

Smart cities in Ukraine: Prerequisites, international experience and prospects for improving the quality of life

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Abstract. Creating smart cities in Ukraine is a pressing issue given the increasing necessity to integrate innovative methods to enhance the quality of living and establish sustainable urban development. The aim of this study was to assess feasibility of integrating smart city concepts in Ukraine, based on experience of some leading cities worldwide, with a view to improving quality of living. The study findings confirm that smart cities play a crucial role in digital transformation and are a significant aspect of contemporary urban developments. Through examining scientific publications and conducting qualitative interviews with urbanism, economics, and innovation experts, this research has identified the prospects for smart cities in both Ukraine and the global context, thereby offering a neutral perspective on the current state and future prospects of smart cities. Important information about city residents' attitudes and expectations toward smart cities was collected through questionnaires and surveys. Big data analysis identified trends and patterns in the development of smart cities using specific data and statistics. Economic models were utilized to estimate the financial impact of implementing smart city concepts and their effects on urban community budgets. These research methods aided in comprehending crucial facets of smart cities and their influence on residents' quality of life. The results of the study may be useful for representatives of city governments implementing initiatives aimed at strengthening the innovation potential of cities and improving the quality of life of citizens

Keywords: digital transformation, innovative development of territories, impact of digitalisation, urban infrastructure, sustainable urban development, urban management

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● INTRODUCTION

In the current context of the implementation of technologies and digital innovations, the relevance of implementing Smart City programmes has become an objective condition for sustainable development. The evolution of cities towards "smart" opens up new opportunities for optimising the urban environment, providing efficient infrastructure, improving the quality of life of residents and achieving sustainable long-term development. However, the effective implementation of smart city concepts requires a clear understanding of the current state and experience of implementing such programmes, which is impossible without a thorough analysis. The objective realities of the functioning of cities in the context of the formation of a digital society, the increasing level of digitalisation of all socio-economic processes implemented in the life of modern cities, determine the relevance of the topic of the article.

The experience of urban digitalisation is an integral part of the modern world, and smart city concepts have

become key development areas for many national economies and urban communities. Expenditures on innovative development and urban digitalisation are not only socio-economic, but also strategic issues for governments and municipalities in their efforts to improve the quality of life of city residents. The modern discourse on smart cities and their impact on the development of society is reflected in the works of leading researchers and scholars who study these issues in the context of multi-functional components. Authors such as L. Mora [1] explore the technological innovations used to create smart cities and their impact on the development of urban areas. The research analysis and forecasting of the development of smart cities by Ukrainian scientists is also reflected in the work of V. Dubnytskyi [2] who considers the prospects for the introduction of digital technologies in urban management and discusses their possible challenges.

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Further research by R.N. Pagani [3] highlights how smart city concepts aim to achieve sustainable development in line with the UN Sustainable Development Goals. A. Pozdniakova [4] explores the existing experience and opportunities for smart city implementation in the Ukrainian context. T. Pushkar [5] states that the digital transformation of society in the 21st century impacts the development and functioning of the modern city by shifting many social and economic processes into the virtual environment and actively altering approaches to the use of information technologies in various aspects of urban life. As part of the latest research and scientific publications related to the digitalisation of cities and the implementation of smart city concepts, attention should be paid to the study by A. Barton [6] in which the author analyses the impact of technological innovations on the development of smart cities and highlights the challenges associated with this process. C. Bremser [7] examines the experiences of early adopters of the smart city concept and the conclusions drawn from them regarding the success of such initiatives. The characteristics of smart cities and the impact of technology on the development of urban areas are discussed by R. Lutsiv [8].

The above-mentioned research papers help to clarify the state and development of smart city concepts at both international and national levels, and also indicate the relevance of studying these issues to achieve sustainable development of modern cities and improve the quality of life of their inhabitants. The aim of the study was a thorough analysis of the prerequisites for the implementation of smart city concepts in Ukraine, a review of international experience in this area, and the identification of prospects for implementation to improve the quality of life of city residents. The objectives of the study include: identification of the theoretical aspects of smart cities and their role in modern society, including the analysis of the conditions for the implementation of these concepts in Ukraine and international experience; the study of financing and budgeting of innovative development in cities and the impact of these initiatives on the quality of life of the population; the forecast of development of smart cities in Ukraine and identification of potential challenges and prospects.

● MATERIALS AND METHODS

The research materials and methods incorporated various techniques to enhance the comprehension of smart cities and their influence on life quality. General approach of this study encompassed scrutinizing scientific publications spanning the most recent 3-5 years, including contributions from distinguished researchers in this domain. This examination enabled to trace emerging paradigms and novel strategies in the arena of smart cities and digital transformation. A comprehensive analysis of scientific publications on smart city concepts was conducted by using the analysis method. This proved critical in comprehending the nature and potential of smart cities in today's society. This analysis of academic literature provided a theoretical basis for future research.

The study is based on the use of modern methods of data collection and analysis, including Big Data. A significant quantity of data was acquired during the research, and the use of Big Data enabled a vast amount of material to be processed. This method of data analysis gave

an opportunity to identify key trends and patterns in the development of smart cities based on specific data and detailed statistical information. Using modern data processing methods and statistical tools, it was possible to process and analyse large amounts of information. This approach allowed to gain a deeper understanding of the dynamics of urban development and identify significant patterns that affect their viability and innovation potential. Modelling methodologies were utilised in this study to develop models assisting in the analysis of a substantial quantity of data and predicting possible scenarios for the development of smart cities in Ukraine. The high-level economic modelling was used to provide an objective assessment of the financial implications of implementing smart city concepts and their impact on the budgets of urban communities. This study used the MIRM model (Model of Integrated Smart City Development). It was designed to forecast and analyze the development of smart cities in Ukraine, taking into account various aspects, including technological, environmental, social and economic dimensions. Key parameters and variables of the model were:

1. Demographic data: Number of inhabitants, age structure of the population, population growth.
2. Transportation infrastructure: Road network, public transportation, road conditions.
3. Energy efficiency: Use of alternative energy sources, electricity and gas consumption.
4. Social services: Access to education, health care, cultural and recreational services.
5. Economic factors: GDP per capita, unemployment rate, investment in infrastructure.

These model parameters were then used to create a survey and predict the feasibility of implementing the smart cities concept. To determine the attitudes of city residents and gain insights from experts in the field of urban digitalisation, a survey was conducted concerning various aspects of digital development in the city of Kharkiv. The survey among Kharkiv residents was conducted online using Google Forms. This method allowed for a wide range of participants and ensured the confidentiality of responses. The survey among residents was anonymous to encourage the free expression of opinions and respondent safety. The total number of surveyed city residents was 1000 individuals to ensure a representative sample and a wide range of perspectives. The survey among experts in the field of urban digitalisation was also conducted through Google Forms and was anonymous to facilitate candid expression of expert opinions. The total number of surveyed experts was 36 individuals, selected to ensure diversity of perspectives and in-depth analysis.

For city residents, two surveys were proposed (each with 15 questions), which collected information on personal data (age, education, employment, social status), attitudes towards the city's digitalisation process, and opinions on potential directions for urban digitalisation not yet present in Ukraine. The most important questions for city residents were: How do you assess the overall level of digital transformation and the development of digital technologies in Kharkiv? What is your stance on the introduction of electric vehicles and charging stations in the city as a part of digital mobility? Do you support initiatives for the implementation of digital solutions in the fields of

education, innovation, and civic participation? How do you assess the importance of digital civic participation for improving the quality of life and environmental sustainability in the city? What are the most important directions for the digitalisation of Kharkiv in your view for its future development?

For experts in the field of urban digitalisation, a single survey was proposed, containing 20 questions, with the most important being: What opportunities and challenges do you see in global urban digitalisation trends and how do they affect the city of Kharkiv? Which specific measures or projects in the field of urban digitalisation can improve the infrastructure of Kharkiv? How do you evaluate the level of preparedness of local authorities in Kharkiv for the implementation of digital solutions? What limitations or challenges exist for the implementation of digital technologies in Kharkiv? Which digital initiatives or solutions that do not yet exist in Ukraine do you consider the most promising for Kharkiv, taking into account its current needs and opportunities?

The survey of city residents allowed to understand the population's attitude towards innovative development and digital transformation in urban environments. The study also included interviews with experts in various fields, including urbanism, economics, and innovation development. These interviews provided context and expert opinion on the opportunities and challenges of smart cities in Ukraine. All participants in the survey were informed of how their anonymity would be guaranteed, why the survey was being conducted, how the information they provided would be used and the risks involved. The research followed the regulations of the Declaration of Helsinki [9].

Modelling various scenarios enabled to comprehend the necessary costs and investments to achieve desired outcomes in the smart city development. The financial flows and economic indicators related to smart city projects implementation were scrutinized. By adopting this strategy, the effectiveness and sustainability of implementing innovations in cities were determined and their contribution to the overall economic development of the regions was evaluated. The combination of research methods, comprising both general and special approaches, facilitated a comprehensive and impartial examination of smart cities and their prospective effect on the quality of life in Ukraine.

● RESULTS AND DISCUSSION

Technological development and its impact on the urban environment, the emergence of digital society as an objective process are key prerequisites for the emergence and implementation of smart city concepts in Ukraine. The growing number of people living in cities leads to an increased burden on urban infrastructure, which threatens the comfort and quality of life of residents. However, modern technologies, especially digital ones, make it possible to develop and implement innovative solutions to improve

urban management and ensure more efficient use of urban resources [10].

Sensor networks, the Internet of Things (IoT) and Big Data analytics make it possible to monitor various areas of urban life, from traffic and urban transport to air quality. This allows for a timely response to problematic issues and the implementation of effective solutions in urban management. Such innovations help to reduce congestion, improve road safety, reduce harmful emissions, including decarbonisation in cities, improve public safety and optimise energy use [11]. However, it is important to consider the environmental impact of technological development. A large number of sensors and IoT devices can lead to increased energy consumption and the accumulation of e-waste, which, along with solving existing urban problems, creates new ones. Therefore, to ensure sustainable urban development, it is necessary to consider effective ways to reduce the negative impact on the environment and promote the transition to renewable energy sources, and in the long term, to create a sustainable system to mitigate the new risks arising from digitalisation. The coordinated combination of technological innovations, taking into account the needs and well-being of the city's inhabitants, is the basis for creating smart cities, where integrated technology contributes to improving the quality of life and implementing sustainable development based on new solutions.

An analysis of international experience in implementing smart city concepts shows that innovative approaches to ensuring sustainable urban development are spreading [12]. Many cities around the world that are already successfully implementing these concepts are trying to balance technological development with the needs of citizens and the environment, and are actively using operational data and information technology to improve the management of urban resources and services. Sustainability, efficiency and improved quality of life are the top priorities in implementing these concepts. Reducing environmental impact and ensuring energy efficiency is a key goal of digitalisation for most cities. IoT technologies, sensor networks and data analytics help to use resources efficiently and reduce environmental impact, particularly by addressing the challenges of decarbonisation in cities. The introduction of technology helps to reduce congestion, ensure road safety and make public transport more convenient.

There is currently a wide range of projects and programmes aimed at implementing smart city concepts, demonstrating their relevance and promise. Cities are using these ideas to attract investment and talent, and to improve the lives of their citizens. At the same time, each city takes into account its specific conditions and needs, and adapts smart city concepts to its needs. An analysis of international experience in implementing smart city concepts identifies a number of cities and countries where innovative approaches to urban development have already been successfully implemented (Table 1).

Table 3. Smart city initiatives worldwide

Cities and countries	Smart city programs and projects
Singapore	This country is an example of the synergy between technology and infrastructure. Singapore uses sensors to monitor traffic, air and water quality, and implements solutions for efficient energy use.
Tokyo, Japan	Technologies are actively used to manage public transport schedules, decarbonise and optimise energy consumption.

Table 1, Continued

Cities and countries	Smart city programs and projects
Copenhagen, Denmark	The city is known for its sustainability initiatives, including the use of bicycles and solidarity between citizens.
Barcelona, Spain	By implementing smart city solutions, Barcelona has improved its water and electricity management and reduced energy consumption.
New York, USA	Through the NYC Open Data programme, the city provides citizens with access to data on various aspects of city life, contributing to more effective decision-making.
Shenzhen, China	The city is known for its extensive use of technology for traffic management, green initiatives and the creation of innovative districts.
Toronto, Canada	In partnership with Sidewalk Labs, Toronto is working to develop a smart neighbourhood that introduces new technologies and concepts.
Seoul, South Korea	Using IoT technologies and smart public transport, Seoul aims to make the city more accessible and convenient for residents.
Dubai, United Arab Emirates	Dubai is using a variety of technologies to enhance public safety, develop smart buildings and improve urban infrastructure.
Hong Kong, China	The city is actively using a network of sensors to monitor air quality and manage water consumption.
London, UK	Data collection and analysis programmes are being used to ensure the efficiency of public transport and other city services.
Sydney, Australia	The city is actively implementing smart water and waste management systems.
Stockholm, Sweden	Stockholm is implementing remote control systems for lighting and transport to reduce emissions and improve energy efficiency.
Melbourne, Australia	The city is using data to reduce traffic congestion, improve access to public transport and develop cycling infrastructure.
Amsterdam, Netherlands	Amsterdam is focusing on creating smart neighbourhoods where innovative technologies and solutions are implemented.

Source: developed by the authors based on the data of [1; 3; 13]

Summarising the international experience of successful city digitalisation programmes, the concept of smart cities is becoming increasingly popular as it promotes a harmonious combination of technological development, effective management and improved quality of life for residents [14]. Ukraine is actively implementing the concept of smart cities, focusing on key aspects that contribute to sustainable development. Technological infrastructure and digital initiatives play an important role in the implementation of this concept. The collection, analysis and use of data allow to respond to the needs of citizens and optimise the allocation of resources [15]. The focus on energy efficiency and green infrastructure indicates a desire to reduce environmental impact and use resources efficiently. The development of public transport and congestion reduction reveals a pragmatic approach to mobility, improving urban transport and reducing CO₂ emissions.

This study comprised interviews with experts and a survey of city residents. The experts were questioned about their views on the significance and potential of incorporating the smart cities concept in Ukraine, as well as potential hurdles and recommendations for the growth of these endeavours. The survey of city residents was designed to determine their awareness of smart cities, the level of support for such initiatives, and to get their feedback on existing and planned projects in their cities. To provide a more detailed understanding of the survey results, the distribution of results obtained in both the survey among residents and the survey among experts should be examined. These findings illuminate the attitudes and opinions regarding the concept of smart cities in Ukraine.

Survey among residents: the total number of 1000 residents of Kharkiv participated in the survey, representing a diverse part of the city's population. The results showed a noticeable consensus on several key aspects: a positive attitude towards the concept of smart cities (approximately

85% of respondents), interest in the implementation of electric vehicles and charging stations (over 70% of residents), support for initiatives related to the implementation of digital solutions in education, innovation, and civic participation (approximately 65%), and the importance of digital civic participation in improving the ecological sustainability of the city (over 75%). Residents also highlighted the directions they consider most important for the digitalisation of Kharkiv, such as improving digital education, developing smart mobility, and enhancing waste management systems.

Expert survey: a total of 36 experts in the field of urban digitalisation shared their valuable insights, providing a nuanced perspective on this topic. Their responses were as follows: recognition of the importance of global trends (almost 90% of experts), emphasis on the importance of specific measures to improve the city's infrastructure (approximately 80% of experts), recognition of the importance of preparing local authorities for the implementation of digital solutions (80%), identification of limitations and challenges related to the implementation of digital technologies in Kharkiv, and identification of initiatives and solutions that do not yet exist in Ukraine, highlighting the most promising ones for Kharkiv.

The results of interviews and surveys show that there is widespread support among experts and residents of Ukraine for initiatives on the implementation of the smart cities concept. Most experts consider this idea important for the country's development and support its implementation. Respondents also expressed a positive attitude towards smart cities and a desire to learn more about the concept and take part in its development. The results of the interviews and surveys indicate the significance of engaging both the public and experts in the decision-making process for smart cities. This highlights the necessity for additional research and development of such initiatives in Ukraine.

An important aspect of implementing the approach is involving the city's residents and taking their needs into account. Involving the public in decision-making and priority setting ensures a strong social impact and support for initiatives. The attractiveness of smart cities for businesses and investors is a testament to their effectiveness and prospects. Transparency of governance and service delivery, openness of data and access to information are components that contribute to citizens' trust in

the implementation of smart solutions. Partnerships between government, the private sector and the public are a key benefit of implementing the smart city concept. It facilitates the exchange of knowledge and resources, creating favourable conditions for innovation and development [16]. Table 2 shows the key aspects of smart cities in Ukraine reflecting important aspects and priorities that should be taken into account when implementing smart city concepts in the country.

Table 2. The key aspects of smart cities in Ukraine

The key aspects of smart cities in Ukraine	Aspects description
Digital infrastructure	The development of digital infrastructure is one of the main prerequisites for creating smart cities. This includes high-speed internet, sensors, IoT platforms and other technologies.
Data management	Appropriate data collection, analysis and use allow cities to make informed decisions about the management of resources, services and infrastructure.
Energy efficiency	An important aspect in smart cities that reduces energy consumption and negative environmental impact.
Transport optimisation	The use of technology to improve public transport, reduce congestion and promote electric mobility contributes to a more sustainable urban environment.
Smart infrastructure	The introduction of intelligent systems for managing buildings, roads, lighting and other infrastructure ensures efficient use of resources.
Public safety	Video surveillance technologies, notification and emergency response systems help ensure the safety of residents.
Citizen participation	The importance of involving the public in decision-making and planning for city development.
Environmental sustainability	Implementation of green technologies, waste management and promotion of ecological development of the city.
Innovation	Creating a favourable environment for the development of start-ups and innovative projects.
Transformation of urban governance	Introduction of e-governance and other tools for effective city management.
Development of "smart" services	Implementation of online services that facilitate the receipt of various services by citizens.
Stimulating business innovation	Involving the private sector in the creation and implementation of technologies in cities.
Ensuring access to information	Implementation of "open data" to increase transparency and accessibility of information.
Social inclusion	Taking into account the needs and capabilities of different social groups to ensure equal opportunities.
E-education	The use of technology to provide quality and accessible education.
Transport integration	Development of a unified system of payment and coordination of public and private transport.
E-health	Implementation of electronic medical services and systems to improve healthcare.
Development of "smart" areas	Implementation of the concept of "smart" neighbourhoods with optimised infrastructure and services.
Communication and information security	Ensuring protection against cyber-attacks and providing secure means of communication.
Democracy and transparency	Open dialogue and transparency in decision-making, including online consultations and public debates.

Source: developed by the authors based on [17-19]

Thus, Ukrainian cities are using different principles to implement the smart city concept, combining them into a comprehensive strategy for sustainable development. Financing and budgeting for innovative development is an important component of ensuring sustainable growth and implementing innovative ideas. Effective allocation of resources for research and development enables the creation of innovative products and services. Government support and investment in the innovation sector is key to creating a competitive economic environment. Partnerships between government, academic institutions and the private sector create a favourable arena for joint investment in research and development. The development of financial instruments, such as grants, loans and start-up accelerators, helps to raise capital for young innovative companies. In addition, the creation of innovation funds and specialised investment pools helps to finance promising projects [20-21].

Diversification of funding sources, including public, private and international capital, ensures the sustainability of the innovation process and makes it less dependent on economic fluctuations. Establishing effective mechanisms for evaluating and selecting projects for funding helps to direct resources to the most promising areas. Support for innovation development also includes tax breaks and incentives for companies engaged in research and development, which help to attract private investment in this area. The development of long-term investment strategies helps to plan the development of the innovation sector for decades to come. Effective financing and budgeting of innovation development are critical factors for ensuring sustainable economic growth and maintaining competitiveness in the global market environment [22]. The data demonstrate important aspects of budget allocation and resource allocation for innovation development in the

Ukrainian cities. Analysing the structure of expenditures, it can be seen that the Economic Activity function plays a key role in financing innovative projects, increasing the volume of expenditures from UAH 81.9 billion in 2019 to UAH 93.9 billion in 2020 [22]. This demonstrates the importance of stimulating economic growth and technological development to support innovation initiatives. It should be noted that spending on Education and Spiritual and Physical Development increased from UAH 187.1 billion in 2019 to UAH 199.4 billion in 2020 [22]. This demonstrates the growing attention and understanding of the importance of investing in the development of educational and cultural initiatives that can contribute to the innovative potential of cities. The significant decline in expenditures on "Health care" from UAH 89.8 bn to UAH 50.9 bn in 2020 may indicate a temporary reallocation of resources due to the COVID-19 pandemic. The decrease in spending on "Social Protection and Social Security" from UAH 103.2 billion to UAH 24.0 billion in 2020 may have a significant impact on the level of digitalisation of cities and the implementation of the smart city concept [22].

Reduced funding in this area could lead to a reduction in resources that could be spent on infrastructure development, technological innovation and digitalisation of cities. In particular, this could affect the implementation of smart city management systems, e-services for citizens and support for technology start-ups. Gradual digitalisation and introduction of innovations require adequate funding to build infrastructure, train specialists and develop and implement technologies. Reductions in social protection budget may lead to insufficient support for initiatives aimed at building information society and creating smart solutions for citizens. Potentially, this could lead to insufficient resources being allocated to innovative projects and development of smart city infrastructure being limited. It may also affect the level of accessibility and quality of services for city residents. In summary, cuts in funding for social protection and social welfare may limit the opportunities for innovation and digitalisation of cities, as well as affect the quality of life of citizens and their access to modern technologies.

The existing system of allocating funds from local budgets in the areas of economic activity, education, mental and physical development, healthcare, social protection and social security has a significant impact on the possibility of implementing the Smart Cities concept in Ukraine. Allocating resources for economic development helps to create technological initiatives and innovative solutions that can form the basis of smart cities. Funding for education supports the creation of human resources for digital transformation and innovation. Money invested in mental and physical development helps create a favourable environment for the growth of innovation and creative solutions. However, reduced funding for healthcare could limit the availability of medical technologies and important infrastructure changes. Reductions in social protection and welfare spending could undermine social stability and a favourable climate for innovation. It is important to ensure a balance of spending between these areas, as this will determine the level of readiness of cities to become 'smart' and implement advanced technologies. The optimal allocation of resources to education, health and social

protection can ensure the implementation of the smart cities concept in Ukraine and improve the quality of life of residents. Therefore, changes are needed in the financing of innovative development in Ukrainian cities, emphasising the importance of economic activity, education, cultural development and social protection in the context of creating a favourable environment for innovation and improving the quality of life of residents.

Smart cities contribute to improving environmental sustainability by reducing pollutant emissions and using resources efficiently, which contributes to the health of residents and the development of a sustainable urban environment. Implementing innovative mobility solutions can reduce traffic congestion and improve public transport, allowing residents to save time and make the city more accessible. The creation of smart infrastructures, such as smart buildings and energy systems, contributes to the efficient use of resources and reduces energy costs, which is reflected in citizens' bills and contributes to the economic growth of the city, while data monitoring and analysis systems help to identify and respond to problems, such as air pollution, in a timely manner, which has a positive impact on the health of residents [23].

Ensuring accessibility of healthcare services can greatly facilitate access to quality medical care and save lives, while the development of digital platforms and e-services contributes to the convenience and efficiency of interaction between residents and authorities, allowing them to resolve issues online and save time. The creation of innovative spaces and start-up ecosystems promotes entrepreneurship and technology start-ups, which contribute to the economic growth and creative development of the city. Encouraging citizen participation in the development and implementation of smart initiatives helps to create a sense of community and ownership of the city's development, which increases life satisfaction.

Predicting the development of smart cities in Ukraine requires a comprehensive approach to analysing and forecasting technological, social and economic changes in the urban environment. The growing urban population and the need to improve the quality of life make smart cities an attractive prospect for creating innovative solutions. However, it is important to keep in mind that accelerated digitalisation can cause imbalances in the development of different areas, so strategies need to be developed to help integrate technological and social change.

Obstacles to the implementation of smart city concepts include a lack of coordination between public authorities, a lack of standards for interoperability of different technologies, and issues related to privacy and data confidentiality. The need for investment in infrastructure and innovation requires new sources of funding and creation of a favourable investment climate. Possible ways to overcome these obstacles include the creation of specialised technology platforms for sharing experience and cooperation, and the implementation of security and privacy standards to protect the interests of citizens. It is necessary to develop education and training systems for the introduction of new technologies and to define mechanisms for interaction between universities, business structures and public authorities. It is important to ensure that the public is involved in the development and implementation of

smart initiatives, and to guarantee their participation and influence on decision-making. Building international partnerships and sharing experiences with countries that have already successfully implemented the smart city concept can be a valuable resource for avoiding mistakes and implementing best practices.

It is important to set priorities for smart city development for each specific location, taking into account its potential, features and the needs of its inhabitants. Ensuring cyber security and protection against cyber threats requires the development of effective strategies and solutions to prevent and respond to potential threats. Optimisation of data collected as part of a smart city can help solve complex social and economic problems, including traffic management, energy efficiency and others. The development of innovative city management methods, such as smart algorithms and forecasting systems, can help optimise resources and improve the lives of residents. Ensuring that technologies and digital solutions are accessible to all sections of the population is aimed at preventing the digital divide and ensuring equal opportunities for all residents. Creating an ecosystem of innovation and collaboration between the community, businesses and government can help solve complex challenges and implement the latest ideas, which include addressing ethical and legal issues related to the collection, storage and use of personal data of city residents, ensuring their privacy and data protection.

Recent studies have emphasized the importance of research aimed at understanding the development of smart cities and their impact on modern society. Well-known scholars such as K. Schwab [24] and S. Joss [25] have examined these aspects from different angles. K. Schwab [24] in his work explores the relationship between technological innovation and urban transformation, providing important guidance for the implementation of smart city concepts. S. Joss' paper [25] offers an analysis of the smart city concept in different countries, exploring the factors that determine its success. The study by G.S. Yigzaw [26] demonstrates the significance of participatory governance in addressing socio-economic issues and realizing sustainable development objectives in the 21st century. This innovative governance approach leverages the collaboration of public agencies, private enterprises, non-governmental organizations, and international public organizations to cultivate trust in government, tackle social obstacles, foster economic prosperity, and revolutionize institutions, particularly in the context of smart urban development. G. Bel [27] highlights the contribution of infrastructure in creating an enabling environment for smart cities. Research by R. Cowley [13] examines the interaction of smart cities with different social groups. J. Ruso [28] studied the impact of international standards on the progress of smart and sustainable cities in different regions, identifying a significant disparity and demonstrating the constructive influence of these standards on their growth. The trend toward smart cities, championed by corporate, political and professional interests was observed in the study by K.R. Kunzmann [29]. This research reveals that cities have evolved into major centers for the formulation and implementation of ideas. Nevertheless, this trend poses a host of social and economic obstacles that demand additional investigation.

To summarize, the reviewed studies acknowledge the crucial role of technological advances in creating and implementing smart city models. The authors emphasize that integrating contemporary solutions, such as IoT (Internet of Things), sensor networks, and other innovations, can enhance urban administration, mitigate harmful environmental effects, and elevate residents' living standards. This viewpoint is shared by a majority of the authors, and the author of this research concurs. On the other hand, the authors emphasize the significance of intergroup interaction in smart cities. They analyze the effects of technological advancements on diverse social groups and their involvement in formulating smart city models. Also most authors point to the importance of public participation and interaction between different sectors (public, private, and civil society) in creating an enabling environment for innovation and the development of smart cities. They emphasize the importance of data openness, access to information, and public engagement. However, it is important to note certain challenges and contradictions, including budgetary constraints and the necessity of balancing resources across various sectors. Additionally, it is crucial to conduct meticulous monitoring and analysis of the social and spatial impacts of smart city concepts.

These papers represent important contributions to the field of smart cities and their impact on modern society. They demonstrate the multifaceted nature of this topic and examine it from different perspectives, providing the basis for further discussion and research in this area. Their findings are of great value in understanding the nature of smart city concepts and ways to implement them. In addition, these works reveal key aspects and factors that determine the success of the smart city concept in different contexts. This provides an opportunity to better understand the nature and potential of urban development in the digital age, as noted by V. Polishchuk [30]. The researchers consider important aspects such as technological innovation, city management, infrastructure, and interaction with different groups of society. In this way, the researchers' work reflects the current state and prospects for the development of smart cities. Their contributions are important for the analysis and understanding of this current trend in architecture and urban management. The future of smart cities lies in the development of global collaborative networks, the creation of sustainable ecosystems, and the implementation of innovations that contribute to sustainable development and improve the quality of life for residents. This study highlights the significance of effective allocation of budgetary resources to promote innovation and urban development in Ukraine. Furthermore, it stresses the importance of maintaining a balance of resources across various sectors, including the economy, education, healthcare, and social protection, thus complementing other studies.

● CONCLUSIONS

This article examines the current state and prospects for the development of smart city concepts in Ukraine and abroad. Analysing the results of researches of leading scientists and researchers in this field, it can be determined that smart cities are becoming an important component of global processes of digital transformation and development of modern urban environments. Technological

advancements drive Ukraine's smart cities, focusing on sustainability, innovation, and community engagement. IoT and sensor networks optimize urban management, reduce environmental impact, and improve residents' lives. The nation emphasizes environmental responsibility, resource efficiency, and enhanced mobility. Transparency, data access, and collaboration among government, the private sector, and the public foster innovation and trust. International experience highlights the importance of aligning technology with residents' needs. Ukraine actively promotes sustainable, innovative development through digital initiatives and infrastructure improvement, positioning itself as a forward-thinking smart city pioneer.

The paper's analysis suggests the significance of allocating budgetary resources to aid the innovative development of cities in Ukraine. The rise in spending in the Economic Activity, Education, and Spiritual and Physical Development sectors indicates a favourable trend in

funding spheres that facilitate technological development and innovation. However, the decrease in expenditure on Health Care and Social Protection warrants consideration, as it may impact the calibre of healthcare services, the degree of social protection, and the innovation potential of cities. It is crucial to balance resources between these sectors to foster smart cities and enhance residents' quality of life. Thus, it is essential to ensure optimal allocation of budgetary resources to support innovation and urban development in Ukraine, considering crucial sectors like the economy, education, healthcare, and social welfare. This measure would aid in creating intelligent cities and lead to an overall enhancement of citizen's quality of life. Further research in this field could concentrate on investigating the mechanisms for financing innovative development, establishing successful strategies for implementing technological solutions in urban areas, and evaluating the social consequences of these advancements on residents.

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Розумні міста в Україні: передумови, міжнародний досвід та перспективи для покращення якості життя

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Анотація. Проблема створення розумних міст в Україні є актуальною у зв'язку зі зростаючою потребою у впровадженні інноваційних підходів до покращення якості життя населення та створення сталого міського розвитку. Метою дослідження було проведення аналізу можливості впровадження концепцій розумних міст в Україні на основі вивчення аналогічного досвіду провідних міст світу задля забезпечення високої якості життя населення. Результати цього дослідження підтверджують, що розумні міста є важливою складовою цифрової трансформації та стали ключовим елементом розвитку сучасних міських середовищ. Аналіз наукових публікацій та якісні інтерв'ю з експертами у сфері урбаністики, економіки та інноваційного розвитку дозволили визначити перспективи розумних міст в Україні та світі, а також надали об'єктивний висновок щодо сучасного стану та перспектив розумних міст. За допомогою анкетування та опитування була зібрана важлива інформація від мешканців міст щодо їхнього ставлення до розумних міст та їхніх очікувань. Аналіз великих даних надав можливість виявити тенденції та патерни у розвитку розумних міст на основі конкретних даних та статистики. Економічні моделі були використані для оцінки фінансового впливу впровадження концепцій розумних міст та їхнього відображення на бюджетах міських громад. Ці методи дослідження допомогли зрозуміти важливі аспекти розумних міст і їхній вплив на якість життя мешканців. Результати дослідження можуть бути корисними для вчених, практиків та представників управлінських структур міст, які реалізують ініціативи, що спрямовані на зміцнення інноваційного потенціалу міст та покращення якості життя громадян

Ключові слова: цифрова трансформація, інноваційний розвиток територій, вплив цифровизації, міська інфраструктура, сталий міський розвиток, урбаністичне управління