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**SMART CITY ECOSYSTEM:  
EVOLUTION, APPROACHES TO DEFINITION  
AND COMPONENTS**

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**Abstract**

The article reveals the essence of the smart city and its ecosystem. Systematized approaches to defining a smart city. The evolution of the development of smart cities is presented and four stages of their development are highlighted.

**Key words:** *smart city, ICT, smart technologies, smart infrastructure.*

Accelerated global urbanization and the complication of the system of cities actualize the issue of their effective functioning and development, use of their infrastructure, budget formation, etc. This requires comprehensive solutions and strategies from city governments and communities to address the economic, environmental, social and infrastructural challenges associated with urbanization. In general, more than 4 billion people live in cities, and according to forecasts, by 2050; the urban population will grow to 7 billion [1].

The history of the emergence and development of smart cities begins in the second half of the 20th century and includes several key stages:

Stage 1 – the first attempts (20–60 years of the 20th century) to create smart cities included the introduction of telephone systems, electrification and other technologies to improve urban life. This period was characterized by limited possibilities of information technologies.

Stage 2 – Emergence of computers and networks (70-90 years of the 20th century). With the advent of computers and the development of communication networks, it became possible to automate many city management processes. For the first time, transport, utility and infrastructure management systems were created.

Stage 3 – Growth of data volumes and the Internet of Things (2000 – present). The development of computing technologies, as well as the emergence of the Internet of Things (IoT), has made it possible to create more integrated and intelligent city management systems. Cities have started using big data to make decisions, ensure security and optimize resources.

Stage 4 – Development of smart infrastructure and 5G. The launch of 5G networks and the development of smart infrastructure open up new opportunities for smart cities. Fast and reliable access to the network will allow the implementation of even more connected devices and control systems.

Modern smart cities use a wide range of technologies, including IoT, Big Data analytics, artificial intelligence and many others, to ensure efficient management, resource conservation, improve citizens' quality of life and reduce environmental impact. The development of smart cities is an important direction for the future sustainable development of cities and global society in general.

At the same time, the definition of "smart city" does not have a consistently accepted interpretation in the scientific literature, a significant number of approaches to understanding are defined through a technological basis. For example, Sharon Shea's definition states that "A smart city is a municipality that uses information and communication technologies (ICT) to improve work efficiency, exchange information with the public, and improve both the quality of public services and the well-being of citizens" [2]. According to this study, the main mission of a smart city is to stimulate economic growth to improve the quality of life of citizens with the help of technology, data collection and analysis, and the value is determined depending on the sphere of implementation of technology in the life of the city, and not only on the actual presence of the technology itself.

The key characteristics of a smart city are defined as:

- high-tech infrastructure projects;
- environmental initiatives;
- extensive and functional public transport system;

- competent urban planning;
- opportunities for the public to effectively live and work in the city, effectively using its resources [2].

A Smart City is an effective integration of physical, digital and human systems in an artificial environment for a sustainable, prosperous and comprehensive future for citizens. This is the definition provided by the British Standards Institute (BSI) [3].

A smart city is a place where traditional networks and services are made more efficient by digital solutions for the benefit of its residents and businesses. A smart city goes beyond using digital technologies to better use resources and reduce emissions. The first priority involves the formation of smart transport networks, modernized water supply and waste disposal, as well as more efficient methods of lighting and heating buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an aging population [4].

Michael Wade and Michelle Pfeffy in their work define a smart city as “an urban area that has become more efficient and/or more ecological and/or more socially inclusive through the use of digital technologies. The goal of a "smart city" is to increase its attractiveness for citizens and/or businesses by improving and/or adding city services" [5]. It is worth noting that this definition is expanded due to environmental and social factors that can determine the quality of a smart city and the possibilities of building its ecosystem. However, building a smart city is not a final goal, but a process that involves constant improvement of its environment depending on existing factors [5].

National Geographic defines a smart city as a system of hundreds and thousands of sensors that collect information on the efficiency of infrastructure use and quality of life. At the same time, citizens can be provided with programs that allow them to expand access to city services and services, receive information about breakdowns, traffic jams, etc., pay for certain services [6].

Conceptually, a smart city is understood as the integration of digital technologies into city networks, services and infrastructure, which makes it more efficient and livable for the benefit of its residents and businesses [7]. According to the European Commission, a smart city uses information and communication technologies (ICT) to improve quality of life, efficiency and competitiveness, while meeting the needs of current and future generations [4].

The United Nations Economic Commission for Europe (UNECE) sees a smart city as a combination of home Wi-Fi connections in public places, smart infrastructure, smart electricity meters, open data, and e-government [8]. A broader definition is provided by Paessler, where the term "smart city" describes the economic, technological and social trends for the envisioned green cities of the future [9].

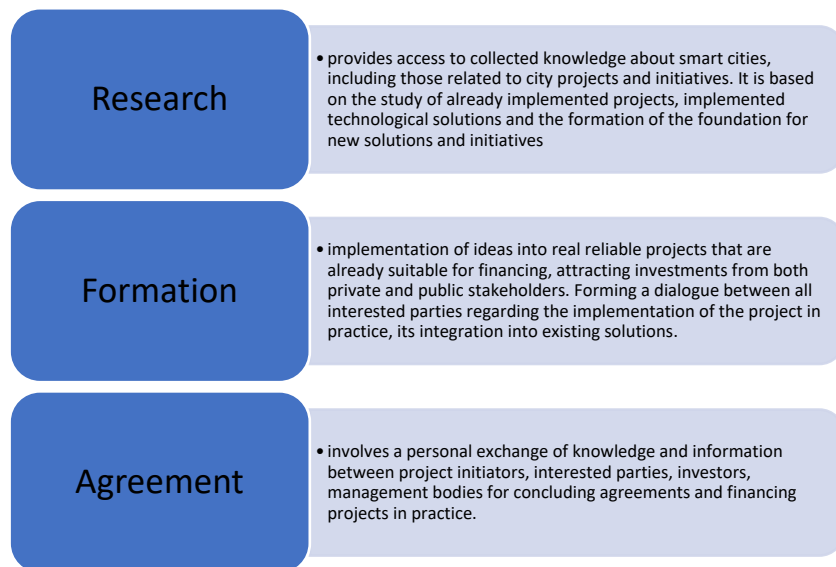
In parallel with the term "smart city", we can meet the definition of "global city", "financial center", etc. The study of financial centers is carried out by the Z/Yen agency, which jointly with the London City Corporation and the China Development Institute issues reports on the study of the functioning of financial centers, trends in their development, etc. As part of their research, financial centers are examined as "full-service international centers with modern settlement and payment systems supporting large national economies. The sources of funds are diverse, and the legal and regulatory framework is sufficient to preserve the integrity of the principal-agent relationship" [10].

The creation of an urban environment that functions to meet the needs of society, ensures a high quality of life for the public, determines the conditions for rapid economic growth, contributes to an increase in the number of services from the city government with lower financial costs. With the growth of the population, adaptation of urban networks is necessary, first of all, through increasing the efficiency of their use, creating new values, which can produce new sources of income or reduce costs [2].

The basis for the smart cities market was the work done as a result of the launch of two platforms "European Innovation Partnership Market for Smart Cities and Communities (EIP-SCC Marketplace)" and "Smart Cities Information System (SCIS)". These platforms aimed to bring together local communities, SMEs, investors, the banking sector, researchers, universities and other stakeholders to create a comfortable environment that would ensure a high quality of life for the population. These initiatives are aimed at increasing the competitiveness of cities and industry, as well as creating prerequisites for achieving the goals of the UN, which are aimed at sustainable development.

The EIP-SCC Marketplace defines the following areas of operation of smart cities: sustainable urban mobility integrated infrastructures and processes in energy, information and communication technologies and transport, sustainable districts and the built environment, citizen orientation, policy and regulation, knowledge exchange, integrated planning and management, baselines, performance indicators and metrics, open data management, standards, business models, procurement and funding [11].

In general, the activities of the Smart Cities Marketplace form certain structures with the help of an integrated process of searching for answers Explore-Shape-Deal Matchmaking, which is aimed at forming a knowledge exchange system, developing and implementing new technologies as part of the Smart City ecosystem, their replication to other cities and localities. The key stages of this process cover the following issues (Fig. 1).



**Figure 1. Stages of implementation of the Explore-Shape-Deal Matchmaking initiative [4].**

A smart city is formed not as a new product, but as an ecosystem built into already existing agglomerations and must take into account the peculiarities of the functioning of the city, its culture and established traditions. The formation of the digital environment takes place within the framework of data management, which in turn is collected by both governmental and non-governmental organizations, which form a single network of various companies, suppliers, and other participants. For example, surveillance equipment for busy streets can be from one company, cameras from another, a server from a third, data analysis will be performed by a third-party organization, etc. The chain can be continued at the expense of companies that are called to solve certain identified problems as a result

of the discovered data. Therefore, the construction of a smart city becomes not just the implementation of a project, but a constantly functioning program that requires constant updating, rejuvenation and the search for new forms of work.

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