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DEVELOPMENT OF ELECTRONIC SERVICES OF THE SMART CITY

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The article is devoted to the consideration of modern aspects of smart city development. It is noted that such development contributes to ensuring the efficient functioning of cities to effectively meet the needs of their residents. A smart city is an innovative system that uses sensors, the Internet of Things (IoT), big data, and electronic services to increase the competitiveness and efficiency of urban services. It is established that sustainable development of a modern smart city should take into account economic, social and environmental aspects. The authors propose to use the classification of smart services in Zaporizhzhia in such areas as administrative and social services, health and medicine, cultural and entertainment services, socio-economic services, housing and communal services, and transport. The strategic directions of Zaporizhzhia's smart development are considered. The development strategy of Zaporizhzhia until 2028 envisages the development of a healthy environment and resource conservation, promotion of entrepreneurship and the creative economy, improvement of the quality of life of the population, and elimination of the harmful effects of hostilities. It is determined that the key tasks of the «smart city» for Zaporizhzhia are to increase the share of waste recycling, reduce air pollution in the city, and reduce the use of water resources by industrial enterprises. Entrepreneurship and the creative economy involve the development of processing enterprises and logistics with a low technogenic impact on the environment, reduction of emissions and introduction of the latest green technologies. To develop the creative economy in Zaporizhzhia, the authors propose the gradual commercialization of science, art projects and festivals, the increase in coworking spaces, and the popularization of IT technologies. The authors propose to expand the list of electronic services of the «smart city». This will help speed up management decision-making, save budget funds, and improve the provision of various services for individuals and legal entities.

Keywords: smart city, competitiveness, development, efficiency, electronic services.

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Formulation of the problem

The post-war reconstruction of Ukrainian cities should take into account the positive and negative experience of smart city development. Urban reconstruction in Ukraine should contribute to a steady increase in the quality of services for the population. This requires studying and planning the development of urban infrastructure and its interaction with the environment. Smart city technologies can efficiently collect and process information in real time, make more efficient use of available resources, and provide quality public services. The smart city concept uses information technology to develop urban infrastructure. The total urban population is growing steadily around the world. This confirms the relevance and necessity of researching the problems of smart city development.

Analysis and research of publications

The issue of smart city has been studied by scientists Tymoshevska I.P., Dmytrenko V.I.,

Muzhanova T.M., Chukut S.A., Yershova O.L., Bazhan L.I., etc. [1-7]. In order to improve the quality of life, safety, introduction of green energy and economic growth, cities in Ukraine and the world are implementing projects related to the smart city concept. The concept of Smart cities in scientific publications is associated with current trends in the implementation of urban development strategies. The authors consider the issues based on the Zaporizhzhia City Development Strategy until 2028 [6].

The purpose of the article

The purpose of the article is to highlight the current aspects of the development of smart cities, to actualize modern components, in particular, electronic services of the smart city on the example of the city of Zaporizhzhia. The authors set out to actualize electronic smart services for individuals and legal entities in Zaporizhzhia by areas.

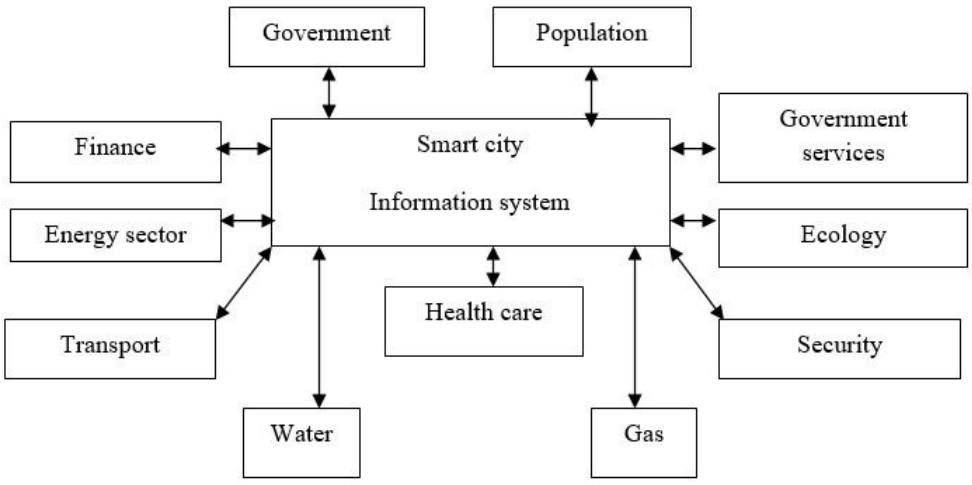
Presentation of the main research material

A smart city is a concept based on a city with a variety of information technologies to meet the needs of its residents. Information technologies allow for 24/7 use of resources based on the principles of sustainable development. Smart city infrastructure includes physical and digital infrastructure. Physical infrastructure includes transportation, energy, water, telecommunications, and waste. The digital infrastructure includes sensors, the Internet of Things (IoT), networks, and big data. It can be argued that a smart city may include the following components:

– smart GRID;
– cloud computing;
– WEB-connection;
– energy-efficient and energy-saving technologies;
– alternative energy technologies (wind, sun, water, etc.);
– use of water resources;
– intelligent transportation systems;
– health care, consumer services;
– intelligent water distribution systems;
– intelligent gas pipelines;
– intelligent waste logistics management systems;
– intelligent public safety and video surveillance;
– "smart buildings".

The concept of a smart city includes the use of information technology for the efficient operation of infrastructure. The main goal of such a city is to use the city's resources productively through constant monitoring of information. This helps to save community budgets and provide quality services. Modern cities are the basis for further technological and social innovations. A city's infrastructure determines its attractiveness to qualified professionals and investors. This increases the competitiveness of cities. The urgent task of smart cities is to combine comfort and social attractiveness for citizens. This is due to the developed infrastructure, environmental safety and rapid development of smart technologies. Big cities are the centers of civilization development. Smart cities are a modern model of interaction between information technologies to solve the problems of the management system and create conditions for the development of the community and each person. The development of smart cities increases the competitiveness of the region, transport, resources and IT, the quality of life of the population, and the realization of the right of citizens to manage the city. Figure shows a multi-component model of a smart city.

The smart city concept uses information technology to meet the needs of individuals and legal



Multi-component model of a smart city [4]

Table 1

Key components of smart city

Components of the smart city	Description of key parameters
Smart Buildings	It involves the creation or arrangement of separate buildings that accumulate all engineering and information systems and are integrated into a single management system (BMS - building management system). The system allows, for example, to heat the building at the right time of the day depending on the number of people in the premises, to regulate the power of ventilation units and air purity. It is also possible to automatically switch to energy saving mode when there are no people in the room
Smart Economy	It includes actions aimed at transforming and strengthening the municipality's economy. The use of (digital) technologies and intelligent approaches leads to economic prosperity. This in turn creates stable and favorable conditions for all stakeholders. Smart economic development is an important tool for actively seizing opportunities and providing conditions conducive to business creation and growth, as well as new jobs
Smart Energy	Provides a range of solutions in the areas of energy supply and energy saving (demand management, energy efficiency and renewable energy integration programs)
Smart Environment	It includes the management of municipal authorities to improve the living conditions of citizens and visitors. The use of new technologies and innovative methodologies facilitates regulatory and cultural change. These changes promote the implementation of sustainable standards and practices. Reducing waste generation, monitoring and managing pollution, reducing emissions, managing water resources, achieving energy efficiency, and accelerating the local energy transition are some of the important goals of smart environment initiatives. New urban planning standards to improve efficiency and minimize environmental impacts, as well as create sustainable communities are further goals
Smart Government:	It includes the use of information technology to provide public services to a wide range of people and allows optimizing the work of various departments
Smart Living	It includes improving the quality of life for residents and visitors by applying an inclusive strategic approach for all age and demographic groups. Promoting livability and optimizing the management of the built environment are two aspects to maximize the benefits for municipal authorities and stakeholders. Smart Living focuses on improving social and digital inclusion (e.g., use of e-services, connectivity, and social platforms), on improving health and elderly care (e.g., eHealth, Ambient Assisted Living), on safety, living conditions, and smart buildings. New methodologies of civic and social engagement, as well as new technologies (e.g. WiFi based IoT or LPWA network technology) are used to improve accessibility and citizen experience in all priority areas
Smart Mobility	It focuses on improving the efficiency and quality of urban transport services to increase the use and adoption of new mobility solutions, and on increasing people's mobility through effective mobility management and targeted infrastructure investments. Achieving cheaper, faster, and more environmentally friendly mobility, as well as integrated multimodal transportation, is an important challenge for cities and communities. Supporting the combination of different modes of public and private transport, as well as the introduction of new modes of transport (e.g. electric vehicles, hydrogen-powered vehicles, autonomous vehicles, bicycle sharing, car sharing) is an important aspect of a strategic approach to the development of future-oriented smart mobility. A customer-oriented and inclusive approach for all citizens, businesses and visitors is necessary to achieve high quality mobility services. Ultimately, this improves the flow of people and goods in a city or community, while reducing the environmental impact
Smart People	It includes transforming the way citizens interact with the public and private sector through information or service delivery. Creating social and digital inclusion/digital equality through educational offerings is an important prerequisite for more efficient delivery of information and services based on new technologies. "Smart people are smart forms of education that facilitate career choices, labor market opportunities, vocational training, and lifelong learning for all ages and demographics. Talent development is also an important aspect from an economic development perspective, as it is becoming an increasingly important location factor. Smart People solutions support the creation of an accessible and inclusive environment to increase prosperity and innovation in a city or community. Participation, openness, and creativity are some of the aspects that are supported or developed through the implementation of smart solutions
Smart Transportation	It involves the creation of a system of intelligent transportation and logistics systems that monitor and manage traffic, control the payment of road tolls, respond to emergencies, and control traffic lights. This area usually also includes intelligent parking and notification services at public transport stops
Smart Water	This includes water management (modernization of water systems, monitoring of water consumption by sector, environmental safety and flood control systems)

Source: developed by the authors based on [5,9]

entities. A smart city monitored 24/7 allows for more productive use of resources based on the principles of sustainable development. There are several approaches to the use of the term "smart city". For example, IT companies use the approach to promote their own products at the local level. This allows automating all the processes of city life support. Another approach is used in the context of sustainable development. It is used to emphasize the importance of using information and communication technologies in all spheres of city functioning to improve the quality of life of the population [2, p. 89].

A city's smart infrastructure includes physical and digital infrastructure. Physical infrastructure includes such areas as transportation, energy, water, telecommunications, and waste. Digital infrastructure includes sensors, the Internet of Things (IoT), networks, big data, etc. Table 1 shows the key components of a smart city.

A smart city should create comfort for its residents. An important component of a smart city is the collection and processing of big data. This allows municipal services to improve the quality of life of the population in such areas as security, transportation, medical services, utilities, landscaping, etc. The data sources are video cameras, various sensors, sensors, and information systems that are implemented in everyday life. The cities with developed smart infrastructure include Amsterdam, Barcelona, Vienna, Hong Kong, Dubai, London, New York, Reykjavik, Singapore. In Ukraine, the most developed smart cities include Kyiv, Lviv, Kharkiv, and Odesa.

The city of Zaporizhzhia lags behind the above-mentioned Ukrainian cities and has development plans in the areas of clean energy, economic and environmental development. The Zaporizhzhia Development Strategy until 2028 identifies the following key areas:

– city of healthy environment and resource saving;

– city of entrepreneurship and creative economy;

– city of comfortable, safe and creative urbanism;

– city of high quality of life [5].

In Zaporizhzhia, the city's key environmental and resource conservation goals include increasing the share of waste recycling, reducing air pollution in the city, and reducing water use by industrial enterprises. The smart economy area includes the development of processing industries and logistics with a low technogenic impact on the environment, reduction of emissions and introduction of environmental technologies. To develop the smart economy in Zaporizhzhia, the city is gradually commercializing science, holding art projects and festivals, increasing the number of coworking spaces, and popularizing IT technologies. To develop a safe and creative city, a new terminal has been built to increase the capacity of Zaporizhzhia airport, modern models of municipal transport have been purchased, and city bridge networks are being developed. Sidewalks and bicycle paths are being built and reconstructed, and the urban environment and proactive marketing of the city are being developed. To improve the quality of life of residents, the Zaporizhzhia City Development Strategy until 2028 [8] proposes the development of educational space, health care and social protection systems, and the development of electronic resources for citizens. These electronic resources are available on the website of Zaporizhzhia City Council [10]. In the city of Zaporizhzhia, electronic services are being developed to improve the further comfort of citizens. In the field of transportation, the EasyWay and Waze services operate. The EasyWay service allows you to track the movement of public transport on the city map in real time and see the schedule of its arrival at the bus stop. The Waze online application helps to monitor the situation on the roads and choose the best route to get to the right place faster. The development of smart city services in Zaporizhzhia will speed up management decision-making, save budget funds, and improve the provision of information services to citizens and businesses. The authors have studied the electronic services of Zaporizhzhia and proposed the following table for their systematization (Table 2).

The study conducted by the authors shows the gradual development of electronic smart services in Zaporizhzhia. There are services that have not yet been implemented. The relevance of certain services has increased significantly under martial law. In modern conditions, the number of residents in Ukrainian cities is changing due to migration and temporary relocation of the population. To improve the quality of electronic services, it is important to analyze open data and make decisions to improve smart services. The goal of the Zaporizhzhia City Development Strategy until 2028 is to solve local development problems, primarily to restore and preserve the city's environment, make it safe for life, increase the competitiveness of the economy, develop tourism, and improve the quality of life of residents by attracting investment and uniting the community around the idea of sustainable development of the

Table 2

Electronic smart services for individuals and legal entities in Zaporizhzhia

Sphere	Name of the service	Website address	Service description
Administrative and social services	Administrative Services Center	https://cnap.zp.gov.ua/echerga/home	a website with all online forms of declarations, registers and all types of services, from business and construction to property and advertising
	Social services	https://zp.gov.ua/uk/page/socialni-poslugi	a web page with all online application forms and forms for applying to social authorities for assistance
	Service for Children's Affairs	https://dity.zp.ua/	a website for contacting social services regarding adoption or guardianship of children
	Registration services	https://drpzmr.gov.ua:8080/	registration services of Zaporizhzhia City Council
	The city for everyone	https://texty.org.ua/d/2021/zaporizhzhia_inclusive/	a web service designed to make Zaporizhzhia more convenient for people with limited mobility. The project aims to ensure transparency of information about the city's accessibility facilities and the work that has been done to equip them.
Health and medicine	Helsi	https://helsi.me/	the ability to make an appointment online
Cultural and entertainment services	Tourist portal	https://zaporizhzhia.city/	a website with the entire tourist infrastructure – hotels, restaurants, theaters, museums, the most interesting hiking routes, etc.
	Culture	https://cultura.city/	a website with all the nearest and most relevant events of the city - concerts, exhibitions, fairs and other events
	The sports portal	https://sport.zp.ua/	a website with sports events and achievements of the city's residents
Social and economic	Electronic petitions	https://ep.zp.gov.ua/uk	a website with electronic petitions that can be supported by any city resident and considered by local authorities
	Public budgeting	https://gb.zp.gov.ua/	allows residents to participate in the use of budget funds to improve the life of the city
	Transparent budget	https://budget.zp.gov.ua/	The site allows you to see the revenues to the local budget from all taxes and all budget expenditures on various sectors of the economy
	ProZorro	https://zp.gov.ua/uk/page/prozorro-1	a page with all tenders and procurements for money from the public budget
	Investment portal of the city	https://invest.zp.gov.ua/uk	Assistance to citizens in investing and deploying the project
	Social media	https://zp.gov.ua/uk/page/socialni-merezhi	Facebook pages of Zaporizhzhia city council and the city mayor, the mayor's telegram channel
Housing and communal services sector	City call center 15–80	https://1580.zp.gov.ua/	the opportunity for citizens to apply online to Zaporizhzhia utilities for the repair or installation of infrastructure facilities; every resident of the city can see on an interactive map the stage of their application
	Personal account of a resident	https://cabinet.zp.gov.ua/login#mainpage	A personal account is an electronic service that acts as a communicator between utility companies and municipal services, on the one hand, and city residents, on the other
	Energy efficiency	https://umuni.com/c=210970	energy efficiency, tracking and optimization of building energy costs
	Safe city	https://safecity.zp.gov.ua/site	the ability to monitor the life of the city through cameras online; in case of an emergency, it is possible to contact the site management with a request to view the cameras for any situations
	Zaporizhzhia city space	http://map.zp.gov.ua/	a website with all projects implemented at the expense of the budget, their location on the city map
	Shelter	https://ukryttya.zp.gov.ua/	a website with an interactive map showing all the city's shelters in case of any emergency
Transport	Waze	https://www.waze.com/uk/live-map	An online application about the situation on the city's roads; it helps to choose the best route and get to the right place faster
	EasyWay	https://www.eway.in.ua/ua/cities/zaporizhzhya/routes	the ability to track the movement of public transport on the city map in real time and see the schedule of its arrival at the stop
	Service of parking inspectors	https://parking.zp.gov.ua/	maintaining law and order regarding parking in the city; the ability to file a complaint against an offender online and pay a fine

city. In Zaporizhzhia, the use of electronic services allows for the use of information technology for the efficient functioning of the city's infrastructure.

Conclusions

The concept of a "smart city" contributes to the efficient functioning of modern cities, taking into account the needs of their residents. The authors propose to consider a smart city as an innovative system that uses sensors, the Internet of Things (IoT), networks, and big data to increase the competitiveness and efficiency of urban services. Sustainable development of a smart city should take into account economic, social and environmental aspects. A smart city must also ensure that it meets the needs of current and future generations. The development of smart cities should include the integration and coordination of services in cities and the possibility of remote participation of citizens in city management.

The Zaporizhzhia City Development Strategy until 2028 envisages the development of a healthy environment and resource conservation, promotion of entrepreneurship and the creative economy, and improvement of the quality of life of the population. The authors propose to consider the classification of smart services in Zaporizhzhia in the following wording: administrative and social services, health and medicine, cultural and entertainment services, socio-economic services, housing and communal services, and transport. The use of alternative energy sources, production of equipment for clean energy is promising for cities, which corresponds to the general world trends and tasks facing Ukraine in the coming decades. The author proposes directions for the development of electronic services in Zaporizhzhia to improve the further comfort of citizens. The development of smart city services in Zaporizhzhia will speed up management decision-making, save budget funds, and improve the provision of information services to citizens and businesses. The implementation of such projects will speed up management decision-making, save local budget funds, and improve the efficiency of information services for individuals and businesses. To develop the creative economy in Zaporizhzhia, it is proposed to gradually commercialize science, hold art projects and festivals, increase the number of coworking spaces, and popularize IT technologies. The smart city concept contributes to solving the city's current problems, its sustainable development and comfortable living conditions.

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РОЗВИТОК ЕЛЕКТРОННИХ СЕРВІСІВ «РОЗУМНОГО МІСТА» (SMART-CITY)

Ткаченко А.М., Севастьянов Р.В.

Стаття присвячена розгляду сучасних аспектів розвитку «розумного міста». Зазначено, що такий розвиток сприяє забезпеченню ефективного функціонування міст для задоволення потреб їхніх жителів. «Розумне місто» (Smart City) є інноваційною системою, яка використовує сенсори, інтернет речей (IoT), big data, електронні послуги для підвищення конкурентоспроможності та ефективності міських послуг. Встановлено, що стійкий розвиток сучасного «розумного міста» (Smart City) має враховувати економічні, соціальні та екологічні аспекти. Автори пропонують використовувати класифікацію смарт-сервісів у м. Запоріжжя по таким сферам як адміністративно-соціальні послуги, здоров'я та медицина, культурно-розважальні послуги, соціально-економічні послуги, житлово-комунальне господарство, транспорт. Розглянуто стратегічні напрями смарт-розвитку м. Запоріжжя. Стратегія розвитку м. Запоріжжя до 2028 року передбачає розвиток здорового довкілля та ресурсозбереження, сприяння підприємництву та креативної економіки, підвищення якості життя населення, ліквідацію шкідливих наслідків бойових дій. Визначено, що для м. Запоріжжя ключовими задачами «розумного міста» є збільшення частки переробки відходів, зменшення забруднення атмосфери у місті, зменшення обсягів використання водних ресурсів промисловими підприємствами. Підприємництво та креативна економіка передбачає розвиток переробних підприємств та логістики з низьким техногенним впливом на зовнішнє середовище, зниження викидів і впровадження новітніх «зелених» технологій. Для розвитку креативної економіки у м. Запоріжжя пропонується поступова комерціалізація науки, проведення арт-проектів та фестивалів, збільшення коворкінгів та популяризація IT-технологій. Автори пропонують розширити перелік електронних послуг «розумного міста». Це сприятиме прискоренню прийняття управлінських рішень, економії коштів бюджету, покращенню надання різноманітних послуг для фізичних та юридичних осіб.

Ключові слова: «розумне місто», конкурентоспроможність, розвиток, ефективність, електронні сервіси.

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