

IMPLEMENTATION OF SMART-CITY TOOLS AS A RESPONSE TO CHALLENGES IN SOCIO-HUMANITARIAN FIELD IN UKRAINIAN METROPOLISES

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Abstract: The article investigates theoretical foundations of public management in the socio-humanitarian sphere of metropolises based on the smart city concept. It defines the essence of the concept of "public management in the socio-humanitarian sphere" in a metropolis, which should be considered as a multi-branch and inter-sectoral complex formed with the involvement of local authorities, business partners, the public, and citizens, and aims to create, maintain, and develop a favorable safe environment as a unified system of life and livelihood of the city based on the balanced development of the main sectors of the economy and socio-humanitarian sphere. The abstract also defines criteria for the efficiency of public management in the socio-humanitarian sphere within a modern metropolis, which include integrity, sustainability, and security of the subjects in obtaining a positive effect of solving socio-humanitarian issues within a metropolis. The main mechanism of public administration in a metropolis is establishment of interaction in the triad "power - business - community" and coordination of their interests (business - "here and now", community - "the welfare of our children", the state - "the welfare of citizens"). It is confirmed that the digitalization of public administration contributes to strengthening control over the use of all types of resources for the optimal development of the socio-humanitarian sphere of Ukrainian cities.

1 Introduction

According to the forecast of WHO experts, already in the 2030-2050s more than 60% of the world's population will become urban residents [1,2] It is known that in 2020 in the world there were about 600 metropolises, which are already shaping the policy of the world economy. According to economists, by 2025, it is metropolitan cities that will produce about 2/3 of the world's gross domestic product [3]. Thus, changes in the historical significance of cities as a result of urbanization naturally determine transformation of their significance not only as centers of

economic growth, but also as centers of spiritual and social activity. Today, many researchers who study the issues of metropolitan governance emphasize that the structure of metropolitan governance is similar to that of state governance. Therefore, in this management system such management subsystems as housing and communal services, transport networks, industry, urban planning and others, can be distinguished. At the same time, in the context of public administration activities carried out by municipal authorities in metropolises, the socio-humanitarian sphere deserves a special focus, since it

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forms the labor resources and labor market to ensure the functioning of other spheres of life in large cities.

Important research trends in the study of life management in a large city are the issues of social welfare of the inhabitants and spiritual significance of large cities as the basis for the formation of a modern worldview and lifestyle. Many foreign and domestic researchers in their works emphasized that large cities spiritually dominate the state. It is from the positions of large cities that the state is managed [4].

Bogaenko considers a large city as a holistic system which is characterized by polystructurality and multifunctionality in terms of influencing the functioning of not only the city, but also the state as a whole [5].

Other experts focus on the processes of municipal governance of metropolises. These scholars understand the municipal management as activities of local government aimed to satisfy public interests and carried out in the forms prescribed by law through the municipal economy [6,7]. At the same time, the main activity of local governments is to direct enterprises and organizations located in the city for meeting public interests of the citizens [7]. Therefore, for the Ukrainian state, which has chosen the course of European integration reformation [8], in the research and applied aspect of public administration it is vital to consider the peculiarities of socio-humanitarian governance in a metropolis to achieve better governance and quality of life of Ukrainians in the conditions of European integration movement.

2 Methodology

The main goal of this work is to generalize and characterize the features of management in the socio-humanitarian sphere in a Ukrainian metropolis.

The structural approach is often used to study issues arising in metropolises and agglomerations, e.g. flood prevention in coastal areas [9]. The Analytical Hierarchy Process (AHP) approach [10] is used to assess and analyze the "network" cities management risks (The concept of ubiquitous cities (U-Cities), for example, Seoul.

To study the specifics of global megacities of the world (the most prominent global metropolises, such as London, New York, Hong Kong, Los Angeles, Sao Paulo, Rio de Janeiro, Paris, Berlin, Moscow, Beijing, Singapore, Shanghai, Sydney and Tokyo), the researchers used the ELECTRE III approach, a multi-criteria decision aid tool comprising twenty indicators [11,12].

To solve spatial problems, in particular, parking in metropolises, simulation of decision-making processes based on the Digital Twin platform "smart things" is used to develop an "ambient intelligence." It is a freight parking management system for last-mile delivery in a smart city, called Smart City Logistics Parking (SCLP) [13]. Modular Integrated Construction (MiC) has been one of the most innovative solutions to address the ever-growing housing demands in metropolises such as Hong Kong, which has been applied by Chinese researchers [14].

Contrast to the aforementioned research, in Ukraine the first developments in the implementation of the Smart City concept are associated with the formation of a distinct research area - municipal government, as well as with the formation and development of the legal framework. This direction accompanies management processes in urban areas, and also aligns them with the processes of decentralization, which has been going on in Ukraine since 2005, and is intermittent by nature. At this stage of decentralization in Ukraine, it is advisable to resort to the method of systems analysis in order to study the status and trends of the Smart City concept implementation in urban management. Using this method, it has been established that a high probability for realization of this concept is made possible due to the intensification of two processes - digitalization and decentralization [15,16]. While the process of digitalization is due to a certain level of investment and resources [17,18], including human, the latter is the result of efforts and agreements between major players in the Ukrainian government and parliament. Therefore, the political factor as a result, a response to external challenges, in particular, in decentralization promotion, is fundamental in modern Ukraine.

The method of statistical analysis is used in this study to compare the demographic characteristics and operation and city management features in European and Ukrainian metropolises. This method allowed to establish the differences between a metropolis and an agglomeration, through the coverage of other, specific characteristics that define the concept of "metropolis" in Ukrainian and overseas research.

The scientific-historical retrospective method is used to visualize the dynamics of the Smart City concept in the metropolises management in the context of intermittent decentralization and the civil society development, and the public sector and public services formation. This method allows to explain not only the backwardness of the processes, but, first of all, the evolution of perception of new political and social economic changes in the society as an objective necessary condition for further progress of the socio-humanitarian sphere in Ukrainian metropolises.

To illustrate the main research results of the study, the appeal to the graphic method allowed to demonstrate the differences between Ukrainian and European practices, and especially highlighted the difference in understanding of metropolises of global importance, such as London, New York, Hong Kong, Los Angeles, Sao Paulo, Rio de Janeiro, Paris, Berlin, Moscow, Beijing, Singapore, Shanghai, Sydney, and Tokyo, and awareness of management issues within the megapolises of the Ukrainian scale.

The study is based theoretically and methodologically on international agreements, laws of Ukraine, research works of domestic and foreign authors, and analytical and statistical thematic reviews.

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3 Result and discussion

The concept of "metropolopolis" (Gottmann, 1989) is directly related to its root "polis", and is interpreted as the growth of large industrial cities accompanied by their merger with the surrounding areas [19,20]. Metropolises are only the nuclei of these extremely complex urban structures. Today this name is used for especially large urban concentrations of the world (in UN publications - with a population of over 10 million people) [2,19,21]. A characteristic feature of a metropolis is high population density and a significant number of out-of-towners. Other

researchers [21] consider a city with a population of over 1 million people to be a metropolis. It is the demographic characteristics of metropolises that distinguish their economic and social identity and influence the formation of public administration mechanisms not only within large cities, but also within a state as a whole.

Many cities in Europe belong to the category of large cities (most often calculations are made from 500 thousand people) [22]. At the same time, taking into account the indicator of the number of over 1 million people, the European rankings also include the metropolises of Ukraine (Table 1).

Table 1 Ranking of Ukrainian metropolises among the 100 largest cities in Europe, 2020

City	Total population (people)	Ranking
Kyiv	2 590 000	7
Kharkiv	1 404 000	16
Dnipro	1 108 000	27
Donesk	1 050 000	31
Odessa	1 002 000	36
Zaporizhzhia	850 000	44
Lviv	790 000	48
Kryvyi Rih	705 000	57
Mykolaiv	510 000	95

So, as we can see, the first 36 positions of the European ranking that are occupied by millionaire cities include, in addition to the Ukrainian capital, such large Ukrainian cities as Kharkiv, Dnipro, Donetsk, and Odessa (positions 36th through 100th include cities with the population of over 500,000 people). In total, the ranking of 100 major cities in the Eurozone includes 9 Ukrainian cities.

In Ukraine, state urban planning norms [23] provide the division of urban settlements into 5 types:

- major (the largest) – over 1 million people;
- significant (very large) – from 500,000 to 1 million people;
- large – from 250,000 to 500,000 people;
- medium – from 50,000 to 250,000 people;
- small – up to 50,000 people.

Therefore, in contrast to European approaches in the ranking of large cities, according to the national ranking as

of January 1, 2020, in Ukraine there were, in addition to the capital, 3 more cities with the population of over one million inhabitants (Table 2).

At the same time, as can be seen from the data in the figures, there is a steady downward trend in the population of millionaire cities in Ukraine, which distinguishes Ukrainian cities from global metropolises, which showed a positive population dynamics over the same period.

Scientists interpret the efficiency of metropolitan management through the processes of managing operation and development of a modern metropolis in terms of meeting the real needs and interests of citizens and the implementation of the public administration fairness principle [24-26]. It is emphasized that in international research traditions it is accepted to consider the bodies of municipal government as public organizations, and activities of such bodies are classified as power-administrative [25].

Table 2 Dynamics in the number of metropolis inhabitants in Ukraine, 2001-2020

Metropolis name	Population number (people)			Dynamics
	2001	2014	2020	
Kyiv	2 611 327	2 868 702	2 967 360	Growth
Kharkiv	1 470 902	1 451 132	1 443 207	Decline
Odessa	1 029 049	1 017 022	1 017 699	Decline
Dnipro	1 080 846	993 094	990 724	Decline

In the complex system of a large city, the socio-humanitarian sphere is singled out as an object of public administration, since the state of this sphere significantly affects preservation and development of the resource

potential of a large city. The socio-humanitarian sphere infrastructure constantly evolves, and the driving forces of this development are the real needs of the community. Therefore, public management of the socio-humanitarian

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sphere in a metropolis can be defined as a diversified and intersectoral complex. It involves local authorities, business partners, the community and citizens in order to create, maintain, and develop a favorable safe environment as a unified system of the city life and livelihood. It aims to develop the major sectors of the economy and socio-humanitarian sphere, in particular, improving the quality of social services in education, medicine, social welfare, innovative and creative development of culture, transport services, housing and communal services, tourism, leisure, etc.

Metropolises are characterized both as the means of material environment realization and the phenomenon of culture [6].

In the context of the public administration development in metropolises, their sustainable development is considered through the issues of effective interaction of government with the public. It is believed that this requires solving a number of problematic issues: organizational, personnel, etc. Also needed are the adaptation of international experience to Ukrainian realities, optimization of dialogue, solution of issues of public activity and community unity stimulation, and in-depth study of social partnership phenomenon, in particular, its conceptual and operational aspects [27].

According to urban development trends, currently metropolises are not only business and industrial centers, but also centers of social activity that create maximum opportunities in the social lives of their inhabitants.

We support the opinion of Makhinya that "metropolis" should be understood as a concentrated form of human settlements classified as large, the largest and very large cities, and associated with the merger of these cities boundaries with adjacent areas of conurbations [24]. "Conurbations" are understood as merging of small cities with metropolises due to the effects of approximation.

A significant advantage of the socio-humanitarian sphere of a metropolis is its saturation with objects of culture, education, health care facilities, sports facilities, etc. Therefore, in the implementation of public administration in this area, one must take into account a number of features that determine the choice of effective methods and tools to achieve the goal of public administration in the identified area. On the basis of systemic, structural-functional and institutional approaches it is possible to determine the following features of public management in the socio-humanitarian sphere in a modern metropolis:

- high social significance of trends in this sphere in the processes of life support of the territorial community (for example, the branches of health care, education, culture, etc.);
- dominance, among social service providers, of state and communal institutions (over 2/3 of the market) and slow entry to the social services market by private and public representatives. At the same time, the

mechanisms of budget-funded financing of communal facilities protect them from the risks of bankruptcy or force majeure, such as the COVID19 pandemic, in contrast to private or public institutions;

- a high degree of intersectoral integration and cooperation in providing social and humanitarian services within a narrow territorial space (for example, sports complexes provide services in aesthetic cosmetology and nutrition, although these are branches of medicine);
- bringing social infrastructure facilities closer to the places of compact residence of citizens (residential neighborhoods), work or study, leisure, etc.

Public management of a metropolis is a set of economic, organizational and legal means of purposeful influence of public administration entities that ensure the coordination of the interests of public authorities, local governments and civil society structures operating in the metropolis.

An important mechanism of public administration in a metropolis is establishment of cooperation in the triad "power - business - community" and harmonization of their interests (business - "here and now", community - "the welfare of our children", the state - "the welfare of citizens").

It is possible to identify the following as the main criteria for the development of the socio-humanitarian sphere in a metropolis: integrity, sustainability, and security, which are determined by the ability of public administration bodies to find solutions to numerous and complex problems of the metropolis.

World practice has accumulated considerable expertise in implementing innovative tools for managing metropolitan cities, as their existence necessitates understanding of their intelligent population in economic, psychological, socio-cultural, environmental, and medical aspects, and implementation of the smart city ideology. Thus, no sphere of life in a metropolis exists separately; it functions as a single "smart network" that provides unity and rational approach to resource consumption, modern economy, high living standards, and ecological and safe life of the population. It is believed that after 2020 the global market for intelligent urban services may reach \$ 400 billion a year [28].

Cities evolve, but so do requirements to them. The smart city concept has an interesting history: first came the idea of a digital city, and then the idea of a smart one. The evolution of the European network of smart cities has been too rapid, and today this network counts 136 cities (Figure 1).

The basis of a smart city is feedback, which means that people as central consumers of urban services must be involved in the process. The general concept is that not the inhabitant adapts to the city, but the city does to needs and behavioral models of people. It is essential that city residents have an opportunity to work with public

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authorities to find the best solution for meeting their social needs and interests (through government websites and social networks).

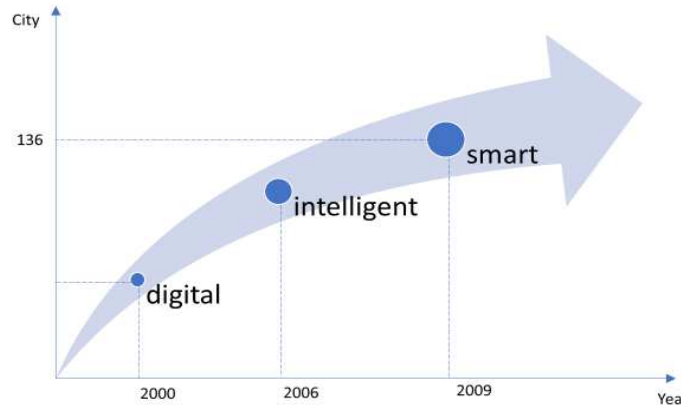


Figure 1 Development of the European Smart Cities Network according to [2,29]

The experience of implementing the program "Smart Seoul - 2015" is of particular interest. South Korea is concerned about its own image, and this program has been running for more than 10 years, so we see a whole range of activities. Here, a single operational center has been created to manage city services, a water and air quality monitoring system has been set up, and "smart metering" of energy consumption has been introduced. Also, smart cameras with video analytics have been installed, and mutual exchange of data between 30 thousand video surveillance systems has been established. A 192-kilometer network has also been built to provide Internet access in the Seoul subway. Naturally, there is an extremely wide range of electronic services in operation, including integrated websites of all government agencies, public access to information from city services, and a system of booking public services based on the "single window" principle. In total, there are over 150 services in such important socio-humanitarian areas as education, municipal infrastructure, tourism and leisure, medicine, municipal transport, etc [30].

As the world experience suggests, management based on Smart City principles consists of technologies that include the following aspects [17]:

- SMART-management: solutions that help increase the efficiency of providing public services, such as e-government and information communications technologies, e-learning, e-passport; transparency and open data, and political demand;
- SMART-residents: the main recipients of services in the socio-humanitarian sphere, the formation of which is provided on the basis of modern competencies, primarily such as educational, vocational, communication and speech (foreign language skills)

ones, an opportunity for lifelong learning and taking an active part in urban life;

- SMART-education: global access to high-quality distance education based on interactive communication between participants in the educational process (educational platforms, distance courses, webinars, etc.); electronic final exams at schools; electronic registration for admission to higher education institutions; distance format of final exams and dissertation defenses in higher educational institutions; creation of a single state electronic database on education issues, etc.;
- SMART-medicine: remote level of service by a family doctor (telephone counseling), telemedicine counseling of in-patients on diagnosis and treatment, electronic clinic, electronic medical record and medical history, electronic prescription, electronic referral to hospital, E-register of doctors and patients by types of the most common and socially significant diseases (including infectious and dangerous ones), the use of the latest safe devices for diagnosing the body condition and appropriate treatment (non-contact thermometers, etc.);
- SMART-energy: solutions that ensure uninterrupted electricity supply to all households and commercial buildings;
- SMART-environment: technologies that will allow to restore energy, manage wastewater, and provide proper sanitation for citizens;
- SMART-transport: these solutions are related to the rationalization of transportation in order to optimize traffic flows (20% reduction of the total travel time to work / home) and increase urban connectivity;
- SMART communications and IT: powerful communication and sensor networks between cities will enable law enforcement agencies and other

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institutions involved in public safety to collect and interpret data and respond effectively to any crime;

- SMART-buildings: solutions needed to build intelligent control systems that can help save up to 30% on water consumption, 40% on energy consumption, and reduce their maintenance costs by 10-30%.

According to domestic experts, today Ukraine is taking confident steps in the development of domestic cities in their approximation to the standards of developed large cities in Europe and the world. The introduction of certain smart city components can be identified in such megapolises as Kyiv (the capital), Kharkiv, Odessa, Dnipro, and Lviv. According to the results of the Kyiv Smart City Forum 2020 [31], the city of Dnipro was recognized as the national leader in the management smart technologies implementation in the field of public safety. For instance, the municipal program "Safe City", funded by the local budget, has been operating in the city since 2016. As part of this program, 1,200 video cameras have been installed in the city and are supervised by two monitoring centers, one at the National Police and the Security Service of Ukraine (1), the other at the specialized Situation Center of Dnipro City Council (2). The video surveillance system helps to implement the information function of metropolis management through the tools of survey, robotic.

The city of Lviv was recognized at the Kyiv Smart City Forum 2020 as the best mobile, ecological and architectural city in Ukraine. In the development of smart-infrastructure, the city authorities use various communication formats, in particular, involving residents, business representatives, and various other stakeholders, including those from neighboring regions, to gain experience.

In 2020, the city authorities of Odessa introduced a system of non-cash fare payment in public transport through Transpod mobile application utilizing Bluetooth technology. Due to the application, it is possible to track public transport routes. For the convenience of citizens, the mobile application also allows users to find a route from point A to point B, also by public transportation.

The city of Kharkiv was recognized as the "Best Digital City" within the framework of the Kyiv Smart City Forum 2020 due to the introduction of the online platforms "Portal of Electronic Services" and "Portal of Kharkiv Citizens", and the mobile application "My Kharkiv". In addition, Kharkiv residents have the opportunity to pay for parking spaces online, and use the unified Helsi.me medical system in addition to other online services. In order to bridge the digital divide among the population, free digital literacy courses are provided for residents. Gradually, local authorities are building partnerships with the business environment to financially support the success of smart projects.

In 2015, the capital city of Kyiv approved a local program called The Safe Capital. The program covered the

purchase of 7,000 video cameras, a video surveillance system, cloud storage, etc. Due to smart video cameras, it is possible to identify a human face and then determine personal data (the name and status). In addition, in 99% of cases the program is able to read cars license plates, regardless of weather conditions, to track the route of the vehicle within the city, and so on.

In general, as we see, many cities in Ukraine have introduced the experience of a smart and safe city based on expanding the capabilities of urban video surveillance networks in public places and places of large crowding such as airports, train stations, shopping and entertainment centers, etc. However, the implementation of "smart" city projects in Ukraine today lags far behind the world's current management practices in terms of the pace of innovation, quality and complexity. In Ukraine, no city or even metropolis is operating in the smart mode yet. The main barriers are the city's economic viability, budget support, and support from local businesses and the community in implementing smart solutions.

4 Conclusions

1. The issue of implementing public management of metropolis development requires taking into account the interaction of public and private sectors and paying special attention to the need to use people's initiative, introducing new relations between the urban community and government, and creating a fair economic system and productive urban environment.

2. Large cities (metropolises) are unique in their geographical location, historical development and architecture, cultural traditions, and development of financial, economic and socio-humanitarian spheres. This applies not only to European cities, but also to such metropolises of Ukraine as Kyiv, Dnipro, Kharkiv, and Odessa.

3. According to the conducted study, currently socio-cultural and research sphere, education and health care, physical education and sports, municipal transport and transport networks (bridges, roads, airports, streets, car lanes, bike paths), in short, everything that provides comfortable conditions, quality of services, safety of human life and community require accelerated development at the metropolitan level. After all, on the map of Europe, metropolises are increasingly playing the role of modern international, research, and financial attractors.

4. All this provides large cities with a special political status of national and international importance due to the greatest movement of goods, capital, and human resources. That is why further research on the issues of public management in the development of metropolises should be considered as an important factor in strengthening the economy for any country in the world. The experience of EU countries in this regard is extremely useful for Ukraine, which is currently actively pursuing the strategic goals of integration into the European Union.

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IMPLEMENTATION OF SMART-CITY TOOLS AS A RESPONSE TO CHALLENGES IN SOCIO-HUMANITARIAN FIELD IN UKRAINIAN METROPOLISES

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