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PATTERNS AND DYNAMICS OF THE FORMATION OF SMART CITIES IN THE WORLD AND IN UKRAINE

The article deals with the patterns and dynamics of the formation of smart cities and describes the problems and prospects of the mechanisms of formation of smart cities in the world and in Ukraine. The purpose of the work is to compare the main achievements in the implementation of smart cities in Ukraine and in the world, in particular, on the example of the European Union countries, where today there are about several innovative models of smart cities. That is why, on the example of intelligent cities of the EU, Ukrainian cities should actively borrow experience and make every effort to develop a strategy for the introduction of an innovative model of a smart city.

Key words: smart city, Ukraine, EU, Europe, innovation model, smart city concept.

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ЗАКОНОМЕРНОСТІ І ДИНАМІКА ФОРМУВАННЯ УМНИХ ГОРОДІВ В МИРІ І УКРАЇНІ

В статті розглядаються закономірності і динаміка формування умних міст і описуються проблеми і перспективи механізмів формування умних міст в Україні та в світі. Мета роботи – порівняння основних досягнень у впровадженні умних міст в Україні та в світі, зокрема, на прикладі країн Європейського Союзу, де на сьогоднішній день існує декілька інноваційних моделей умних міст. Саме тому на прикладі розумних міст ЄС українським містам слід активно переняти досвід і застосовувати максимум зусиль до розробки стратегії впровадження інноваційної моделі розумного міста.

Ключові слова: умне місто, Україна, ЄС, Європа, інноваційна модель, концепція розумного міста.

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ЗАКОНОМІРНОСТІ ТА ДИНАМІКА ФОРМУВАННЯ РОЗУМНИХ МІСТ У СВІТІ ТА УКРАЇНІ

У статті розглянуто закономірності та динаміку формування розумних міст й описано проблеми та перспективи механізмів формування розумних міст у світі й в Україні. Мета статті – порівняння основних здобутків у впровадженні розумних міст в Україні та світі, зокрема на прикладі країн Європейського Союзу, де на сьогодні

існує близько десятка інноваційних моделей розумних міст. Саме тому на прикладі розумних міст ЄС українським містам слід активно запозичувати досвід та застосувати максимум зусиль до розробки стратегії впровадження інноваційної моделі розумного міста. Сучасні механізми розвитку відкритості, незалежності й унікальності міст у світі та Україні, у тому числі, насамперед, уключають створення інструментів для розвитку партнерських відносин між громадянами, державними структурами та бізнесом. Тому визначення «розумне місто» набуває все більшої популярності. Нова концепція міського розвитку передбачає розумну мобільність, навколишнє середовище, управління, інфраструктуру та, передусім, розумну економіку. Відтак питання, що стосуються концепції розумних міст в Україні, безумовно, є актуальними.

Ключові слова: розумне місто, Україна, ЄС, Європа, інноваційна модель, концепція розумного міста.

Formulation of the Problem. Modern mechanisms for the development of openness, independence and uniqueness of cities in the world and Ukraine, including, first of all, the creation of tools for developing partnerships between citizens, government structures and business. That is why recently, the words «smart city» or «intelligent city» are becoming increasingly popular. A new concept of urban development called a smart city implies smart mobility, the environment, governance, infrastructure and, above all, a smart economy. That is why the issues concerning the creation and development of concepts of smart cities in Ukraine are undoubtedly relevant.

Analysis of Research Problems. Among the scholars Phil Goldstein, Mark Gregory, Manfred Shnepshneppe and others were exploring the topic. The obtained results give the basis for the formation of a new vision in the field of smart cities development.

Several years ago, the trend of smart cities was considered to be inherent exclusively in the «Western civilization», Japan and China, that is, the countries that achieved an innovation breakthrough and long established their leadership in this field. However, today there are other trends: in the next 10 years, half of the world's smart-city will be located outside of North America and Europe – at least such information in forecasts up to 2025 was promulgated by analysts of the IHS and Frost & Sullivan companies [8].

By 2018, significant increases in traffic (both mobile and cloud services) are expected in Middle and Middle Eastern cities: some progress has already been made – Tel Aviv is recognized as one of the leaders in creating a smart city by 2014 due to the program Digi-tel. This program personalizes a number of city services for citizens, using data from the «cloud» [18]. In the same direction another innovative city – Dubai. Recently there was launched a universal mobile application for government services; There are plans to launch 100 smart buses all over the emirate and other interesting smart staff [15].

The movement of cities towards the intelligent technological community demonstrates not only the desire of city leaders to turn them into centers of technology, but also the correspondence of such technological aspirations to demographic trends. According to the UN, the population in the world by 2050 will be 9,8 billion, and the level of urbanization will reach 70 % by the same time [19]. Not only traffic in the largest cities of the world will increase, but also consumption of energy and drinking water. Therefore, for cities in different regions of the world, the transition to smart-services and technology is not only an option for «advanced» residents, but also a prerequisite for community survival and infrastructure development and living conditions.

World experience shows that every city turn in to the smart city in its own way. In some cities, emphasis is placed on the deployment of security and crime prevention, in others on e-government, the «reasonable» regulation of traffic or the improvement of the environmental situation. In fact, the choice of the path should be due to the fact that most of the problems currently affect the cities. As for Ukraine, it should be said that problems exist in almost all spheres of city life. Attention should be focused on the introduction of technologies that reduce corruption and non-targeted costs in utilities, electronic procurement systems, a single property management system and a number of other similar initiatives. It is also important to improve traffic safety, traffic control and, given the high energy prices, effective energy savings. In order to succeed in the above-mentioned smart implementations, one should definitely pay attention to the experience of foreign countries that have achieved remarkable success in building own smart cities.

Across the globe, there are undoubtedly dozens of smart cities that have achieved significant success in this area. That is why Ukraine should actively borrow the experience of such cities. However, it would be ineffective, for example, to borrow experience from such pioneers in a smart city concept like Singapore or Hong Kong, as these cities are already at a different level of development and, due to their geographical

remoteness, cannot be taken as an example. That is why it is necessary to focus, first of all, on the European countries, where cities are increasingly introducing the concepts of smart cities. This direction is important due to the European choice of Ukraine and the all-Ukrainian goals of rapprochement with Europe.

One of the countries that has been actively launching the concept of smart cities is Estonia. Not so long ago, the country began to receive first benefits from such a novelty. Estonian Smart City Cluster primarily aims to support the development of smart urban solutions to improve the quality of life in cities, as well as to accelerate the export of enterprises. Mainly, attention is focused on the launching of new technologies in different actions and processes of cities and in the development of solutions for energy conservation and sustainable development, as well as effective and economical provision of health and social security [7].

The cities of Estonia have introduced many innovative functions, for example, a register of urban planning procedures, a web-based solution for landscaping and repair work, a city planning program, or the AKIS public events management portal designed for the city of Tallinn. Innovations include several intellectual infrastructure initiatives, such as the reconstruction of former Soviet multistory buildings in energy-efficient and modern buildings, as well as a district cooling system that uses residual heat in the city of Tartu [6]. Solutions for smart street systems, for example, projects in Tallinn in 2017–2020 will include a new system of traffic lights (with motion sensors), an information panel, a meteorological station, a cycle and a pedestrian system with cameras, a street with alternating directions of motion, etc.

One can say that Estonia is the most effective in the European Union to innovate in everyday life of citizens. Tallinn looks like an ancient European city, but in buildings of past centuries and Soviet high-rise buildings live people who use electronic passports, take part in elections and interact with authorities through the Internet. Usage of public transport is for free: the capital of Estonia became the first major European city, in which it was decided that spending money on urban transport is meaningless. That is why Ukrainian cities should actively take Estonian experience in initiating smart cities.

The next European city, which received the status of the smart capital of Great Britain is London. London, of course, pays great attention to the categories that relate to a smart economy. The city has long been considered to be the financial center of Europe, but it has also become a leader in entrepreneurship. The Startup Genome project was ranked seventh in the world's best business ecosystem in London, number one in Europe [17].

Another London city, located in Ontario, Canada, is worth mentioning. Canadian London is just a huge step towards its goal of becoming a smart city. The City's Strategic Plan and The London Plan has identified smart cities and its associated initiatives as an investment that will help London to promote economic development, civil society innovation, sharing of data, while gaining efficiencies and efficiency in municipal processes, all in effort to improve our residents' overall quality of life. The city has focused on four main criteria that are key to building a smart city. Smart Economy which includes creation/enhancement of technology incubators/accelerators/business hubs; attraction/retention of talent to grow digital economy; provision of resources and organizations to support economic development; workforce education/skill development opportunities to support digital economy. Smart Infrastructure which includes optimize the construction/operation/management of infrastructure (water, sewer, transportation, energy and information and communications technology); coordination and monitoring of physical assets through use of digital infrastructure; data collection to assist with municipal decision-making; smart buildings/green infrastructure. Smart Governance and Decisions which includes use of data analytics/metrics to improve corporate decision-making; governance model to support collection/maintenance/dissemination of municipal data; improving and building the corporate digital culture; governance structure for public/private partnerships to operate potential municipal assets. The last one is Smart Living which includes sharing data to allow the public to use and republish data; improve access to and education required to use digital technologies; use of web-based citizen engagement tools/applications to enhance collaboration; create digital service delivery methods to improve customer service [16]. All four aspects are the key to successful implementation of the concept of a smart city.

The next European city that is in the field of innovation is Copenhagen. Copenhagen has established a reputation as the leading green city across the globe. Copenhagen led the Siemens Green City Index for Europe and has also been selected as the European Green Capital for 2014 [5]. Copenhagen has one of the lowest carbon footprints / capita in the world (less than two tons / capita). Copenhagen also has the most ambitious carbon reduction plan of any major city in the world. They aspire to achieve carbon neutrality by

2025. That may sound a way away but that's just 12 years from now. In order to achieve such an ambitious goal, the city has established hardcore goals including energy efficiency and renewable targets, green building standards (all new buildings being carbon neutral to 2020) and increased access to the transit to name a few. It is impressive fact that cycling rates in the city-about 40 % of all commutes are conducted by bike. The city also recently collaborated with MIT to develop a smart bike equipped with sensors to deliver real-time information to not only the rider but also to the administrator for the open data aggregation on issues of air pollution and traffic congestion [4].

Barcelona is the undisputed leader in Europe in introducing various types of innovations and ideas for a smart city. The city, which annually organizes and hosts Smart City Expo World Congress, is undoubtedly the leader in Europe to implement the concepts of smart cities. Barcelona became the first city in Spain, which received the status of a smart city in 2013, taking the fifth place in Europe, ahead of such well-known cities as London and Paris [14]. Definitely Barcelona is the epicenter of technology and innovation. But, it's not always necessarily a technology that makes a city «smart». According to Boyd Cohen, a renowned urban and climate strategist, Smart City ranks high on these six «Smart» indicators: Smart Economy, Smart Environment, Smart Government, Smart Mobility, Smart Living, and Smart People [3]. Its citizens live in vibrant culture with an open government trying to improve green living spaces, and it makes wise investments in the future.

However, Barcelona, just like a smart city, forms several components. Firstly, citizens are involved in a transparent government. Citizens are provided more accessible, effective, and democratic opportunities. Among them, such programs as: *Bústia Ciutadana* – citizens can complain, file reports of city problems such as broken street light, or make suggestions. The data is sent to a central location, and the authorities respond to the user promptly; *IDBCN* – this application allows citizens to digitally identify themselves remotely. They can get a Barcelona residence certificate, check their registry details, or even locate their towed vehicle [12]; *Open Data BCN* – this is public information that is available for everybody to reuse it however they like. Citizens, businesses, and other institutions can use the info such as election results, population, public facilities, or economy to generate new services instead of starting from scratch [13]. For example, according to the Microsoft Case Study of Barcelona, they can open data about Barcelona's citywide festival, *La Mercè* – to find out how people moved, their interests, or entertainment venues. Then they can use this data to improve the logistics for future «festes». Also, Barcelona is the Mobile World Capital. Since 2011, Barcelona beat out 29 other cities as the Mobile World Capital from 2012 until 2018 [9]. Barcelona was an attractive candidate because of its conference and exhibition facilities, tourism and transportation infrastructure, and its commitment to extending the reach of mobility locally and nationally. Over 72,000 people attended the Mobile World Congress [10], the massive international telecommunications event. Supposedly, the grand four-day affair has created more than 7,000 temporary jobs and added a whopping 350 million euros of extra spending to the local economy. And that is general benefit for the people.

Another important component, which today is more than just a smart city, is energy conservation and alternative energy sources. With seven hours of sunshine a day, Barcelona has taken advantage of the ample solar energy. Barcelona Energy and the Barcelona City Council implemented a sustainable energy initiative, making Barcelona the first city to require to use solar water heaters in 2006 [20]. the Barcelona Solar Thermal Ordinance also regulated all new large buildings such as hotels, hospitals, gyms, or swimming pools to produce their own domestic hot water, lowering emissions. This ordinance is the first of its type to be executed in a European city, and other cities have followed suit. Already in use in 78 buildings and is expected to expand, the *Districlima* heating and cooling system produces green energy «equivalent to planting 548,000 trees, or nearly 4 times the number of trees in Barcelona». The heating uses steam from the incineration of urban waste and the cooling uses seawater for refrigerating, producing less fossil energy consumption and carbon emissions [2].

Barcelona's transport system, *Transports Metropolitan de Barcelona (TMB)* recently debuted a new orthogonal bus network (horizontal, vertical and diagonal lines), making it faster, easier to use, and more frequent, among other features. Its goal is for the traveler to make one transfer between any two points in Barcelona in 95 % of its journeys. The bus system also has urban sustainable mobility, reducing emissions with hybrid buses. One of the cleanest surface public transport fleets in Europe, it also has smart bus shelters using solar panels and screens provides waiting times [11].

More efficient lighting using LED technology is being installed in Barcelona to reduce cost and

pollution. These lights optimize energy and use a smart function: it activates when detecting motion, but also gathers environmental information, humidity, temperature, pollution, and noise. Last but not least, 22@, the districte de la innovació (innovation district) was approved in 2001, and it's a daring and experimental project of urban planning and entrepreneurialism. 22@ is a regeneration project: the use of refurbished buildings in a neglected part Poblenou, a former industrial hub. Municipal leaders are engaging the private sector – companies, universities, research, and communities work in close proximity in clusters in these buildings to accelerate the pace of knowledge sharing and quickens innovation. They're also creating subsidized housing and green spaces. Interestingly, they've created the Barcelona Urban Lab, a public space where companies can pilot test their products that will improve city living, such as the parking and rubbish bin sensors mentioned above.

22@ is proven to be successful because of its sustainability – the five clusters are all united by green infrastructure. Also, from 2000 to 2007, 1,000 new companies and 31,000 new employees were working, an impressive amount of growth in a short period of time [1]. Now, other international cities like Rio de Janeiro, Cape Town, and Boston have followed Barcelona's lead.

Barcelona, of course, is not a perfect city. However, while introducing innovative technologies for the government and mainstream society, the city can really be called smart. It is these aspirations that make it possible to succeed, first of all, for the better future of the city.

Conclusions. Consequently, without the use of innovative technologies at this stage of development of society it is impossible to increase the efficiency of city management. The experience of using innovative systems and technologies in other cities, in particular in the European Union, can be successfully applied to improve the quality of the development of the inland concept of a smart city. So, in Ukraine about smart cities there is still only talk. The problem is that almost a single city cannot fully cover the concept of a smart city and effectively begin to rebuild it into a practical one. The greatest attention is paid to the infrastructure of cities, which is built on new technologies and management systems that allow to use energy sources rationally and minimize the negative impact on the environment. These include new technical solutions in the areas of electricity supply, water supply, resource management, waste management, and the creation of a more efficient transport system and the construction of so-called «smart» buildings.

All this is definitely important, but it's not a complete complex. On the example of European cities, one can see that there is still a reasonable government, intelligent people, a reasonable quality of life and other components of the system. Sharing experiences and practices with a focus on the full range of components of the concept of a smart city is the key to building the concept of smart cities in Ukraine.

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СТРУКТУРНІ ПЕРЕВАГИ ПРОМИСЛОВОСТІ УКРАЇНИ: МАКРО- Й МЕЗОРІВНЕВІ ПОРІВНЯННЯ

Розроблено методичний підхід та інструментарій оцінювання конкурентоспроможності промислового сектору економіки, який уключає визначення внутрішньої й зовнішньої ефективності його функціонування. Проведено порівняльний аналіз структурних переваг промисловості України та її областей із ЄС-28 за показниками частки промисловості у випуску економіки, валовій доданій вартості (ВДВ) економіки, експорті ВДВ, а також за показником частки ВДВ у випуску промисловості. Агрегуванням названих вище показників розраховано коефіцієнт структурних переваг промислового сектору національної економіки в регіональному розрізі. Запропоновано організаційно-економічні механізми зниження витратності вітчизняних виробництв, які, зокрема, передбачають оптимізацію схем розміщення та взаємодії промислових підприємств і вдосконалення управління матеріальними потоками.

Ключові слова: промисловість, структура, випуск, валова додана вартість, ефективність, експорт.

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СТРУКТУРНЫЕ ПРЕИМУЩЕСТВА ПРОМЫШЛЕННОСТИ УКРАИНЫ: МАКРО- И МЕЗОУРОВНЕВОЕ СРАВНЕНИЕ

Разработан методический подход и инструментарий оценивания конкурентоспособности промышленного сектора экономики, который включает определение внутренней и внешней эффективности его функционирования. Проведен сравнительный анализ структурных преимуществ промышленности Украины и ее областей с ЕС-28 по показателям доли промышленности в выпуске экономики, валовой добавленной стоимости (ВДС) экономики, экспорте ВДВ, а также по показателю доли ВДВ в выпуске промышленности. Путем агрегирования указанных показателей рассчитан коэффициент структурных преимуществ промышленного сектора национальной экономики в региональном разрезе. Предложены организационно-экономические механизмы снижения затратности отечественных производств, которые, в частности, предусматривают оптимизацию схем размещения и взаимодействия промышленных предприятий и совершенствование управления материальными потоками.

Ключевые слова: промышленность, структура, выпуск, валовая добавленная стоимость, эффективность, экспорт.