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CONTEMPORARY CHALLENGES TO THE DEVELOPMENT OF CITIES – THE EXPERIENCE OF POLAND AND UKRAINE

WSPÓŁCZESNE WYZWANIA ROZWOJU MIAST – DOŚWIADCZENIA POLSKI I UKRAINY

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ABSTRACT: The article reveals the key problems of the development of cities facing modern challenges. The demographic, ecological and financial problems connected with the functioning of modern cities are determined. The range of issues that need to be solved with the purpose of effective development of cities is clarified. The principles of the functioning of the smart city system due to the continuous processing and updating of data coming from various information channels are revealed. The key approaches to understanding the main components of the smart city are presented. The perspective of the idea of a smart city was substantiated and comparison of the current state of the smart city concept in Poland and Ukraine was made.

The article uses literature studies to define the ideas and challenges of a smart city as well as case studies to present solutions in this field used in Warsaw and Kiev. It turns out that these cities, though they have a great development potential, are based on individual innovations rather than on a coherent strategy. It is particularly visible in Warsaw, where the problem is the lack of integration of activities that are undertaken in a selective manner. A positive fact is the increasing involvement of ICT in the city management process. The added value is the systematic improvement of the quality of public services and the increase in social participation in the process of making public decisions. The latter aspect makes it possible to integrate local society and build trust in public institutions.

KEY WORDS: modern challenges, urbanization, information and communication technologies, smart cities

ABSTRAKT: Artykuł opisuje współczesne wyzwania, kluczowe dla rozwoju miast. Określono w nim problemy demograficzne, ekologiczne i finansowe związane z funkcjonowaniem nowoczesnych miast. Sprecyzowano zakres zadań, które wymagają rozwiązania w celu efektywnego rozwoju miast. Zaprezentowano zasady funkcjonowania systemu *smart city* przy uwzględnieniu ciągłego przetwarzania i aktualizacji danych pochodzących z różnych kanałów informacyjnych. Przedstawiono kluczowe elementy koncepcji „inteligentnego miasta”. Uzasadniono potrzebę wdrażania idei *smart city* i dokonano porównania aktualnego jej stanu w Polsce i na Ukrainie.

W artykule wykorzystano studia literaturowe do określenia idei i wyzwań miasta inteligentnego oraz studia przypadków do przedstawienia rozwiązań z tego zakresu stosowanych w Warszawie i Kijowie.

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Okazało się, że miasta te, chociaż mają duży potencjał rozwojowy, bazują raczej na pojedynczych innowacjach niż na spójnej strategii. Szczególnie widoczne jest to w Warszawie, gdzie problemem jest brak integracji działań, które są podejmowane w selektywny sposób. Pozytywnym faktem jest coraz większe zaangażowanie ICT w proces zarządzania miastem. Wartością dodaną jest systematyczna poprawa jakości usług publicznych oraz wzrost partycypacji społecznej w procesie podejmowania decyzji publicznych. Ten ostatni aspekt daje możliwość integracji lokalnego społeczeństwa oraz budowy zaufania wobec instytucji publicznych.

SŁOWA KLUCZOWE: współczesne wyzwania, urbanizacja, technologie informacyjne i komunikacyjne, inteligentne miasta

Introduction

Informatization and virtualization of modern society leads to the formation of an entirely new social space, which involves the design of new managerial strategies implemented in response to processes occurring in the external environment. This inevitably leads to the need to change the paradigm of urban development: industrial 'Fordist' megacities displaying predominance of administrative and production functions of the city, cease to meet the needs of urban population under the conditions of increasing competition between cities for information technology, human resources and natural resources (Sokolovska 2014: 77).

Urbanization processes are an important feature of the modern stage of society's development. As the population is growing rapidly, cities overtake the functions of economic and cultural centers that stimulate changes in the environment and forms of economic activity. One of the dynamic trends in recent years has been the movement of humanity in creating cities for a comfortable life through the introduction of innovative solutions in the area of municipal governance. Thanks to the introduction of a complex of various technologies within the framework of a smart city one can solve the problems that are pressing and provide more efficient functioning of modern megacities in accordance with the needs of their inhabitants (Kasych et al. 2017: 50).

Experts predict that urbanization trends will continue in the near future: by the year 2020 there will have been 600 smart cities around the world, and these cities will have made about 60% of the world's GDP by 2025. According to the UN estimates, by 2050, the global population of the urban population will have increased by 2.3 billion people and will account for 70% of the world's population (United Nations 2010). In 2019, the trend continued. Only in Ukraine there are four cities-millionaires (Kiev, Kharkiv, Odessa, Dnipro), while the urban infrastructure of these agglomerations does not meet modern requirements, thus increasing the burden on the ecosystem. The largest cities in Poland include Warsaw (1.7 million inhabitants), Cracow (0.8 million) and Łódź (0.7 million), which also struggle with infrastructural problems.

In total, more than 70% of Ukrainians and 60% Poles live in cities. This raises challenges that we have not faced yet. A large concentration of population in cities causes a number of consequences for the functioning of cities. These can include an increase in the degree of congestion, waste production, water consumption, energy, CO₂ emis-

sions. Therefore, city authorities face many challenges in the field of energy, waste, public space, transport management and administration. The consequence of this is the necessity to constantly monitor the level of the city's development and implement innovative solutions in these areas. At the same time, it should be noted that city management is under great pressure and faces numerous limitations. This is related to the constantly growing expectations of residents in terms of the quality of life, more restrictive environmental protection law, and reduced tax revenues (the COVID 19 pandemic, financial crises).

The purpose of this article is to reveal the key issues related to the functioning of modern cities, to substantiate the prospect of the idea of a smart city and to compare the current state of implementation of the concept of a 'smart city' in Warsaw (Poland) and Kyiv (Ukraine). Warsaw was selected for the study because it is the smartest city (next to Prague) among Central and Eastern European cities. The city took the 55th place in the Smart City Index 2020 prepared by The Institute for Management Development in Switzerland, in collaboration with Singapore University for Technology and Design. Kiev is the most developed city of Poland's close neighbor, which is not yet a member of the European Union and does not benefit from the structural funds of this organization, like Warsaw does. Therefore, the possibilities of implementing new solutions in various areas of the city are quite limited there. It is interesting to compare Warsaw, supported with EU funds in its innovativeness, and Kiev, with its internal financing of innovation.

The article consists of three parts. The introductory section is followed by the presentation of the smart city idea and its main challenges. In the next part, the areas of city's functioning were analysed, which constitute a comprehensive vision of an innovative city. The empirical part includes case studies concerning Warsaw and Kiev as these two cities systematically implement new instruments of the smart city concept. The article ends with conclusions.

The 'Smart City' concept and the challenges of modern cities

The rapid growth in the urban population has led to an expanded transformation of cities on the global scale. A particularly popular trend in the transformation of modern cities is the introduction of concepts and programs for the development of a smart city.

The purpose of the smart city concept is to improve the quality of life, improve the condition of the environment and increase development prospects (Lee et al. 2014). Technologies and innovations constitute an integral part of a smart city. Their use in the city allows improving the quality of services, establishing city processes, reducing the cost and volume of consumption of resources, and improving communication with the cities. Smart technologies can be applied in all sectors of city management: transport, energy, healthcare, construction, e-government, public life, and others. A smart city is a modern technology, urban solutions, city culture, social services and quick access to administrative services. All of these enable cities to control the infrastructure and social processes in order to make the city more comfortable (Kyiv Smart City Guide 2019: 183)

A smart city is a city where traditional systems work more efficiently through the use of information and communication technologies. Information and communication technologies make it possible to use less energy resources, meet regular needs and reduce greenhouse gas emissions. This means introducing a smarter urban transport system, an updated water supply and waste disposal system, as well as building more efficient heating and cooling systems. In this case, all systems should be interconnected and work as a single coherent mechanism. The entire ICT infrastructure improves the efficiency of public management and increases the involvement of residents in the city's life, thus influencing the processes of socio-economic growth (Hollands 2008).

Information and communication technologies are accompanied by human and social capital, which is responsible for improving the safety of public places and creating amenities for residents. It is worth mentioning that ICT is only a tool enabling progress in the social, environmental, economic and cultural spheres (Nam and Pardo 2014). Thus, the concept of a smart city is aimed at providing real benefits to the life of the population and the functioning of business in accordance with the principles of sustainable development (Eurostat 2019).

The smart city concept is not always perceived as a certain state or end result. One can come across a view that it is a process, an interaction between urbanization and ubiquitous digital technology (Hanna 2016). This technology integrates physical infrastructure, local public institutions, the urban community and the geographic environment. It increases the availability of data on the functioning of the city, which can be used to improve the quality of existing public services, create new ones, and spatial planning. It also allows the participation of citizens in the process of making public decisions. This integration is based on the use by residents of various technological solutions supporting, among others, transport (intelligent transport systems), development of public spaces (applications that allow voting on infrastructure projects, reporting acts of devastation, etc.).

Contemporary urban development is created by new technologies that acquire enormous amounts of data. They are stored and analysed using cloud computing or big data instruments. At the same time, there is an increase in the number of network users and in the range of available Internet-based services. All this makes that a key challenge to city authorities is ensuring an efficient transmission infrastructure, such as, for example, the Fifth Generation Mobile Communication System (5G).

The 5G network, which will be launched in Europe in the oncoming years, will allow the implementation of various services within the smart city concept – in the broader context, within the Internet of Things. It offers a number of benefits that the existing network technologies cannot provide. These benefits are as follows (Deutsche Telekom AG 2017: 7):

- high transmission speed – up to 20 Gbit/s allowing ultrafast mobile broadband Internet;

– low latencies – less than 1 millisecond, which means that signals are transmitted almost in real time. This is a key utility from the point of view of managing the power transmission infrastructure, where in the case of voltage changes a quick response is needed to avoid failure. In addition, it will allow fast communication between autonomous cars (car-to-car) and other devices in the car (car-to-everything);

– the possibility of connecting 1 million devices to the network per square kilometre at the same time with guaranteed quality of services. This is a great convenience for the operation of readers and sensors acquiring data on atmospheric conditions, the level of air pollution or congestion of streets.

In the digital world, however, one cannot forget about the most important link, that is people. In the smart city concept, particular emphasis should be laid on processes of involving citizens in technological issues. The available tools should be popularised, while features and benefits explained. This is particularly important in the context of ageing societies and limited use of devices and applications. The constant updating of citizens' knowledge and skills should be managed by city authorities in consultation with business communities.

A city can be considered 'smart' when it invests in human and social capital, as well as in traditional (transport) and modern (ICT) infrastructure and when these activities contribute to the improvement of the level of sustainable development, improvement in the quality of life, including rational management of natural resources, taking into account social participation (Caragliu et al. 2011: 70). Only by acting in a comprehensive manner is it able to achieve its goals on multiple levels.

A smart city can be defined as a city of knowledge, a digital city, a cyber city or eco-city, in which communal systems are organically matched. It is a system that allows the most efficient use of available resources of city services and maximize the security of urban life. This city is constantly increasing the quantity and quality of services provided to the population, providing a sustainable environment that promotes the well-being and health of the citizens, improving the comfort and quality of life. However, one should remember not to neglect other, *i.e.*, alternative development paths in managing the city. Smart solutions, especially those based on new technologies, should not replace the traditional ones, such as direct contact with residents or tourists. This is especially important from the point of view of older people who do not always use mobile devices.

Historical prerequisites for the formation of a prudent city included the combination of different management systems in a holistic organic unity in order to achieve a synergistic effect from city management by streamlining different directions of the communal economy, medicine, education, culture, etc.

For the successful implementation of SMART-approaches to the development of large cities, the priority tasks are the development of appropriate normative and methodological and technological support (at the national, regional and local levels); formation of general and local systems of social, economic, ecological, food security; development of civic initiatives and social responsibility in this sphere; implementa-

tion of programs and projects on the formation of the economic basis of structural transformations of institutional and socio-economic systems of large cities (Andrienko 2018: 105).

The Smart City concept dimensions

Any interpretation of the ‘smart city’ concept implies understanding of the urban space (both real and virtual) as an open platform for interaction between authorities, business structures and urban population. The concept of a ‘smart city’ is based on six characteristics: ‘smart economy’, ‘smart mobility’, ‘smart environment’, ‘smart people’, ‘smart living’, ‘smart governance’ (Kuibida & Dehtiareva 2011; Sokolovska 2014: 78-79).

‘Smart economy’ refers to economy based on high-tech industries that include ICTs and those industries that use ICT at different stages of the production cycle. ‘Smart mobility’ provides sustainable, innovative and safe transport systems based on ICT infrastructure that improve urban mobility and mobility of city-dwellers in everyday urban life. ‘Smart people’ are residents of a city, who have a high level of education and qualifications and are actively integrated into the city’s public life. ‘Smart environment’ includes life-friendly natural conditions, as well as environmental measures. ‘Smart living’ means the high level of development of various components of the phenomenon of quality of life (culture, health, safety, housing, tourism, etc.). ‘Smart governance’ means diversification of governance. Delegation of functions and the diversification of power are the basis of social interaction between social institutions in a smart city.

According to M. Horoshko (2018), “a smart city is the only system in which organically interconnected are city communications, information technology data transmission and IoT (Internet of Things) devices. The goal of creating a smart city is to improve and simplify city management, improve the urban environment, provide security and improve the quality of life of the city’s residents.” The smart city system operates through the continuous processing and updating of data coming from information channels.

Primary electronic devices, the IoT itself – various sensors, meters, surveillance cameras, etc., actively collect information on the state of urban communications and infrastructure, supplemented by information that is obtained directly from the city’s residents. For the purpose of the transmission of collected data, high-speed communication network channels are used, through which the information is transmitted as quickly as possible to the next level – to the data processing center (data center). After computer processing of the collected data, the analysis of the obtained results is carried out, and the information is transferred to the higher level of management and analysis – to the services of the city administration, which conducts the data audit and chooses the ways of optimization and improvement of the efficiency of the municipal economy.

It is very important that IoT end-points integrated with modern communication technologies can collect data in real-time, which allows the most efficient and effective solution to the problems of urban amenities (Horoshko 2018).

In order to implement the concept of 'a smart city', a number of technologies and solutions based on them are needed. It is possible to distinguish four basic elements in the technological structure of smart cities, namely:

- Internet of Things, a technological concept which allows collecting the necessary information from objects and provides feedback with them;
- data transfer infrastructure, connecting applications with objects of urban infrastructure;
- data analysis systems that allow selecting useful information from a large amount of data;
- a system of aggregation and unification of data, designed to organize and synchronize huge flows of information (Huawei Russia 2017).

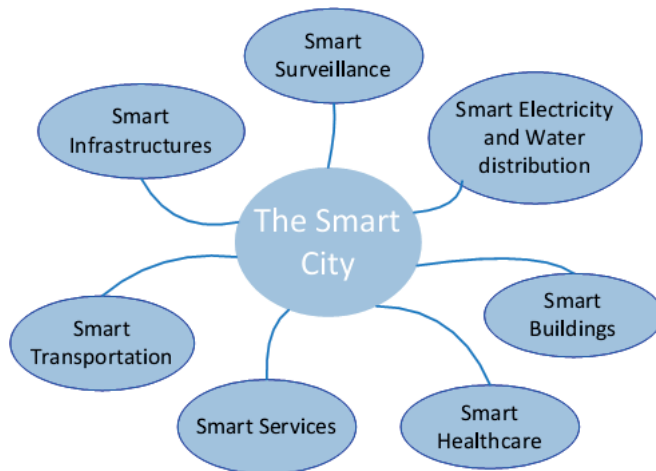


Fig. 1. Structure of a smart city

Source: Hancke et al. 2013.

In science and practice, many approaches to understanding the basic components of a smart city are presented. Its structure can be represented in an integrated scheme (Fig. 1).

The list of areas that require introduction of smart technologies covers virtually all areas of the city economy and urban infrastructure, including banking, building, commerce, e-government, communications, education, energy, emergency, public catering, healthcare, manufacturing and services, transport, retail, public safety, environment and environment monitoring, water and gas supply and many more. The general scheme of the process of 'intellectualization' of urban management is given in Figure 2.

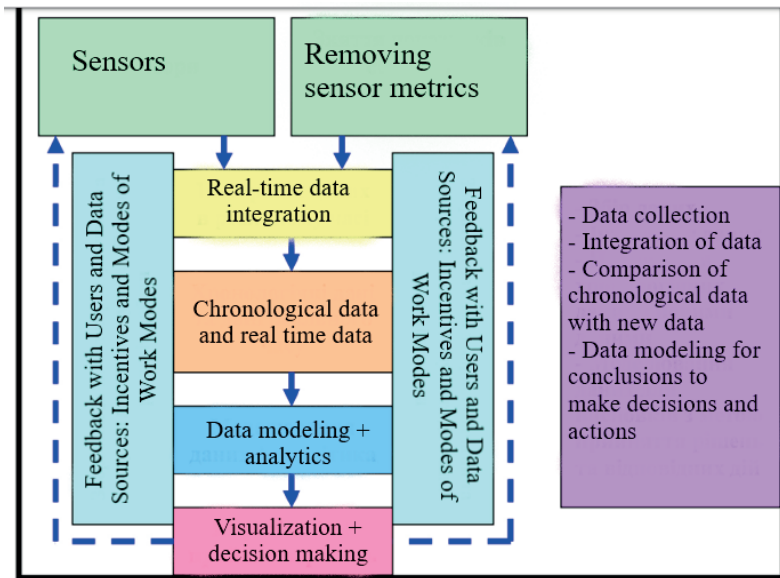


Fig. 2. General scheme of the functioning of a smart city

Source: Sokolovska 2014.

The use of Smart City instruments in Poland and Ukraine

An urbanist expert – Bill Hutchinson, offered an interesting and understandable classification of smart cities: versions 1.0, 2.0 and 3.0. In the smart city 1.0, there is no general strategy, automation affected individual components that are not interconnected. In the next version, i.e., 2.0, there is an association and interconnection of previously independent initiatives and the largest number of different sources of information. Version 3.0 assumes that the integration of all components is complete, and the whole infrastructure is literally infused with intelligent technologies.

The general current situation in Ukraine is as follows: the overwhelming majority of settlements are at the beginning of the road to the smart city version 1.0. Throughout Ukraine one can find examples of only individual projects that fit into the smart city concept. Although Kiev, Lviv, Odessa, Dnipro, Vinnytsia, Ternopil and other cities 'declared' their desire to become smart cities and intensified their activity in this direction. Especially active today is implementing the concept in Kiev – the capital city of Ukraine.

In turn, in Polish medium-sized and large cities, such as Krakow, Łódź, Gdańsk, Wrocław, Poznań, there can be found some examples of the use of various smart city instruments. These are most often city bike rentals, traffic control systems, lighting lamps, phone applications that allow exploring the city or buy a public transport ticket, etc. However, these are individual instruments that facilitate city management in various areas. It is still too little for any Polish city to function as a comprehensive smart

system. They reflect B. Hutchinson's version 1.0 of the smart city. The most technologically advanced city is Warsaw.

Warsaw

In Warsaw, the city authorities implemented IT systems managing the agglomeration and their communication within a common system. One of its elements is the 19115 communication platform. It is a Contact Center that allows residents to handle notifications, requests and inquiries, which are then carried out by competent organizational units of the city (e.g. Municipal Roads Authority or Municipal Police) or districts (vehicle registration, housing, registration, etc.). Therefore, this platform performs both informative and intervention-related functions. It works 24 hours a day, 7 days a week. The system is based on CRM (Oracle Siebel) and Call Center (Interactive Intelligence) applications. After reporting a case, residents can monitor its progress. Everything is done via telephone, Internet portal or application on mobile devices (Warsaw City Hall 2019a). Another element of the Warsaw IT system is the open data platform. It contains over 200 data collections from the City Hall and municipal units. They include spatial information (orthophotomap, ATMs, healthcare, accommodation), city transport (public transport runs, city bike, stops, paid parking zones), sports and recreation (tourist information, sports facilities), history and religion (cemeteries, historical maps), education (list of facilities) (Warsaw City Hall 2019b). Cities increasingly use the potential of Big Data. They can be used, for example, to analyse movements of groups of residents and tourists. From the infrastructural point of view, it can be important to identify the routes people take to and from work. In the case of planned road repairs, it will be easier to mark road detours, and after the renovation is completed, it will be easier to check how the investment contributed to the improvement of traffic in the renovated area of the city.

The City of Warsaw organizes and supports competitions, hackathons and programming marathons, during which applications are created using available public data. Then these applications are made available to residents and all interested partners (Knight 2018: 11). Examples of such events are Wawcode and Rat Relay. Hackathons are limited in time meetings of programmers, interface designers, graphic designers, entities interested in software development as well as citizens and organisations focused on creating new solutions. The effect of these events can be software applications that meet the expectations set by sponsors. The added value of civic hackathons is the opportunity for private entities to interact with public authorities through modern technologies. A hackathon is a type of event that can be described as an idea competition. It is based on the principle of competition leading to open innovation processes. The competition is about designing and implementing a digital service prototype for a specific purpose based on open participation. Governments publish data from various areas, while participants transpose their interests and skills into the public good (Thoreson 2013: 28). In this way, benefits are reached through the engagement of both

parties. For the authorities, this means greater transparency of activities, establishing communication with citizens and the opportunity to use innovative ideas (Brown 2007). Moreover, applications resulting from the open data contest affect inclusiveness, deliberation, influence, publicity, mobilisation, and knowledge production, which translates into more democratic governance (Jäske and Ertiö 2019). In turn, for citizens, this is a way to develop their skills and interests and implement solutions that reduce their problems. Furthermore, they develop their soft skills through teamwork, joint problem solving and conflict resolution. In this way, new relationships are created.

Citizens of Warsaw and tourists have at their disposal many mobile applications that facilitate, among others buying a ticket, paying for city parking, checking the departure time, planning a route, or estimating the actual time of arrival of a bus or tram based on vehicle location data provided by Warsaw. Work is currently underway on the implementation of the Integrated City Card. This project is to be completed by 2023. It assumes creating a special system for residents to facilitate the use of public services, especially urban transport. The relevant card can be stored on various types of carriers, such as smart cards or mobile devices (smartphones, tablets, etc.). As part of this project, new solutions will appear, including payment or travel planning. It is also planned to introduce a digital travel assistant, thanks to which it will be possible to choose and optimize the journey, 'end to end' with the use of transports of various carriers, including rail ones. The passenger information system will cover parking lots, city bikes, electric car rentals and charging stations. It is also planned to introduce a system of simple and convenient payments for journeys by public transport, making the payment dependent on the distance traveled. It will be possible to book and settle accounts for other city services, and joint loyalty programs will also be created. Interestingly, the card can also be used in other cities that have implemented a similar system. The greater popularity of public transport means fewer private passenger cars on the streets, which will have a positive effect on the natural environment and will help in the fight against smog in the capital and surrounding municipalities (Warsaw City Hall 2019c).

Warsaw authorities pay a lot of attention to reducing pollution, especially air pollution. There are already several dozen electric buses in Warsaw, and 140 more have already been ordered. In the coming years, the capital will replace the public transport fleet with electric and gas vehicles. Apart from this, in order to combat smog, the city has recently purchased two special drones equipped with cameras. They monitor buildings where rubbish and other harmful substances are burned.

The city authorities also encourage residents to leave their cars in parking lots and use city bikes. One of the largest city bike systems in Europe operates in the capital. It is an important element of the transport ecosystem of Warsaw. In 2017, it was used by 610 thousand users who rented bikes five million times.

Still another element of the city's ecological policy is applications for the phone. For the sake of clean air, the 'Million trees' application was created. It allows the user to indicate the place where a tree should be planted. The application was launched in the

spring of 2017. Residents of Warsaw joined the action in large numbers, indicating so far over 8.5 thousand such places.

An interesting solution is also the Warsaw Air Index. It is an official municipal system that allows checking the air quality in the capital, as well as to learn about the forecasts of changes in the level of harmful dust concentrations in the atmosphere. Its important elements are recommendations regarding the activity of residents outside and warnings related to the occurrence or forecasting pollution for the next day. In the coming years, it is planned to install 100 additional air quality monitoring devices (Knight 2018).

In May 2018, the City Council adopted the Development Strategy #Warszawa2030. It was developed in the process of social consultations lasting many months. The strategy includes many important issues for the smart city concept, for example, the role of social participation, co-decision about the city, development of creative potential, generating innovation and creative response to challenges. It should be emphasized that Warsaw, with its base of incubators and various forms of support, is becoming a significant center for the development of entrepreneurship, innovation and start-ups. It is influenced by numerous initiatives undertaken by the public, private and scientific sectors. The activities carried out in the modern spaces of the Smolna Center of Entrepreneurship and Targowa Creativity Center prepared by the city gather a constantly growing group of start-ups and developing companies. They also host events in the area of promoting entrepreneurship and new technologies.

Kiev

In April 2015, the Kiev Smart City Project commenced, which has so far been aimed at developing possible directions and the formation of an official roadmap for transforming Kiev into a smart city. In Kiev, the focus is on 'smart governance' (including e-governance, opening urban accounts and ensuring transparency of public administration actions), 'smart transfer' (in particular, incentives to use special vehicle traffic programs and track traffic intensity on roads and parking) and 'smart life' (introduction of Wi-Fi coverage, video control systems, etc.). Already in the first year of the project functioning, the street lighting system was changed by replacing the existing light bulbs with energy-saving LED lamps and introducing a computerized street lighting control system that limited energy consumption and reduced city budget expenditures. Thanks to the implementation of the concept of 'Kiev Smart City', it is planned to reduce traffic congestion to 25%, reduce energy costs by 40%, and increase the use of urban transport to 50%. According to expert estimates, the implementation of the project will amount to about UAH 320 million. These funds are planned to be raised both from public-private partnership and investment and personal investments of business entities (Ukraynska Pravda 2015).

The priority directions of the concept implementation were selected including efficient management of utilities services: energy, water, solid waste and waste water, use, storage and processing of renewable energy sources; ensuring favorable conditions

for business and attracting investments, developing electronic forms of education and involving citizens and business in the field of urban innovation; e-government, which provides for the creation of mechanisms for active participation and involvement of Kiev residents in city administration (in particular, the system of E-petitions), definition of strategies for its development, transparency and control over urban policy (open city budget); use of modern technologies for qualitative changes in the field of transport (public program on road safety and control over violations of the rules of the traffic); improvement of medical care of Kiev, in particular the creation of a medical portal and the implementation of the 'Polyclinics without queues' project, the use of technologies for security, rapid response to emergencies, timely response to the problems of cities (Kyivsmartcity 2019).

The traffic lights that prevent the congestion and the charging stations for electric cars in city parking lots are all in the plans of Kiev officials. However, one of the main tasks of smart cities is to protect the environment and save energy. Therefore, for example, in Kiev and the Dnieper, with the help of DTEK, the installation of energy-saving lights has already begun. Solar panels collect energy in the daytime and feed lights at night. One saves up to 3.5 euros a day (*Segodnya* 2019).

Analyzing the best practices of Ukrainian municipalities, one can conclude that most of them are moving in the right direction; however, they do so at different speeds. The undisputed leader in this process in Ukraine is the city of Kiev. Accordingly, it is worth considering here in more detail the main aspects of implementing the Kiev Smart City Concept 2020 (Kyivsmartcity 2019), which envisages the development of the city in certain key areas. In particular, according to the concept, in 2019, the 'Public Budget' allocated UAH 150 million. In 2018, 140 projects were implemented, for which 130,000 people voted. 4,500 petitions have been posted on the KCSA website since 2015, 49 of which received the necessary 10,000 votes and six have been implemented.

In terms of globalization, traditional means of interaction between public authorities and local self-government with citizens are not sufficiently effective and need reforming. Modern information and communication technologies are increasingly being used to create new, more convenient methods of accessing information and providing administrative services. That is why, on 23 January 2019, in the test mode, there was launched the upgraded system – 'The only web portal of the territorial community of Kiev.' This is a new service for the residents of the capital, where they can monitor the activities of the city authorities. The new portal of the Kiev City State Administration aims to gather all information about city life and services that can be used by the residents of Kiev. It is the only web-portal to be the point of access to all digital services of the capital and will contain up-to-date information about everything that is happening in Kiev. Also, the Contact Center of the city of Kiev has been set up, whose employees accept complaints and suggestions from residents of the city to improve the quality of life in the capital. Residents can contact the center either on-line or by registering on the site and leaving the relevant request. 1,047.827 appeals from Kiev were registered in 2017, 179,161 of which came through the site. Integration of the Contact Center with

IAS 'Maine' is already underway, as well as an application for all of the most popular mobile platforms.

Kiev is the first city in Ukraine to fully implement the 'Open Budget' system. This start-city tool provides an opportunity to open for the city all financial transactions carried out by the city, ensuring their full transparency. All data in the system are valid, maximally protected, and their exchange is automated. There is also the possibility to switch to the system of electronic purchases and to view how the auction took place. Scanned contract is available. And in the section of districts you can view the 100 largest taxpayers.

In terms of the system of electronic government procurement, Kiev is ahead of the entire country. After all, the capital itself became the springboard for the deployment of Prozorro, the first city that has completely switched to this system and still holds leadership in terms of use. Currently, 1,800 structural units make purchases through the Prozorro system. Over its period of operation, the capital has already saved more than UAH 2.5 billion of the budget funds.

E-petitions are available to the residents of Kiev, too. Electronic petitions to the Kyiv City Council give Kievans the opportunity to participate in the development of the city and directly influence the authorities, cooperate with them on important issues, and build a public dialogue. In the case of collecting 10,000 signatures for a period of 90 days under a petition for each of them, the Kyiv City Council, in the person of the Mayor, within 10 days, promotes an official position on the support or non-support of the petition. In the case of support, the process of public dialogue and cooperation begins, a relevant working group with the author of the petition involves the relevant committees of the city council and the KCSA departments. Thanks to one of such petitions night connections appeared in Kiev public transport.

Kyiv Citizen Card 'Kyiv Card' is the only card for access to city digital services. With its help one can identify himself as a city dweller, keep his personal history and the card gives him access to the city's information and communication infrastructure. The main modules are medicine, utilities, transport, trade, education, admin services, culture, and insurance. Function cards are now being updated, new modules are being developed and they will be accessible to a large number of Kievans.

E-services – implementation of information activities by executive authorities in the form prescribed by law and the provision of informational products electronically to the attention of consumers. The purpose is to meet the information needs of citizens in public (administrative) services. Services are categorized for citizens and businesses. Locals can find answers to many questions of public life, ranging from choosing the name and surname of your child to registering ownership of real estate. Business services consist of more than ten sections. They include, in particular, education, medicine, culture, transport, the environment, etc.

It is also worth noting the Information System of Kiev. The service promptly informs about events in Kiev – changes in traffic, roadblocks, disconnection of utility services, emergency events, search for donors of blood, etc. Email and SMS are free. The Depart-

ment of Information and Communication Technologies is currently working on the creation and implementation of new functional notifications, which can be received, in particular, through all major mobile messengers. 60,000 Kievans have already subscribed to the information service. 20,000 of them regularly receive SMS messages. GPS tracker is a receiving and transmitting device designed for remote monitoring of the location of a mobile object. By link, you can track 478 GPS trackers that are installed on public utilities in Kiev. This allows monitoring the location and operating conditions, in particular, snow removal equipment. So, for example, during winters, it is possible to control how the city is removing snow.

Summary and conclusions

Smart cities in the 21st century have become the basis of economic growth and social progress, since the transformation of functions in the traditional sense is taking place through the use of information technologies that enable them to solve the most difficult problems as well as to change the management system qualitatively, which will ultimately ensure the creation of conditions for development of community and every person. Smart city decisions of local authorities create additional opportunities for increasing the city's value, its investment attractiveness. The significant spread of modern technological solutions, especially in the sphere of municipal management, increases the efficiency of the use of resources, ensures the development of economic potential, the establishment of new business directions, as well as improves the quality of life of the citizens of the city, as emphasized in the work by Marciniak and Owoc (2013).

The present study leads to the conclusion that in order to remain attractive and competitive during the fourth industrial revolution, cities should be transformed and this transformation should be carried out in accordance with the demands of the fourth industrial revolution and those of their community. At the same time, the concept of a 'smart city' as a complex system of information and communication and social technologies is expected to solve the need to solve the imminent problems in the near future and ensure the efficient functioning of modern cities. We are deeply convinced that technology and innovation are an integral part of a smart city. Smart technologies can be applied in all areas of the city's life and its management sectors: administrative services and e-governance, energy, education, health care, construction, transport, public life, and others. It is their use in the city that allows improving the quality of services, to establish city processes, to reduce the cost and volume of consumption of resources, to improve communication with the cities.

Despite the fact that the smart city concept is relatively new, the capital cities of Poland and Ukraine are gradually implementing its instruments. New solutions applied in transport, environmental management and administration prove the innovative attitude of local authorities and the awareness of the changes that are a necessity in the face of civilization challenges. Nevertheless, many of these instruments are used

selectively and are not systemic in specific areas of city functioning. It is particularly visible in Warsaw, which included certain elements of the smart city in the Development Strategy adopted only in 2018. It is too early to name any of the analyzed cities a smart city. Both Warsaw and Kiev seem to be in a transition phase between version 1.0 and version 2.0 of the smart city, according to Bill Hutchinson's concept. A positive fact is the dynamics of the changes introduced and the increasing cooperation between local governments and residents who, through consultations, participation in meetings or hackathons, express their needs and support the authorities in satisfying them.

It is worth remembering that technology itself is not a panacea for transforming cities into modern, efficient and comfortable smart cities. We believe that only effective allocation of efforts of municipal managers in the direction of investing resources and capital in the triad of people, processes and technology will allow cities to be successful in the conditions of modern dynamic changes and transformations of public life.

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