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## INNOVATION-BASED CITY AS A RESULT OF THE EVOLUTION OF THE SMART CITY SPATIAL ORGANIZATION

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**Introduction.** The beginning of the third millennium is marked with the powerful implementation of IT technologies in all spheres of the modern society life, in particular, for the transformation of the spatial organization of the city as a whole.

**Problem Statement.** The functional and socio-planning organization of the territory of Ukrainian cities, as formed during the industrialization period of the 1930s and the restoration of the national economy period of the 1940s and 1950s, has been increasingly contradicting the general world trends in the formation of a modern comfortable living environment and needs to be reformed.

**Purpose.** The purpose of this research is to identify trends in the formation of the urban space functional planning organization during the post-industrial period of society development and directions for the transformation of the territory and buildings from the existing condition into an innovation-based city.

**Materials and Methods.** Systematization of results of the analysis of scholarly research publications, legal framework, and information sources in the field of urban design during the post-industrial period of society development; graphoanalytic method of design and planning documentation analysis; structural and logical modeling.

**Results.** The evolutionary stages of the transformation of the "ideal" city paradigm from Renaissance cities to modern "smart" and "innovation-based" cities have been characterized. The conceptual differences in the formation of the spatial organization of the smart and the innovation-based city have been identified; the features of horizontal and vertical urban space polyfunctionalization have been formulated. The principles and recommendations for the possible transformation of the Ukrainian cities territory have been developed.

**Conclusions.** The key principles for the formation of the human comfortable and safe living environment evolve in strict accordance with the engineering, technological, and social basis of the society development. The current stage is characterized by the active implementation of the cutting-edge IT technologies in all spheres of life, causing the need to transform the urban space from the monofunctional use of territories to the horizontal and vertical polyfunctionalization. Such trends shall be enshrined in the legislative and regulatory framework of urban planning for the further implementation into the reconstruction practice of Ukrainian cities.

**Keywords:** ideal city, smart city, innovation-based city, spatial organization, monofunctional use, polyfunctionalization of urban space, city reconstruction.

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With the beginning of the new millennium, the 4<sup>th</sup> industrial revolution has actively embraced the system of industrial, organizational, business and cultural relations of the world community, radically changing people's perceptions of activities and labor market, comfort and safety of the environment both globally and in the daily life of each individual [1–3].

Scientific breakthroughs (scientific revolutions) and fundamental changes in technology lead to a qualitative transformation of the economy and a significant transformation of society. One of the characteristic features of the 4<sup>th</sup> industrial revolution is the use of artificial intelligence and robotics in a growing number of areas that are not limited to production and business, but increasingly involving education, health care, and even culture [2]. The spread of IT technologies and the Internet, which unites more and more participants in different processes and different vector interests, leads to the fact that almost everything becomes part of a single global network governed by the same laws of the development of space and personality. The innovative processes of globalization have particularly brightly manifested themselves in the evolution of urban space as the environment for maximally concentrated and active human life [4, 5].

The initial stage of the introduction of innovation-based approaches to urban planning has led to the formation of a new model of spatial organization of the economy both at the national and regional levels, namely to a new system of placement of means of production and the formation of a new settlement system [6, 7]. The second stage of the evolutionary transformation of urban systems of the post-industrial period of society development is notable for a complex modernization of the architectural and spatial environment of a separate urban object with the gradual formation of a new type of cities, smart cities, known as smart city [8, 9].

An important stage in the development of urban planning in the post-industrial period is a radical change in urban space on the innovative basis of

the 4<sup>th</sup> industrial revolution. Innovative research, creative, and engineering achievements have stimulated the development of regulative and legislative and design activities, which has resulted in the formation of new type of objects – innovation-based urban formations – innovation-based cities built on fundamentally different laws of spatial organization of their territory [10, 11]. At this stage, the innovative city is the next level in the development of urban theory and practice, embodying the most advanced ideas about the ideal environment for human life, which is the ideal city.

### **The Stages of Evolutionary Transformation of the Ideal City Paradigm**

Any settlement that arises in a certain place at a given period of time in the process of its development goes through various evolutionary stages, which mirrors the evolution of people's ideas about a comfortable environment for human life. The factors that cause the need for transformation of urban space directly depend on a set of political and ideological, scientific and technological, economic and cultural features of the development of society at a particular historical stage [12]. In urban planning, a certain aggregate idea of the most rational and comfortable structure of the environment for human life has been embodied in the paradigm of the "ideal city." The common definition of the ideal city concept may be formulated as follows: the settlement that is ideally organized in terms of both social environment and architectural planning and harmoniously combined with the surroundings.

In the course of the millennial development of civilization, mankind has many times revised the concept of ideal living conditions. What is the "ideal city"? The first attempts to create an orderly settlement in which not only everything would be clearly subordinated to the existing hierarchy, but also where there would be completely comfortable living conditions for both the ruler and craftsmen or common people, were made in ancient times, in the Egyptian Kingdom and Roman Empire.

The term “ideal city” was first proposed by Plato in his dialogues *The Republic* [13], where he described the structure of some ideal city-state Atlantis, a fortress with a radial-circular system of streets. Since then, this concept has become a kind of goal that everyone was aspiring after: from the architects of antiquity to modern businessmen. At the same time, each epoch formed its own idea of the ideal city, with the evolutionary stages of urban space transformation shortening, as a result of the acceleration of the pace of scientific and technological progress (Fig. 1).

In the Renaissance, this term makes a new sense. What is the ideal city of the Renaissance? This is a safe city. Numerous threats of attacks had formed the idea of a safe city as a fortress city that performed the functions of defense, governance, and trade. In addition, the city should be beautiful and shaped as a circle, star or sun.

Leon Battista Alberti had come as close as possible to this goal. According to his teaching that was based on anthropometric humanism as key philosophical idea of the Renaissance, the ideal city should fully reflect all the humanistic aspirations of the individual and meet his/her needs. The planning of the territory was based on the principles of regularity and beauty: straight streets divided the city into quarters that were further shaped circular or rectangular, according to the hierarchical principle or depending on the type of business or job of the inhabitants. In the center of the city, on the main square, there should be an administrative building where power was concentrated, a main cathedral, and houses of the elite who ruled the city. The houses of merchants and artisans were located closer to the outskirts, with the lowest strata of the population settling near the very outskirts of the city. There were also schools, libraries, markets, etc. All architectural structures had to have strict geometric shapes and be located at an equal distance from the street.

In the 17<sup>th</sup> century, as manufactories and factory production emerged and more complex social relations in society started to be formed, there was the need for building a socially just society,

with the subsequent reflection of these ideas in the architectural and planning structure of the settlement. The ideas of utopian socialists gave birth to the idea of a new form of organization of urban space. This was a socially just space — the *social city* with equally fair living conditions for different social groups. The most famous among them were Thomas More (author of the idea of a city on the island of Utopia), Francis Bacon (The New Atlantis), Charles Fourier and Robert Owen, who proposed to create a network of small independent communities instead of a large city, evenly distributed within territory of the state [14, 15].

The development of industrial production in the 19<sup>th</sup> — early 20<sup>th</sup> century gave rise to an understanding of the need for the functional ordering of the urban space. The basic principles of the formation of the functional city in the period of industrial urban planning were first formulated by the French architect Le Corbusier in his *Charte d'Athènes* (Athens Charter) (1933) [16]. The most important of them was the principle of clear monofunctional use of the territory. According to the core functions that could be realized in an industrial city (life, work, and leisure), the urban area should be clearly divided into functional zones: the residential (residential communities), the industrial (industrial enterprises, factories, and plants), and the recreational (recreation places, parks, and squares) areas as well as the area of transport infrastructure connecting all the elements into a single urban space.

The principles of *Charte d'Athènes*, which primarily aimed at improving the ecological condition of settlements, underlay the urban planning for many decades, and, in fact, all cities of the industrial period were shaped according to them. These ideas still lay the foundations of the urban planning regulatory framework. Even the latest regulative document in the field of urban planning DBN B.2.2-12: 2019 *Planning and Development of Territories* is based on the ideology of monofunctional zoning of urban areas [17].

The problems of regulating the use of urban areas are closely related to the problem of the eco-

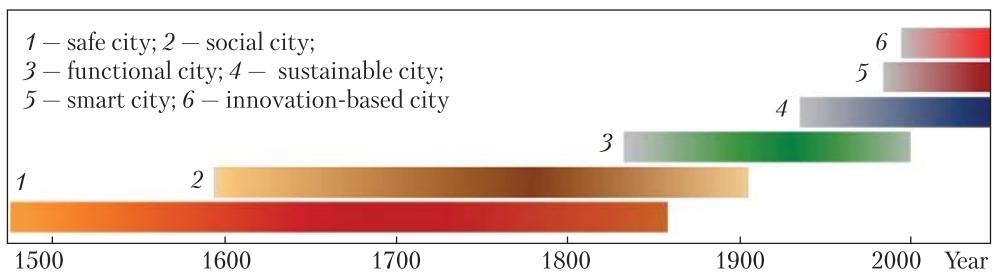


Fig. 1. Dynamics of transformation of the most widespread ideal city models

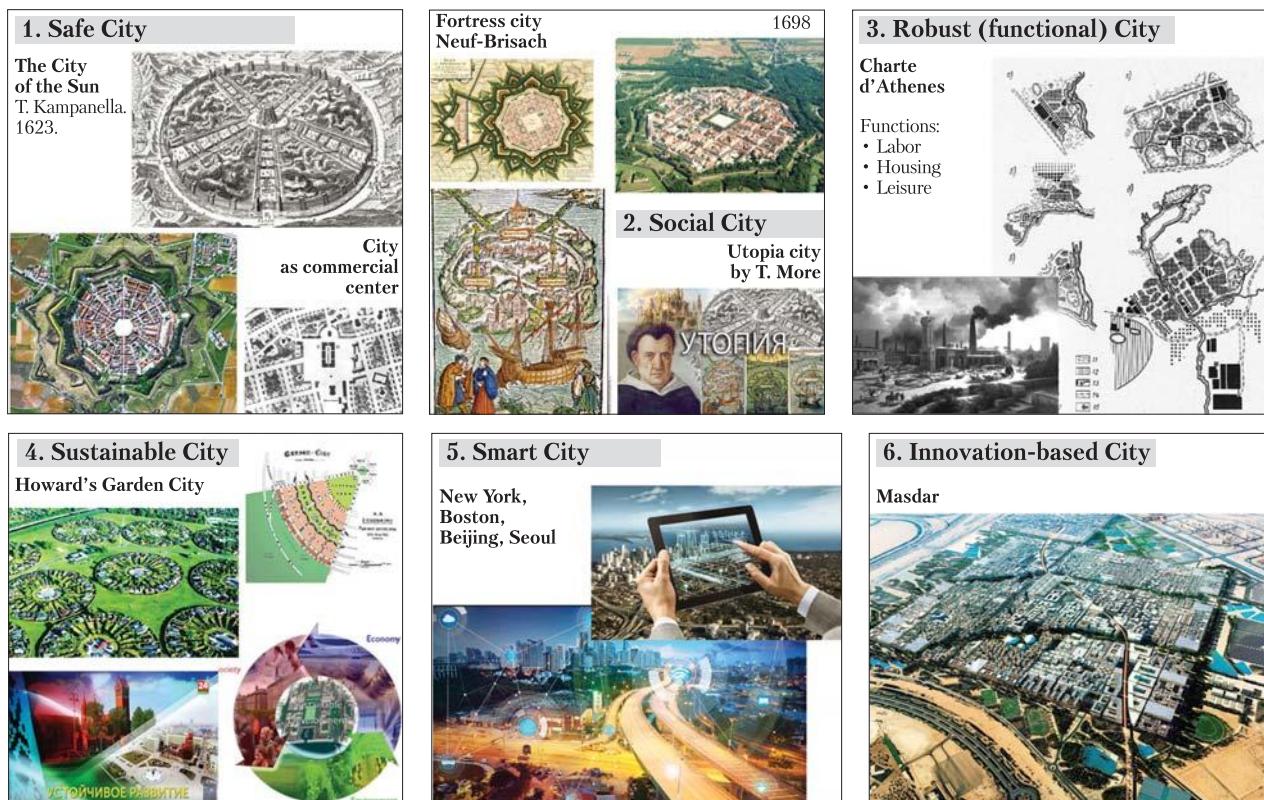


Fig. 2. The most widespread models of the ideal city: 1 – the safe city; 2 – the social city; 3 – the robust (functional) city; 4 – the sustainable city; 5 – the smart city; 6 – the innovation-based city

logical state of the urban environment. As early as at the beginning of the 20<sup>th</sup> century, there had been ideas of ecologically ideal green garden city Howard [14], which by the middle of the century were transformed into an ideology of balanced or sustainable development of both settlements and society as a whole from ecological, economic, and social points of view. There has been an understanding of the need to create the

*sustainable city*. Thus, in the course of the development of the Concept for Sustainable Development of Settlements of Ukraine, the following key criteria of sustainable development have been formulated, according to which the settlement should [18]:

- ◆ have sustainable economic efficiency;
- ◆ be characterized by a high environmental performance;

- ◆ provide a well-developed social infrastructure;
- ◆ maintain historical and cultural attractiveness;
- ◆ be convenient in terms of the city planning structure;
- ◆ be ruled by means of highly effective management decisions.

At the end of the 20<sup>th</sup> century, thanks to the computer technology, a completely new idea of the ideal city was formed. This is the most technological and convenient city to live in or the smart city. The ideology of smart city is based on several key factors: energy efficiency, environment friendliness, optimization of infrastructure subsystems (transport and engineering), active development of an innovation-based economy that creates conditions for comfortable living. The smart city is a city for people, where education and medicine are available as a priority irrespective of age and income; the city is maximally technological, filled with the cutting edge computer technologies that enable the creation of a fundamentally different quality and comfort of the urban environment.

Almost in parallel with the spread of the smart city ideology (see Fig. 1), there has emerged a new idea of the ideal city of the third millennium — the innovation-based city. It foresees the urban development according to a fundamentally different approach to planning. This is a city based on neo-economic enterprises: IT technologies, R&D

centers, universities; a city that shall ensure a modern quality of life through the use of innovative technologies that ensure the economic and environment friendly use of resources for the urban development and the operation of urban life systems.

A generalized description of the main types of ideal cities is given in Table 1 and Fig. 2.

### Emergence of the Innovation-Based City

The beginning of the third millennium has been marked with the transition to a new postindustrial stage of civilization development of mankind, which is called neo-economy (new economy). A.L. Grigoryan defines the “new economy” as the first stage of new postindustrial system [19, 20]. Neo-economy is an economic infrastructure characterized by the predominance of intangible assets (services and technologies) and a significant reduction in the role of tangible production. That is, it is an economy of knowledge, new information technologies, new business processes, which provide leadership and competitiveness. The radical transformation of the economic paradigm inevitably causes the need to change the living environment of modern man on the basis of the latest technologies and opportunities.

The embodiment of such a transformation is the smart city, and its variant is the innovation-based city. Below, let us consider their common features and fundamental differences.

Table 1. Characteristics of the Main Types of the Ideal City

Conception	Period	Basic principles	Ideology	Type of city, examples
Safe city	The Middle Ages	Safety, beauty	The Renaissance (Da Vinci, Campanella, etc.)	The Sun City; the Star City, the Fortress City
Social city	Emergence of industrial relations	Social justice	Utopian socialists (T. Moore, R. Owen, D. Ricardo)	Utopia
Robust (functional) city	Development of industrial relations	Functionality, rationality	<i>Charte d'Athènes</i> (Howard, Le Corbusier)	New industrial monofunctional cities
Sustainable city	Industrial period	Environment friendliness, sustainability	The Concept of Sustainable Development (UN);	Gothenburg, Vauban (Freiberg, Germany)
Smart city	Postindustrial period	Constructability	SMART-city	Singapore, Copenhagen, Barcelona
Innovation-based city	Postindustrial period	Comfort	Neo-economy	Masdar, Innopolis, UNIT.City

The concept of the smart city was first used by the Peter Drucker in *The Practice of Management* [21] almost 60 years ago in relation to the management of the city. This abbreviation includes five components: specific; measurable; achievable; realistic; time. That is the smart city means open effective management based on the use of innovative technologies that are skillfully used by city residents.

G. Seisdedos, a Spanish economist and expert in smart cities, interprets the concept of the smart city as an efficiency achieved through intelligent management and integrated information computer technology, as well as active involvement of citizens in the city development [22]. The changes in the system of economic relations have led to new principles of organizing the operation of urban systems, i.e. the principles of SMART-city. These include as follows [23]:

- ◆ The development of the economic base of the city on the basis of intellectual capital;
- ◆ The efficient use of energy resources;
- ◆ The communicativeness of urban space;
- ◆ The creation of a pedestrian-oriented city, the minimization of individual transport;
- ◆ Environment friendliness and nature conservation, the creation of a “green” city;
- ◆ The universality of the complex information support system of the city government;
- ◆ Remote access to all types of services and services;

- ◆ The optimization of the education system, the development of distance learning;
- ◆ The healthcare system shall focus on disease prevention.

At first glance, the smart city, the digital city, the intelligent city, and the innovation-based city are one and the same, synonyms. However, this is not entirely true, as they were identical only at the initial stages of formation.

The first projects and decisions on the introduction of IT-technologies in the urban structure were implemented in certain areas that usually were depressive and required revitalization. These projects were a kind of promotional campaign, demonstrating the amazing opportunities of digital technologies (Digital Mile in Zaragoza, Spain) [24]. These projects are even named to demonstrate the transition to a new era of computers and the Internet: Digital Mile (Zaragoza, Spain), Digital Media City (Seoul, South Korea), New York Digital District (New York, USA), and so on (Table 2).

The second stage – the formation of smart city – is characterized by the introduction of innovation principles in the operation of integrated urban subsystems and structures. More and more cities around the world, including Kyiv, have been competing for the title of the smartest city. The ratings may vary slightly depending on the initiator of the assessment. For example, 82 influ-

Table 2. Innovation-Based Districts and Cities. Basic Characteristics

Country	District, city	Year of creation	Area, ha	Population	Employed population
Digital or innovation-based districts					
Spain, Zaragoza	Digital Mile	2005	24		
South Korea, Seoul (Sangam-dong dis-trict)	Digital Media City	2006	57	30 000	80 000
USA, New York	New York Digital District	2010	13	1140	10 000
Canada, Toronto	Digital District in Toronto	2017	144	14 900	93 000
Ukraine, Kyiv	UNIT-City	2017	25	7 500	14 000
Innovation-based cities					
France	Sophia Antipolis	1980	4 800	100 000	28 000
UAE, Abu-Dhabi	Masdar City	2006	600	45 000	60 000
Russian Federation	Innopolis	2012	600 (1 500)	50 000 (155 000)	35 000

ential academic journals, including the *Nature*, *Science*, and *Cell* [25, 26] made a survey of the contribution of various cities around the world to the global implementation of innovation-based projects since 2012. By 2017, New York was recognized as the most innovative city, followed by Boston, Beijing, San Francisco, Tokyo, Paris, Shanghai, Los Angeles, Seoul, and London.

At the present stage, the term “innovation-based” city has been increasingly used. Being “digital” or “smart” in the above interpretation, it takes radically new features of the “ideal” city of the third millennium.

The innovation-based city is not a mere city of the post-industrial period of social development, the economic basis of which is formed on the sectoral structure of the neo-economy. This is a city with a fundamentally different spatial structure and organization of the city plan. The world experience of creating the newest innovation-based cities has been actively developing. The most remarkable examples of truly innovation-based cities are Sophia-Antipolis in France, Masdar in the UAE, Innopolis in Russia. In Ukraine, an example of the implementation of such innovative projects is UNIT.City in Kyiv, a project that has been successfully implemented on the territory of the former Motorcycle Plant.

The construction of Masdar, or as it is also called the city of the future or eco-city started in 2006. On the area of 600 hectares there reside 50,000 permanent residents, and it is planned that the same number will come to work. The project includes revolutionary ideas for the organization of urban life. The core of the city is a university with numerous innovation research centers. Masdar focuses on “green” technology. The public transport is located exclusively underground, any cars with gasoline engines are prohibited. Instead, there is an automatic individual electric transport port. The city's energy independence is ensured by geothermal and solar energy (solar panels, mirror devices that concentrate sunlight, etc.), as well as by energy from waste incineration. In Masdar, there is formed an ecological environment with

a system of complete recycling of municipal waste and minimal emissions of carbon dioxide into the atmosphere and [27].

### **Specific features of spatial organization of the innovation-based city**

As already mentioned, the innovation-based city is formed in parallel with the smart city, based on the key principles of the latter. At the same time, its spatial organization is radically different. Analyzing the design and solutions for planning and development of new cities, we can formulate several basic features of the spatial organization of the innovation-based city:

1. Fundamentally different model of planning and organization of the territory. In contrast to the spatial organization of the industrial period cities, which is based on the ideas of *Charte d' Athènes* (the central zone is the area of the city center in combination with residential houses, the middle zone is formed by residential areas and housing estates, the peripheral zone is the area of concentrated labor service (industrial and municipal buildings, large engineering and transport facilities), the postindustrial city is formed on innovative models of spatial organization, namely: the places of localization of labor, which are mainly environment friendly objects of the neo-economy (universities, R&D centers, office and business centers, IT-based corporations) are located in the central and middle zones, while in the middle and peripheral zones there are residential quarters surrounded, as close as possible, by natural environment (Fig. 3) The research centers and the university, which are the core of the innovation-based city, symbolize a new era — the era of science and technology, and the accelerated pace of scientific and technological progress requires a high level of educational training.

2. **Polyfunctionalization of the urban space.** The polyfunctional use of the territory, which had been typical for cities at the early historical stages of urban settlement formation, when within one land plot (one house) the functions of living, employment, and recreation were combined, in the

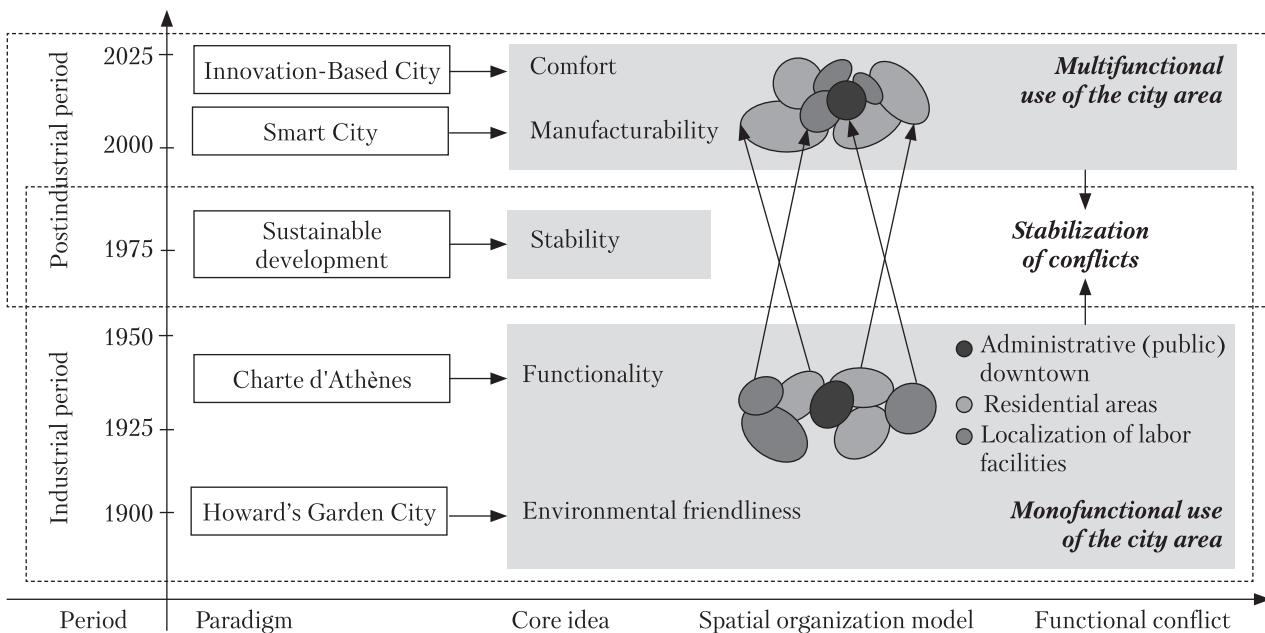


Fig. 3. Transformation of urban spatial organization

period of industrial development of cities gave way to monofunctionality. In the postindustrial period or the period of neo-economy, energy-efficient and environment friendly technologies as well as the growing market of goods and services allow the placement of labor service directly in residential buildings. The horizontal polyfunctionality i.e. the adjacent location of different monofunctional objects in the city plan has become widespread. The next step is the vertical polyfunctionality of the urban space, which manifests itself in a combination of vertical functions within one object or one plot of land. Placing different functions on different floors of the building (both underground and above ground) allows creating fully-featured, self-sufficient objects. For example, residential estates with underground parking lots and engineering and infrastructure facilities, with numerous office, shopping, sports, and entertainment facilities in the ground floors, and, sometimes, with preschool establishments for children; or office and business centers with underground parking and shopping and entertainment facilities on the ground floors and apartments on the top floors of the estate.

In recent decades, there has been a trend of maximum greening of the urban space. The use of the state-of-the-art technologies allows ensuring the operation of urban subsystems at the expense of renewable energy sources and optimizing the consumption of various resources of urban development. The minimization of harmful emissions and the polyfunctionality (both vertical and horizontal) of the urban space significantly affect the function-based compaction of the city and the optimization of the use of territorial resources of the city by reducing sanitary and environment gaps.

**5. The formation of city architectural and spatial composition on the principle of urban village.** The industrial period aiming at the growing manufacture of products, goods, and services for the growing urban population, which formed the stereotype of human being as part of a single powerful production system, has given way to understanding of the uniqueness of human personality and its perception as the main value of society. All these factors make it necessary to take a new look at the formation of the human life environment, safety, and comfort of living conditions.

The residential areas in innovation-based cities are mainly formed on the principle of urban village [28] as close as possible to nature. They consist of low- and medium-rise residential buildings of multifunctional type with an emphasis on the formation of open public space, minimization of individual road transport with the priority of pedestrian traffic with well-developed public transport. The residential estates, mainly in the form of a closed circuit with a large number of greenery inside the courtyard spaces, are a kind of self-sufficient planning entities that combine all the basic functions of the city within one site.

### **Prospects for the formation of innovation-based cities in Ukraine**

The difficult socio-economic situation in Ukraine caused by political instability and the consequences of the military conflict in the east of the country do not stimulate the widespread introduction of innovative approaches to the development of urban settlements. However, despite this, Ukraine has been making efforts to use the state-of-the-art technologies in urban development. This has been confirmed by the fact that according to the joint study by the IMD World Competitiveness Center Smart City Observatory in partnership with the Singapore University of Technology and Design, Kyiv is ranked among the TOP-100 (the 92<sup>nd</sup> place) of the world's most technology-intensive cities [29].

In January 2019, the first International EXPO Congress *Business for Smart Cities* was held in Kyiv, where representatives of more than 30 countries discussed the innovative development of cities and their transformation into smart cities. Among others, the project of the first Ukrainian innovation-based district UNIT.City in Kyiv was presented. UNIT.City is an example of a multi-functional innovation-based city with a developed infrastructure, built on the territory of former Kyiv Motorcycle Plant. The 25 ha plot is located in the central part of the capital of Ukraine. UNIT.City is positioned as a city within a city, designed for the development of Ukraine's crea-

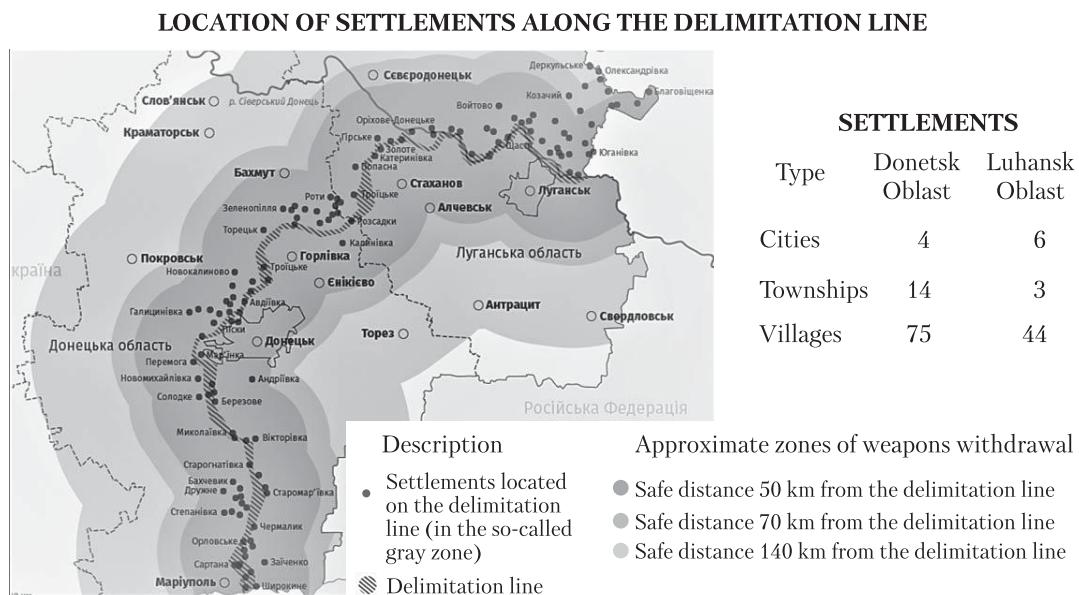
tive economy: support of innovative business and supporting startups, training in high technology, conferences and research, as well as for living, recreation, sports, and cultural entertainment [30].

The city opened in 2017 and is under development. The project foresees the creation of up to 15,000 jobs, the construction of up to 200,000 sq. m housing with infrastructure, cultural and educational facilities. The expected number of inhabitants is 14.0 thousand people. The first object is UNIT.Factory, a higher education institution based on innovative Peer-to-Peer learning method [30]. Currently, there are about 800 students, and, in the future, up to 3,000 students are expected to master the program.

The implementation of the smart city concept is possible both in the conditions of reconstruction and building of a separate city district of existing or new city as a whole, irrespective of the size of the district and city (area and number of inhabitants), the formation of the innovation-based city is possible only in the conditions of the creation of a new or the total reconstruction of existing city as integral system. In the second case, we are talking about small and medium-sized cities or satellite cities formed based on innovation.

The introduction of a new innovation may be an impetus for the radical transformation of the existing or the creation of a new project of spatial organization of the city plan according to the smart city principles. Such an innovation may be:

- ◆ production-related innovation based on industrial or innovation park formed on the basis of enterprises of neo-economic industries, in contrast to large enterprises of heavy engineering, chemical, and mining industries;
- ◆ educational innovation: university as a core, with research institutions and business centers and incubators;
- ◆ medical innovation: a complex of clinical hospital with research centers and laboratories, educational institutions of higher and secondary level;
- ◆ resort&recreation and culture & education innovation: tourist centers and sanatoriums, re-



**Fig. 4.** Settlements located in the “gray zone” of the military conflict in the Donbass

Source: Order of the Cabinet of Ministers of Ukraine dated 07.11.2014 No. 1085, as amended 07.02.2018 No. 79-r) [31].

sorts based on available balneological resources, objects of cultural heritage, objects of nature reserve fund;

- ◆ spiritual innovation: religious center based on an outstanding religious building, a memorable place;
- ◆ sports and wellness innovation: physical culture and sports center, sports base.

The last large-scale urban development projects to create new urban settlements in Ukraine were implemented more than 35 years ago (Slavytch, Kyiv Oblast, 1986; Tavriisk, Kherson Oblast, 1983; Teplodar, Odesa Oblast, 1981). During the time of independent Ukraine, no such project has been implemented. Of course, the creation of new innovation-based cities requires large investments (for instance, USD 22 billion for Masdar [27]) and is problematic for Ukraine, given the current economic and political situation. A more realistic option is a radical reconstruction of existing settlements.

The objects of such a promising innovation-based reconstruction may be, in particular, settlements located on the line of conflict in Donetsk

and Luhansk Oblasts, which are affected by hostilities [31] (Fig. 4).

The reasons for innovation-based spatial organization of the urban environment include:

- 1) unconditional need for the total reconstruction to restore the affected settlements after the end of the conflict in Donbass;
- 2) inexpediency of restoring the partially destroyed or technologically obsolete city formation facilities with the use of old technologies;
- 3) the need to attract significant investments (both foreign and domestic) for a radical reconstruction of settlements, which is more realistic and attractive in the case of innovative projects;
- 4) the psychological attractiveness of the renewed innovation environment for young people, which contributes to the demographic recovery of Donbass;
- 5) the traditional structure of employment of the population of this region (other than agricultural sectors);
- 6) the possibility of partial involvement of existing engineering and transport infrastructure to reduce the cost of projects.

One of the conditions for the implementation of innovative urban planning projects is a proper legislative and regulatory framework for urban planning. Unfortunately, some provisions of the new regulation DBN B.2.2-12:2019 *Planning and Development of Territories* [17] is based on the principles of the industrial period (*Charte d'Athènes*) of the formation of the spatial organization of the urban environment. In particular:

- ◆ New settlements may be created in connection with the need to relocate new large industrial enterprises, to develop minerals, as well as in connection with the resettlement of the population from existing and potential areas of disasters and environment catastrophes, historical and cultural factors (Clause 4.10 of DBN B.2.2-12: 2019 [17]);
- ◆ Neighborhood unit or microdistrict is the primary element of the socio-planning structure of the settlement... (Clause 3.36 of DBN B.2.2-12:2019 [17]).

The neighborhood district (microdistrict) is formed on the principles of: a) clear functional zoning of the territory... (Clause 5.8 of DBN B.2.2-12:2019 [17]).

Such formulations do not provide for a legally defined possibility of creating innovation-based cities (Clause 4.10) and make it impossible to form a spatial organization of the city on the basis of the latest trends in multifunctional urban environment (Clause 5.8).

Having analyzed the regularities of transformation of urban spatial organization, we make the following conclusions:

A. The evolution of the ideal city paradigm is driven by the development of the economic base of urban settlements and by perceptions of residents about comfortable and safe living conditions. The dynamics of the ideal city model evolution accelerate with each new stage of the development of science, technology, and social structure of society. The modern models – smart city and innovation-based city – are based on the achievements of the 4<sup>th</sup> industrial revolution, the

formation of the neo-economic base of settlement development, and the widespread introduction of IT technologies in all spheres of city life.

B. The innovation-based city may be considered a model of evolutionary development of the ideal city of the postindustrial period of human existence, namely of the smart city. The operation and management of complex socio-technical system of the smart and the innovation-based cities are organized identically and based on the smart city principles. However, their spatial organization has significant differences. The smart city may be created on the basis of both existing and new city, regardless of its size, the innovation-based city requires a radical reconstruction of existing city, or creating a greenfield city, usually small or medium-sized.

C. The peculiarities of the spatial organization of the innovation-based city include: 1) fundamentally different, as compared with the industrial period settlements, model of functional and planning organization characterized by the concentration of neo-economic sector job places in the central and middle zones and the location of housing estates as close to recreational areas and natural environment as possible; 2) horizontal and vertical polyfunctionalization of urban space, due to environment safety and energy efficiency of innovation-based facilities; 3) the formation of the living environment on the urban village principles.

D. Ensuring the possibility of developing projects for new and radical reconstruction of existing settlements on the basis of postindustrial development of society and introducing the innovative principles of the formation of architectural and spatial organization of the urban environment require the revision of the urban planning legislative framework.

E. The settlements that have suffered during the military conflict in the east of Ukraine and certainly need essential reconstruction after the cessation of the acute phase of the hostilities may be basis for the creation of innovation-based cities in the conditions of modern Ukraine.

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lements of Ukraine, as well as the draft detailed plan of the territory that includes the innovation-based area of UNIT.City.

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## «ІННОВАЦІЙНЕ МІСТО ЯК РЕЗУЛЬТАТ ЕВОЛЮЦІЇ ПРОСТОРОВОЇ ОРГАНІЗАЦІЇ МІСТА «РОЗУМНОГО»

**Вступ.** Початок третього тисячоліття ознаменовано потужним впровадженням ІТ-технологій в усі сфери життедіяльності суспільства, зокрема й на перетворення просторової організації міста в цілому.

**Проблематика.** Функціональна та соціально-планувальна організація території міст, що склалася в період індустріалізації та повоєнного відновлення, все глибше входить в протиріччя із загально-світовими тенденціями формування комфорту середовища існування сучасної людини та потребує реформування.

**Мета.** Визначення тенденцій формування функціонально-планувальної організації міського простору в постіндустріальний період розвитку суспільства; встановлення напрямів трансформації території і забудови сформованого міста в місто інноваційне.

**Матеріали й методи.** Систематизація результатів дослідження наукових публікацій, законодавчо-нормативної бази та інформаційних джерел проєктування міст; графоаналітичний метод аналізу проєктно-планувальної документації; структурне та логічне моделювання.

**Результати.** Охарактеризовано еволюційні етапи трансформації парадигми «ідеального» міста від міст епохи Відродження до «розумних» та «інноваційних» міст. Виявлено концептуальні відмінності просторової організації «розумного» і «інноваційного» міста; сформульовано особливості «горизонтальної» й «вертикальної» поліфункціоналізації міського простору. Розроблено принципи та рекомендації щодо можливої трансформації території вітчизняних міст.

**Висновки.** Принципи формування комфорту середовища еволюціонують відповідно до техніко-технологічного й соціального базису розвитку суспільства. Активне впровадження ІТ-технологій на сучасному етапі викликає необхідність трансформації міського простору від монофункціонального використання територій до горизонтальної та вертикальної поліфункціоналізації. Такі тенденції вимагають свого обов'язкового закріплення в законодавчо-нормативній базі містобудівного проєктування для подальшого впровадження в практику комплексної реконструкції вітчизняних міст.

**Ключові слова:** ідеальне місто, розумне місто, інноваційне місто, просторова організація, монофункціональне використання, поліфункціоналізація міського простору, реконструкція міста.