea.cajkova@ucm.sk; ORCID: 0000-0002-5951-1281.

Introduction

The topic of introducing intelligent technologies in cities and towns is still relatively new in Slovakia. The implementation of smart solutions brings new possibilities for improving the quality of municipality management, more effective cooperation between individual departments, as well as opportunities for better connection between municipalities and citizens, including staffing for the creation, assessment and implementation of smart solutions and innovations. It will also bring tools for cooperation between municipalities, especially within the urban region, which requires effective cooperation between several larger and smaller municipalities. In 2021, a new EU program period began, where integrated territorial strategies are the basic strategy for ensuring integrated territorial development supported by EU territorial instruments, such as integrated territorial investments. The new program period emphasizes the decision-making powers of municipalities in terms of allocations and the use of European funds while strengthening partnership cooperation, and thus places increased demands on the quality of municipalities management and the implementation of innovative approaches, to which the smart city agenda undoubtedly belongs. The comprehensive agenda of smart cities and regions and the management of the public policy for the development of smart cities and regions in the Slovak Republic fall within the competences of Ministry of Investments, Regional Development and Informatization of the Slovak Republic (MIRRI SR). One of the main activities is to provide cities and regions with the support that will address their needs in the field of strategic planning, preparation, and implementation of smart solutions, as well as support in the evaluation of alternatives and financial planning of investments. The goal is to ensure comprehensive coverage of the issue of the development of smart cities and regions and at the same time contribute to deepening the ability of local governments to put into practice the concepts of the development of smart cities and regions. It is necessary, in terms of spreading smart city awareness, to realize the need for a change of thinking among all interested entities with regard to the broad benefits resulting from the inclusion of the agenda of smart cities and regions as an integrated part and preferred approach to regional, urban and territorial development.

The Government of the Slovak Republic (www.smartcity.gov.sk) approved for the current program period the Program Slovakia 2021 – 2027, which follows on from the Partnership Agreement 2021-2027 and represents the main program document for drawing resources from EU funds, as well as a key investment tool for increasing the living standards of the population and increasing the competitiveness of the Slovak Republic. The Slovak Republic will be thus able to draw on European resources in the amount of almost 13 billion euros in the new program period and use them for its development and investment priorities. The package also includes 106.3 million euros allocated for the construction of smart cities in the regions, with which the MIRRI SR fulfills its ambition to support the so-called smart development in the Slovak Republic in terms of the Program Statement of the Government of the

Slovak Republic and other focus materials of MIRRI, including the prepared Action Plan for Smart Cities of the Regions for the years 2023-2025, the approval of which is expected at the end of this year. Its key areas are based on European legislation and will be directed towards six specific goals, these are: A more competitive and intelligent Slovakia (1.89 billion euros), which also includes the allocation of 106.3 million euros within measure 1.2.2 intended to support the development of smart cities in regions; Greener Slovakia (4.2 billion euros); A more connected Slovakia (2 billion euros); A more social and inclusive Slovakia (3.25 billion euros); Europe closer to citizens (400 million euros) and the Fund for a just transformation (441 million euros) will be a specific goal. One of the focal outputs of the project "Methodological-evaluation unit and expert platform for supporting the development of smart cities and regions" is the so-called Action plan, which was launched at the end of 2020 as part of OP EVS with a duration until the end of 2023. The action plan for smart cities and regions for the years 2023 – 2025 represents a set of measures and activities that aim to significantly contribute to the possibilities of Slovak cities and regions to advance in the field of smart development in the mid-term horizon, also with the use of contributions from EU funds (www.zmos.sk). The focused expert support of MIRRI SR, the national coordinator of smart cities of regions, will be provided in this context by the department of smart cities of regions MIRRI within the project of the Operational Program Effective Public Administration under the title "Methodological-evaluation unit and expert platform for supporting the development of smart cities of regions", which was launched at the end of 2020 precisely with regard to the creation of an action plan with the aim of contributing to the development of intelligent self-governments in the Slovak Republic and to improving the overall quality of life in Slovakia. The highest amount of 49.5 million euros will be concentrated in favor of territorial strategies of sustainable urban development (SUD) at the level of eighteen members of the SUD territories, including the so-called urban functional areas. The remaining amount of 15.5 million euros will address the area of integrated territorial investments implemented at the level of higher territorial units. Unfortunately, Slovak specificity, fragmentation of public administration at the municipal level, where 70% of municipalities have less than 1,000 inhabitants, creates high overhead costs and hampers the effectiveness of local self-government. Therefore, the financial capacities of municipalities are often limited to the provision of basic public services and infrastructure, as a result of which resources are not directed to social services, education, spatial planning, and building permits (European Commission, 2019). The approach of creating key cities, by connecting optimal adjacent cities or municipalities, or peripheral parts of the city to a city that has significant economic power within the region, it is possible to create sufficiently strong urban units that can be compared with larger agglomerations within the countries of the European Union. Such key cities have sufficient economic strength and population, as well as prerequisites, for the ability to apply Smart City. However, the development of these cities is conditioned by the creation of Functional Urban Areas operating within the

premise of the smart cities policy. There are currently 141 cities in the residential structure of Slovakia, while Bratislava and Košice are the only two cities with a population of over 10,000 (www.sodbtn.sk). In their research, the authors follow up on the need to create functional areas, as one of the main prerequisites for the real possibility of implementing smart city strategies, but in their research, they are oriented precisely on the content page of smart city policies and therefore which areas and in what perception of their individual elements are key for building smart cities concept accepted by the inhabitants of the cities of the Slovak Republic. We want to achieve this goal using a quantitative method of data collection through questionnaires distributed online was used. As part of the research, respondents were asked about six areas of smart city policy implementation, the aim of the research was to identify the content perception by the respondents according to the weight they assigned to individual areas. The results are processed by mathematical and statistical methods.

1. Literature review

Nevertheless, it has to be mentioned that the Smart City concept itself is not quite new. The first mention of a "smart city" was during the Annual Lecture of the Auckland Branch of the New Zealand Geographical Society at the University of Auckland in October 1998 (Ismagilova et al., 2019). It continued with speculating on "the urban center of the future" during the 2nd International Life Extension Technology Workshop in Paris, France on 28 September 2000 (Baig et al., 2017).
The real rise in conceptualizing the idea of smart city was in the early 2010s (Rathi et al., 2021). This can be associated with initiatives related to the integration of ICT smart systems in technologically advanced European cities, such as Barcelona or Amsterdam (Troisi et al., 2022). In Amsterdam, there were over 170 projects run by local residents, government, and private companies. Innovations such as interconnected platforms through wireless devices to enhance the city's real-time decision-making abilities were integrated in the city of Amsterdam (Chiabai et al., 2014). In the case of Barcelona, there were a number of projects that can be considered as a "smart city system" within its "CityOS" strategy. For example, the bus network was designed based on data analysis of the most common traffic in the city. Smart traffic lights were also designed as a part of the program. These were the first attempts to implement the concept of the smart city in practice. However, there was also a logical issue of government or company surveillance.
The concept evolved from being understood only as a green technology first (Sharifi, Khavarian-Garmsir, 2020), and then further progressed to an explanation and encompassing of the organizational, collaborative, and experimental dimensions (Mnif, 2021).

1.1. Smart city domains and their content elements - definition of the structure of individual domains in the context of the SR concept

Higinio et al (2021) point to the fact that new Information and Communications Technologies (ICT) are changing the way in which the world works. These technologies provide new tools to face the issues of contemporary society (poverty, migration, sustainable development challenges, governance, etc.). Intelligent development is one that increases the standard of living of all citizens in them and at the same time makes efficient use of all available resources. In addition, the entire system of smart growth of cities and regions includes several mutually cooperating entities including public administration, the private sector, the academic sector, as well as the residents of cities and regions. According to Filip (2022) in this complex system, it can be very difficult for the municipality to absorb and effectively use the many opportunities offered by intelligent solutions, also due to the lack of financial or personnel capacities. On the other hand, the impossibility of integrating small residential agglomerations into functional regional and local areas also appears to be a problem. At the same time, the question arises as to whether the smart city elements applied within the framework of development policy in Western countries and cities characterized by a number of inhabitants over 100,000 are identically applicable also in the conditions of the SR's residential structure. Last, but not least, there is a question that the authors ask as a key for their own investigation: is it possible to fulfill the expectations of the population with smart elements defined in this way? Will we achieve the desired outcome of satisfaction by implementing the determined content structure of the smart city policy in individual areas and in the cultures of Central and Eastern Europe?

Slovak municipalities face similar challenges as other European cities and regions – population aging and migration, gradually increasing temperatures, droughts and floods caused by climate change, depletion of natural resources, radically changing business models, etc. At the same time, the pressure to reduce CO2 production is increasing. Solving the issue of mobility is a serious challenge, while Slovakia has a significant modernization debt, especially in the area of infrastructure. Significant changes also occur in the behavior of the inhabitants and their lifestyles. Citizens are increasingly interested in participating in the development of self-governments, they want to be a part of decision-making even outside the election cycle, they demand transparent processes for handling public property, but above all, they want to communicate effectively with local, regional, and state authorities. Slovakia is working with several strategic documents that directly speak of the need for the application and management of a smart city, i.e. the implementation of Smart City elements into institutional processes and structures. For the development of smart cities and regions, it is not necessary to prepare any separate document at the level of strategic documents in the Slovak Republic. The key is to link intelligent development with the currently ongoing preparation of integrated territorial strategies (IÚS) of self-governing regions and sustainable urban development (SUD)

territories, which should be integrated in one planning document - the economic development and social development plan (PHRSR). The development of smart cities and regions should be the core of the PHRSR and should be characterized by 4 principles: sustainability, integration, inclusiveness, and innovation (technical, technological and/or non-technological). However, due to the current lack of a unified definition of so-called Smart cities in Slovakia, we consider it crucially important to unite on the conceptual definition of the content of smart cities and regions. The definition of the main aspects of smart cities and regions will play a key role in the further planning of support for the smart development of cities and regions by MIRRI SR in the coming years. The European Commission (EC) defines a smart city as one where traditional networks and services are managed more efficiently for the benefit of residents and business development. For the purpose of better use of resources and reduction of the volume of emissions, the EC also highlights a more interactive and accommodating city administration, safer public spaces and meeting the needs of aging citizens. OECD (2019) defines a smart city in terms of benefits for the individual; at the same time, it emphasizes the use of an effective level of digitization to improve people's quality of life, the creation of effective, sustainable and inclusive services and broad cooperation. At its Habitat III conference (UN, 2016), the United Nations, by adopting the New Urban Agenda, committed to a smart city approach that takes advantage of the opportunities arising from digitization, clean energy, and technology, as well as innovative transport technologies, as a result of which residents will have the opportunity to choose more environmentally friendly solutions, increase economic growth and provide better services in cities. Authors dealing with the topic of Smart Cities from an academic point of view agree on six main components, which are the pillars of the Smart Cities concept. The individual names for these areas do not always match, but they contain the same areas for all academics and their approaches. We can therefore generally define the following generally recognized pillars of Smart City: Government and self-government; Buildings; Mobility; Energy and environment; Education; Health (e.g. ChuanTao, et al. 2015, Halegoua, 2020, Dustdar, et al. 2017, Pereira, et al. 2018, McClellan, et al., 2018).

An internal contradiction already arises here, given that MIRRI SR defines the exact composition of the expert platform for supporting the development of Smart Cities, reflecting the current demand from cities and regions, in the following areas: transport and mobility, network industries, waste management, environment, public services, social services, education and more. On the other hand, the concept of smart city and regions is most often applied in six strategic domains, the potential of which lies mainly in their interconnection and continuity, MIRRI as the national authority defines them for the Slovak environment as follows:

Table 1. Strategic domains of the Smart city concept

Smart city „domain“	Main characteristics
Intelligent public administration	Smart public administration assumes the interaction of public, private and civil organizations in the administration of public affairs and the support of further development. The main tool is innovative solutions to challenges, e.g. in the form of behavioral approaches, information and communication technologies, data-based decision-making and effective processes and services available in electronic form and through useful applications.
Smart life and services	Smart life and services reflect the lifestyle and behavior of citizens, the provision of a healthy and safe environment with developed cultural, social, economic, health and sports infrastructure. The goal is to increase the standard of living with a focus on the user experience of the residents.
Smart environment	The introduction of this concept in the area of the environment aims to make the management of energy, natural resources or waste more efficient and at the same time to strengthen the monitoring of environmental impacts across value chains. An important part of the domain are e.g. solutions for increasing energy efficiency, optimizing consumption or switching to renewable energy sources.
Smart society	Smart communities have access to quality education, information and the opportunity to engage creatively in social life for everyone, including disadvantaged residents. The main factor is the company's proactive approach to new forms of raising living standards.
Smart mobility	Smart mobility uses safe, innovative and connected transport systems across all modes of transport. The goal is to increase the quality and efficiency of transport, minimize its impact on the environment, and at the same time shorten the distances between cities, regions and points of interest in them. The use of information and telecommunications means can contribute to proper planning and cost reduction.
Smart economy	Smart economy primarily optimizes and supports new business and trade models, production with high added value, innovation support, and creation of new products, services and business models. By connecting various actors and providing suitable conditions and opportunities, public administration can support the creation of a quality business environment and benefit from it for its further development.

Source: MIRRI, 2022

In the methodological development document Forms of smart transformation of cities and regions (MIRRI, 2022), MIRRI defines the following areas as key – already at first glance conceptually different from the six domains of smart cities policy:

Table 2. Key areas of smart cities policy

Areas of recommended transformation of smart cities and regions	Characteristics
City administration	Open city data has the potential to bring greater transparency, its collection and use in the city infrastructure in the form of electronic city services helps to increase the quality of services to residents. At the same time, the data make it possible to identify the real challenges of the territory, and support decision-making and planning for further development.
Smart economy	Support for research and development centers in cities with university backgrounds, innovation hubs and different cultural and educational institutions for different groups of people has the potential to be a source of innovation and support experimentation with new technologies in the city or regional environment. The result can also be the creation of new, innovative and more efficient solutions, improvement of the overall business environment and attractiveness of the city for start-ups, investors and new talents, as well as innovative and sustainable economic growth.
Public services	Smart management of public services such as optimization of waste management through monitoring of waste collection routes, installation of sensors in bins to monitor their contents, intelligent street lighting responding to the movement of pedestrians or cyclists, provision of better services in the field of education increases the economic profitability of the city.
Engagement	Positive changes can also be achieved by directing the population towards the desired behavior through creative measures that use the knowledge of psychology. By changing the city's communication with the public, the involvement of the population will increase, and thus the effectiveness of city policies when they are put into practice.
Ecology	Monitoring the environment through sensors (noise, CO2, water quality and many others) and using this data for mapping and evaluating risks and impacts on residents, evaluating necessary changes and restrictions, and investing in urban greenery as prevention against overheating of the city. New urban planning standards to increase efficiency and minimize environmental impact, as well as create a resilient and sustainable community.
Mobility	With the use of data from sensors, security cameras and the Internet connection, the city can monitor the traffic situation, share the data analysis outputs on city applications and dynamically change the settings in the traffic or parking strategy of the territory according to

Areas of recommended transformation of smart cities and regions	Characteristics
	current needs. Promoting the combination of multiple modes of public and private transport and the introduction of new forms of transport (e.g. electric vehicles, hydrogen-powered vehicles, autonomous vehicles, bike-sharing, carpooling/car-sharing) are important aspects of a forward-looking strategic approach to promoting "smart mobility".
Digital technologies	Integration of digital technologies into the main infrastructure systems as a basic element for building a smart city (green buildings, functional public services, efficient transport infrastructure, energy savings). Digital technologies have already proven themselves in many cities and regions as an accelerator of intelligent transformation of cities and regions.

Source: MIRRI, 2022

The development in Slovakia shows that both national and local governance (e.g. Lukáč, Ganobčík, 2021; Srebalová, Peráček, 2022, Campmas, et al 2022) works on increasing the scope of digital public services and their interaction with the information systems of other European Union countries.
The problem is that the smart city concept is often performed within the concept of the intelligent city – the local governance focuses on the high efficiency of selected infrastructure, it is not creating a functional network of infrastructures bringing higher standards to their citizens. However, citizen participation and sustainability are two main concepts used in the definitions in the smart city literature. Citizen participation is often used within the context of improving good governance in smart cities. (Bingöl, 2022).

2. Research methodology

In the Slovak Republic, we see smart cities and regions as those that effectively and sustainably use their resources and their potential, and at the same time proactively look for innovative ways, approaches and technologies in solving the challenges and opportunities of society and the environment. But for the Slovak Republic, the perception of smart cities in the context of the so-called Functional Urban Areas is very likely unrealistic. The authors perceive the smart city concept differently in conglomerations of typologically large cities - in Central European scale (over 100,000 inhabitants) and in areas characterized by a significantly diversified residential structure uniting smaller cities and surrounding villages in the region, for the purpose of smart cities with the assumption of functioning together as so-called Functional Urban Areas. For example, Mihálik et al. (2019) point to problematic

financing in the context of (in)dependence of such a diversified residential structure as it is in Slovakia (e.g. also Klimovský et al. 2014, Nemec et al. 2021). We draw attention also to the research of Micozzi (Table 3), Yigitcanlar (2022), as well as Osman, Elgaral (2021).

Table 3. Key 6 domains within the Central European Scale

Node	Sub-Node
Smart Economy	Business competitiveness, Business efficiency, Business intelligence, Business technology, Digital assets, Digital innovation, Economic business growth, Entrepreneurship, Market
Smart Environment	Carbon neutral, Climate change, Environmental conservation, Natural disaster, Reduce energy consumption, Renewable energy, Sustainable city, Sustainable Development, Waste and water management
Smart Governance	Citizen engagement, Collaborative leadership, Community engagement, Digital democracy, E-government, Multi-sector collaboration, Open data portal, Stakeholder engagement, Urban innovation
Smart Living	Attractive city, Cultural diversity, Data privacy, E-services, Entertainment, Livability, Sense of place, Smart home, Urban infrastructure
Smart Mobility	Active transport, Electric vehicle, Mobility as a service, Noise and air pollution, Public transport, Smart parking, Sustainable mobility, Traffic management, Transportation management
Smart People	Collaboration networks, Community environment, Digital citizenship, Digital education, Digital inclusion, Diverse population, Equal opportunity, Resilient community, Skill development

Source: Micozzi, Yigitcanlar, 2022

It is necessary to realize that the sustainability of a smart city development depends on the interpretations and prioritization driven by the key actors. Currently; the "top-down" smart city implementation in many countries is at risk of disengaging with local stakeholders and further widening the social disparities in the cities (Sontiwanich, Boonchai, Beeton, 2022). In the document Support for innovative solutions in Slovak cities (2017, p. 47) a survey analysis is presented aimed at clarifying the awareness, interest and opinion on the subject of smart cities implementation among representatives of cities and selected companies in the regions. Almost 92% of city representatives interviewed would welcome the opportunity to learn about specific Smart City solutions, and the same share of city representatives would like to invest in Smart City solutions in their city. The benefits of Smart City solutions are also positively perceived by over 91% of city representatives (Support of innovative solutions in Slovak cities, 2017, p. 47). However, only less than half of the respondents stated that their city had invested in Smart City solutions in the past. Given the complexity of the topic, cities alone are

not enough to grasp it. It is alarming that almost a fifth of the addressed cities represented by the vice mayors in the survey said that they are not aware of the Smart City phenomenon, despite the fact that this topic is becoming a global trend to which not only developed countries and their metropolises are adapting, but also entire regions. For the purpose of sustainable urban development in Slovakia, national authorities thus must provide system management with an initiative aimed at raising awareness of Smart City.

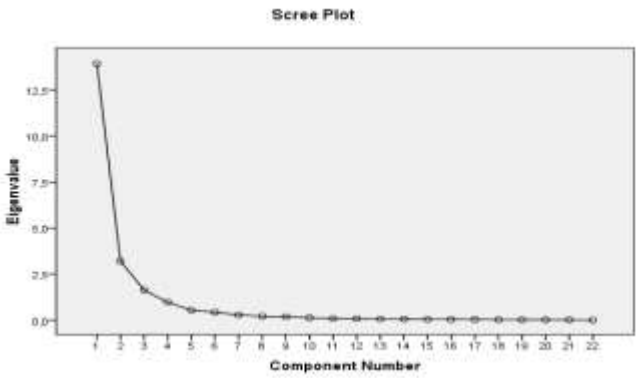
We conduct an empirical analysis of the need, acceptance, and usage of novel smart technologies by the inhabitants of all towns in Slovakia (141 towns). Our data come from our survey administered in the Slovak Republic between September 2022 and January 2023. We used quasi-random sampling and utilized both the elements of the snowball technique assisted by opportunity sampling. We recruited the participants taking part in our survey both in person via social networks by addressing, for example, through the profiles of interest associations in specific towns, or town profiles on social networks - we selected only closed groups, where it was assumed that the members were residents of the given towns. In total, we obtained a sample of 4317 respondents from Slovakia (38,6% women and 61,4% men, median age 47 years) who completed our questionnaire voluntarily and anonymously. All of the respondents lived in towns, except the two largest cities Bratislava and Kosice in the European Scale (over 100,000 inhabitants). The questions were composed on a 5-point scale ranging from 1 (strongly agree) to 5 (strongly disagree). Incompletely filled questionnaires were not included in the research statistics. The questions were compiled specifically in relation to the six key domains of the smart cities policy and their content page, based on the research concept of Micozzi, Yigitcanlar, 2022 and MH SR, 2017. The strategic document in question and its interpretation appears to be the closest in terms of content to the document processed in SR conditions to the world-known description of Smart City domains. Respondents were asked about six areas of smart city policy implementation, the so-called six domains. The aim of the research was to identify the perception of these areas by the respondents according to the weight they assign to individual areas and then, within the framework of individual domains, to define the elements/characteristics perceived by the population as key to the growth of their quality of life in cities and regions. At the same time, we assume the possibility of the absence of perception of some domains as directly related to citizen satisfaction and a certain inability to perceive the essence of the implemented smart city policy strategy within the given domain/domains by the target group. To extract the key perceived factors, we used the method of factor analysis, taking into account the questions of the questionnaire (No. 1 - No. 22). The questions were designed in such a way that they fulfilled the essence of the characteristics of the individual domains. By identifying the key factors (domains) perceived by the respondents as clearly contributing to the quality of their lives as citizens of single cities and regions, we then approach the identification of the content side of these factors based on the answers perceived as dominant. Respondents were asked two additional identification questions, namely gender

(male/female) and age. The age structure was defined according to the research procedure Popularization of science among the public (Final report, 2022): 18-25 years, 26-35 years, 36-45 years, 46-55 years, 56 and over years. We analyzed the statistical results of the research carried out using the SPSS program and are presented in tabular and schematic form for easier interpretation. We show the visual structure of the identified factors in a three-dimensional graphic presentation of the outputs of the factor analysis.

3. Research results and discussions

On the basis of factor analysis, we extracted key factors or clusters using the Principal Component Analysis method and VARIMAX rotation in a rectangular system (Rotated Solution), while we assume that each of them corresponds to one of the assumed key factors perceived by the surveyed respondents as a priority within each of the six domains - we refer to them as F1 - health, F2 - mobility, F3 - living environment, F4 - living, F5 - economy, F6 - people (education). We transformed questions No. 1 - No. 22 as items q1 - q22 for the purposes of factor analysis. 22 questions were assigned to individual content items of the investigated six domains. As can be seen in Table 6, the distribution of these factors is as follows: questions 1-4/F1, questions 5-8/F2, questions 9-12/F3, questions 13-16/F4, questions 17-19/F5, questions 20-22/ F6.
The research assumption was established as follows: We assume that there are differences in the perception of the importance of individual smart city domains among the population in terms of supporting the growth of their quality of life.
In multivariate statistics calculation, the scree plot was used as a line plot of the eigenvalues of factors or principal components. The authors determine the number of factors to retain in an exploratory factor analysis and define the principal components to keep in a principal component analysis.

Figure 1. Scree plot analysis of investigated domains



Source: Author's contribution

The performed analysis explains 72.238% of the variability of the original variables, the remaining 27.762% remains unexplained by the model. Based on the statistical processing of the respondents' answers, we identify four preferred areas perceived as key, with one significantly dominating the others. The area of health is perceived by the population as the dominant factor, followed by the domains of mobility, environment and living. When answering the other questions, the respondents' answers were at the level of the average value of the scale, or in a negative value. The population does not perceive the domains of smart economy and smart people (education) as crucial or meaningful for the development of their quality of life - this is probably due to a lack of interest or a negative experience (for questions directed to these areas, the most common answer is "I can't judge").

Table 4. Total Variance Explained

Component (question q)	Initial eigenvalues			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13,822	16,111	35,155	3,385	*35,596*	35,596
2	3,630	15,223	51,266	2,916	*14,652*	50,248
3	1,720	11,197	62,463	2,823	*11,230*	61,478
4	,995	9,775	72,238	2,369	*10,760*	***72,238***
5	,530	5,122	77,360			
6	,425	4,462	81,822			
7	,281	4,230	86,052			
8	,211	3,256	89,308			
9	,184	2,712	92,020			
10	,129	2,073	94,093			
11	,097	1,627	95,720			
12	,083	,901	96,621			
13	,071	,712	97,333			
14	,052	,665	97,998			
15	,044	,520	98,518			
16	,040	,395	98,913			
17	,031	,312	99,225			
18	,023	,207	99,432			
19	,021	,202	99,634			
20	,020	,187	99,821			
21	,013	,096	99,917			
22	,005	,083	100,000			

Source: Author's contribution
Authors note: Extraction Method: Principal Component Analysis.

As can be clearly seen in the previous table, for the first four identified factors (smart city domains), the cumulative sum of the percentage share of the components is 72.238%, therefore we can consider them relevant. We consider the first identified

factor to be dominant – clearly dominant even in view of the slope of the curve in the graphic representation of the Scree Plot (Figure 1). The percentage of explained variance within the selected components obtained by the Principal Component Analysis extraction method is shown for the identified components in italics (previous table). We describe the carbonation of these factors in Table 5.

Table 5. Rotated Component Matrix(a)

	Component			
	1	**2**	**3**	**4**
q01	*,914*	,079	,009	,219
q02	*,851*	,143	,813	-,004
q03	*,968*	,110	,789	,072
q04	*,871*	,212	,028	,694
q05	,258	*,754*	,013	,039
q06	-,104	*,719*	-,103	,108
q07	,680	*,844*	,059	,012
q08	,004	*,897*	,070	-,102
q09	,004	-,032	*,743*	,426
q10	,087	-,024	*,815*	-,002
q11	,286	,113	*,646*	-,056
q12	,299	-,051	*,828*	,111
q13	,068	-,165	-,011	*,778*
q14	-,029	,235	-,037	*,698*
q15	-,131	,012	-,046	*,740*
q16	,038	,654	,231	*,799*
q17	,118	,091	,216	,240
q18	-,102	-,091	,080	,113
q19	-,174	,134	-,075	-,032
q20	-,046	-,050	,032	,100
q21	,085	-,012	-,104	,125
q22	,019	-,035	-,011	,035

Source: Author's contribution according to the statistical program SPSS
Authors note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 5 iterations.

As can be seen in the previous table, the perceived domain is dominant - F1, i.e. health. Subsequently, the population places great emphasis and interest in the domains of mobility, environment and living. The population perceives the domains of economy and people as secondary in relation to the direct influence on the quality of their life in cities and regions. It is necessary to note that some questions are perceived by the respondents as intersectoral, despite the orientation of the questionnaire to one specific area. For example, question no. 2 is almost identically

perceived in the agreeable scale answers regarding the health domain (.851) as well as the environment domain (.813). In the case of such a spectrum of answers, we took into account the one with the highest value of the scale of agreeing answers as the dominant factor for the given question in the subsequent Reliability Analysis.
We implemented Reliability Analysis for additional confirmation of the existence of the identified four key domains within the statistical evaluation, which was based on the recalculation of relevant Cronbach's Alpha values reflecting the internal consistency of the investigated domains. We calculated the average score for each of the factors F1-F4 separately by merging all the questionnaire items related to each of the expected output factors (F1, F2, F3, F4) and then we calculated the Cronbach's output values using the SPSS statistical program Alpha (Table 6). As with the factor analysis, here too we are based on the number of 4317 returned fully filled questionnaires (% of the total number of distributed questionnaires cannot be defined, the questionnaires were distributed via social networks). Factors F5 and F6 are not further included in the reliability analysis due to their low perception percentage.

Table 6. Cronbach's Alpha for domains

F - Domain	Questions	Cronbach´s Alpha	Deviation*
F1 - Health	q1, q2, q3, q4	0,901	0,878 – 0,917
F2 – Mobility	q5, q6, q7, q8	0,803	0,772 – 0,831
F3 – Environment	q9, q10, q11, q12	0,758	0,734 – 0,795
F4 – Living	q13, q14, q15, q16	0,753	0,745 – 0,772

Source: Author's contribution according to the statistical program SPSS
*The value of Cronbach's Alpha is recalculated within the deviation for the case of removing any of the items from the statistical calculation, and it is essential that it does not change significantly and represents statistically reliable values.

Last but not least, the statistical processing of identification questions, i.e. gender and age of the respondent, has an informative value. The gender representation of the answers to the questions in the subject analysis is in the ratio of male 61.4 percent to female 38.6 percent. The only area showing strong agreement in the group of female respondents compared to the small group seems to be the living room, the other domains are almost evenly covered by both sexes in the scale of agreeable answers. By evaluating the identification question of the respondent's age, we arrive at interesting results. Regardless of age, there is a high percentage of agreement with the answer scale for the area of health. In the other three areas, we observe the diversity of opinion distribution, which opens up space for a discussion about the precisely targeted focus of the strategy in the implementation of education while supporting the development of each of the domains. For a comprehensible clarification, see Table 7.

Table 7. Percentage expression of agreement regarding the importance of the factor in the age categories of respondents (within the scale: strongly agree/agree)

Domain	Age category of respondents (in years)				
	18-25	26-35	36-45	46-55	> 56
F1 – Health	78,2%	78,2%	91,2%	88,2%	93,1%
F2 – Mobility	69,1%	76,3%	89,1%	75,7%	73,6%
F3 – Environment	82,3%	82,3%	72,3%	62,6%	45,3%
F4 – Living	55,2%	65,8%	75,4%	75,2%	64,2%

(Source: Author's contribution)

Authors note: The table is made in such a way that f1 dominates and the other second, third, fourth on average, and I guessed the age groups that might be interested in it, a calm transcription, as long as it remains clearly f1 and then the other percentage average.

4. Conclusions

The conducted research opens up questions for discussion by the professional public as well as national authorities about the further direction of the smart cities policy as well as the urgent need to spread awareness among the participating parties, above all the population. Awareness remains questionable among the population, who in two cases perceive the areas of smart city policies as uninteresting, or not directly related to their quality of life. The above four areas are perceived as important, but even here there are internal contradictions. The key domain seems to be healthcare, regardless of the structure of the respondents (age, gender). The priority for respondents is functional and integrated healthcare systems - making an appointment with a doctor, availability of healthcare services, reducing the paper burden (paper exchange tickets, paper results sent to the doctor electronically at the same time). Another three areas strongly perceived by the population are mobility, environment and living. Among the common questions, the population perceives the need to invest in lagging rural areas by eliminating differences in their infrastructure and other identified development needs, to take into account depopulation in certain less developed areas (such as the "hunger valleys" in the south and east of the country) and to provide the population with opportunities to strengthen local growth using links with surrounding urban areas. Within the framework of living comfort, in many cases, there is a desire for high-quality and functional e-services at the level of leading electronic equipment, in the context of mobility, the respondents see availability as a problem, i.e. the connection/continuity of connections, the development of integrated urban and suburban transport, not only in Bratislava but also in smaller cities and sparsely populated regions. In the area of the environment, the maximization of green transport, the construction of cycle paths, and energy saving are priorities for citizens. In the context of young people's lifestyle, from the point of view of younger respondents, real recycling and waste separation is a priority effort. One of the solutions is also strengthening the principle of partnership within and between regions and investing in capacity building and strengthening the position of local authorities and local organizations. By creating urban agglomerations, administrating and managing these agglomerations towards Smart

Cities, it is possible to create a highly competitive environment for obtaining new investments, improving the lives of residents, setting approaches that will improve economic indicators and, in the future, will bring economic growth of these agglomerations and an overall increase in the level of quality of life in the country. Smart cities and regions thus are those that are sustainable, green, inclusive, with a competitive and innovative economy and that use new digital and communication technologies for the faster and more convenient provision of public services for the benefit of the increased quality of life of their residents (Čábyová, Krajčovič, 2020). The smart cities policy does not only take into account the goals of the European Commission and the priority axes of individual ministries of the Slovak Republic, it integrates all the requirements of building a smart city in relation to the satisfaction and growth of the standard of living of its citizens, as well as citizens from the territorial point of view of adjacent areas (EC). At the same time, recent analyzes by the European Investment Bank (EIB, 2017, 2018) showed that the following areas are problematic when implementing the concept of smart cities in Central, Eastern and South-Eastern Europe: availability of technical assistance, regional coordination of smart development, level of digitization and technological and capacity maturity of municipalities, planning, management and financing of activities in the field of development of smart cities and regions, sub-activities and focusing exclusively on conventional domains such as transport, lighting or waste management. The consequence of these facts is also the weak involvement of Slovak cities and regions in European and international activities and initiatives in this area.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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