Architectural and Technological Dialogue: Development of "New City" Generation

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Abstract. The article considers urban concepts of new generation cities based on comparison of their architectural and technological features. Analysis of approaches to the design of modern urban areas allowed to determine the dominant principles of urban planning as a synergy of "Creative + Comfort + Smart + Green". In this context, the author identifies a group of futuristic cities whose projects are based on the synthesis of technological and architectural innovations and eco-friendliness. The definition "neo-city" is introduced and examples are given that are already being built. Population density, lack of territories and environmental problems are reasons for foundation of neo-cities in South-Eastern countries. It is noted that neo-cities are represented in concepts "city without cars", "city without cars and skyscrapers", "energy-saving", "garbage-free" and "high-tech city". Architectural appearance of each city has its own innovation. Using of bionics principles in architecture of cities is aimed at creating a comfortable environment. Neo-cities are quite ambitious projects in terms of design and financial and technical characteristics. Risk of their operating is technical failures due to the concentration of technical devices and sensors. It is actualized, that the attractiveness of such cities is determined by a comfortable social infrastructure and effective urban management.

1. Introduction

In the context of post-industrial economic growth, reducing barriers to the diffusion of innovation and increasing the role of human capital, traditional industrial cities are losing ground, and the era of innovative cities is coming. Within the framework of the "smart city" concept, the synergy of technology, ecology and unique architectural image is particularly relevant. It is the architectural appearance forms constructive uniqueness of cities. This factor becomes a "visit card" and a factor of tourist attractiveness.

Development of architectural and design innovations revolutionizes the appearance of "new faces" of cities. Using of new composite materials and technologies allows to create strong structures of fantastic shapes and huge sizes. Breakthrough artificial intelligence technologies create the basis for implementation of infrastructure systems. A new generation of cities, so-called futuristic, is emerging.

The purpose of this study is to analyze modern architectural concepts that are used to design new innovative urbanizations that differ from traditional cities in a particular way. The objectives of the study are reveal the definition of neo-city, review of design features of neo-cities, identification of risk factors for the functioning of neo-cities.
2. Materials and methods
What is the city of future and what should it be? Engineers, architects and government managers are thinking about this issue. In this case, often the answer is sought in close cooperation with each other. As a result, the planned fundamental points that become an integral part of the modern project of cities. This is a convenient city for people, developed infrastructure, environmental friendliness. And attractive architectural concept. Modern researchers show that uniform elements of building and facilities harm eyes and psycho-emotional state [1-3]. Thus, negative "psycho-emotional" factors of modern cities are: lack of visual elements, lack of a convenient urban environment, distinct mono-functional city division, grey color prevailing in buildings and others [2, 3]. These factors can provoke diseases such as myopia and mental disorders [3]. Thus, the favorable development of urbanized territories is one of the factors of citizen's health.

Urban development researchers emphasize the importance of creativity and innovativeness. In some works "creativity" is associated with the branding and marketing of cities [4, 5]. Ch. Landry wrote that creative city model focused on the potential of creativity and cultural industries for sustainable urban development. Applied to architecture, "creative" initiatives are understood as projects that use elements of creativity and design to change the urban environment, it can be projects for public space or development of an alternative system of traffic [6]. International organization Creative Cities Network (UNESCO) includes more than 180 cities out of 72 countries. The criteria of creativity is the specialization of the city: folk art (Gabrovo, Cairo and Isfahan), design (Detroit, Singapore, Dubai), cinematography (Sofia, Yamagata, Bradford), cooking (Bergen, Tsuruoka, Ensenada), literature (Dublin, Krakow, Seattle, Barcelona), music (Hanover, Kingston, Liverpool) and media art (Toronto, Lyon, Dakar) [7].

The digitalization has led to creation of a new kind – "Smart City". It is a strategic concept for the development of urban space, implying the joint use of information technology and Internet solutions in urban management. So, researcher T. Bakisi understands smart city as a high-tech and rapidly developing city that combines elements of urban infrastructure with the help of new technologies to create a competitive and innovative economy, as well as a high quality of life [8]. According to his opinion, a modern smart city also involves smart architectural solutions that combine aesthetics, ecology and high functionality. Study [9] traces the importance of architectural elements in the development of smart cities: the task of architects and designers of "smart cities" is to create such infrastructures and services that can become part of the structure and life of communities and people.

From the position of using environmental principles in urban design, there is type "Green City". The solution of environmental problems, including architectural and urban planning means, is currently in demand in all areas of human society. "Eco architecture" involves the use of safe materials, renewable energy sources, vacuum garbage disposal, collection and processing of rainwater, reducing carbon emissions. These are cities with minimal loss of natural resources [10]. So, based on the design of smart and green architecture can achieve decoupling effect. Introduction of green principles in the design will allow to achieve a triple "benefit": reducing harmful impact on the ecosystem, reducing cost of resources and improving urban image. Environmental principles are actively implemented in industrial, social, urban and financial spheres [11].

Researchers note that cities are gradually turning into intelligent systems. Urban projects seek the optimal combination of social (people, housing, urban production) and architectural components. Modern architects do not limit themselves to the task of erecting buildings and go to the frontiers of social engineering [12]. Digital and eco-oriented technologies affect all the main areas of city's functioning – health, education, energy, transport, resource management and urban space [13]. There is a dialogue between architecture and technology. Green strategy follows the principles of sustainable development. Environmental-oriented style of progress is one that meets the needs of modern people without compromising the opportunities of future generations. Construction industry is considered one of the most energy intensive and polluting industries that is why it is essential that it be considered in the context of sustainable development [14].
In the XXI century, development of cities goes in two ways: the modernization of existing ones (traditional urban concept) and the construction of new (untraditional or futuristic concept). If the first direction occurs in Russian and in world practice almost everywhere, the second is presented specific examples [15].

Traditional urban concept is cities with preservation their architectural appearance and developing digitalization. Examples: Amsterdam (Amsterdam Smart City program), Barcelona (program iBarselona), Madrid (Madrid Inteligente program), Milan, Stockholm and others. Analysis of these examples shows that each city has a different interpretation of smart city concept [16].

Futuristic concept is new cities with a unique urbanistic design. Cities built on the new place are examples of modern architecture and planning culture, focused on the maximum use of the latest technologies for organizing urban life. Specifically, that these cities initially combine the urban synergy "Creative + Comfort + Smart + Green".

In this article, the author offers a new definition for futuristic urban concept – "neo-city". The prefix "neo" means "new", that is, neo-cities are fundamentally new, modernized cities built on unique creative design projects and meet the requirements of sustainable development (comfort, smart, green). This position correlates with opinion that it is combinatorial of the most successful models of urban development will present a new type of city – anthropocentric, eco-friendly, with the ability to dynamically integrate material and non-material resources [17]. Necessity to create the appropriate infrastructure lays framework of "healthy lifestyle city" model.

Analyzing modern projects of futuristic cities, we can see that a new generation of cities with a unique urban concept is being formed. Responding to the modern problems and challenges, some cities are initially designed as high-tech, intellectual, resource-saving and special architectural delights. Such neo-cities as Masdar, "Great City" Chengdu, Sino-Singapore Tianjin and Songdo are being built. City Neom in Saudi Arabia is also an ambitious project is under construction. These cities are planned in the concept of eco-technological urbanization and have their own architectural novelties. The peculiarity of these cities is hybrid spaces, the structure of which represents the spatial interaction of residential, public and recreational functions.

Masdar is low-carbon green city project being built in Abu Dhabi (figure 1). It will use solar energy and other renewable energy sources. Tall wind tower modeled on traditional Arabic designs sucks in air from above and pushes a cool breeze through streets. Buildings are grouped close together to create streets and paths that are protected from the sun. City will use a combination of electric vehicles and other environmentally friendly vehicles for mass transit within the city.

"Great City" is an autonomous satellite of Chinese metropolis Chengdu (figure 2). One of the features of this city is the lack of cars. The idea is that everything should be so close that residents can get to any destination within 15 minutes. This is a dense vertical city project where innovative technologies and infrastructure systems will achieve 48% energy savings. If the project is successful, similar satellite cities will appear in other regions of China.

**Figure 1.** Masdar (UAE). Concept: city without cars and skyscrapers. Architectural novelty: huge "umbrella-sunflowers".

**Figure 2.** "Great City" (Chengdu, China). Concept: city without cars. Architectural novelty: ensemble of skyscrapers of different shapes.
China-Singapore eco-city Tianjin is an international project and is seen as a model of sustainable city (figure 3). It is the second flagship government project between Singapore and China after the Suzhou (industrial park). Urban concept is environmentally friendly and resource-saving city. Projected waste management with a focus on waste reduction and recycling, vacuum garbage collectors. The main mode of transport is light rail transit system, supplemented by a secondary network of trams and buses. Other international neo-city projects are possible in the future, as they will benefit investors and society.

Songdo is the first district in South Korea received leadership in energy and environmental design (LEED) accreditation (figure 4). This city built upon the principles of New Urbanism and Smart & Green Growth. At the same time, designers used such traditional techniques as New York's Central Park and Venice's canal system. Different social and recreational spaces from around the World are designed to harness the wisdom of the past and add complexity to neo-city. The city's infrastructure contains sensors that monitor and regulate everything from temperature to energy consumption and traffic. The 65-floor North-East Asia Trade Tower became South Korea's tallest building.

![Figure 3. Sino-Singapore Tianjin (China). Concept: energy-saving and garbage-free. Architectural novelty: gate towers.](image)

![Figure 4. Songdo (South Korea). Concept: high-tech city. Architectural novelty: NEATT skyscraper.](image)

It is known about the intentions of building other futuristic cities (figures 5 and 6). These are only projects of architects that have originality and practical value. Chinese architect Ma Yansong believes that the future belongs to structures that are similar to the forces and forms of nature: clouds, mountains, waves [18]. A futuristic direction of architectural research is also the design of "water city". Concept of floating cities consisting of prefabricated modules that form a single metropolis with its unique architecture is aimed at solving the problem of lack of free territory and ensuring zero carbon emissions. The most famous project is an amphibious city (floating eco-polis Lilypad), developed by the French archibiotect Vincent Callebaut [19].

![Figure 5. Project of Shang-Sui (author Ma Yansong). Concept: high-rise city with a high population density. Architectural novelty: water & mountain skyscrapers.](image)

![Figure 6. Project of Green Float City (author Vincent Callebaut). Concept: floating eco-city. Architectural novelty: Lily shape.](image)
Thus, architectural concepts are based on geographical and social features of territories taking into account environmental challenges. So, South-East Asia is a fairway for neo-urban projects. Population density, lack of territories and environmental problems are the main reasons for searching new models of urban development. Using the principles of bionics is aimed at creating comfortable living conditions.

Despite positive initiatives, there are also specific issues of neo-cities that require attention. First, widespread use of technical and intelligent devices increases the risk of breakdowns and failures. The questions arise: how viable is the "high-tech" landscape? What technologies will create a harmonious socio-cultural environment? Second, social and business infrastructure is needed. It is important to understand which categories of people form the residency of new cities. Third, effectiveness of urban management. It is necessary to gain experience in managing high-tech and green cities. Also it is necessary to create business attractiveness of city and consider stages of its development. Fourth, such concept as "city without cars" seems utopian. To create a city center without cars is possible, but an entire city is not realistic. Fifth, there is an environmental ricochet. For example, the use of solar panels and electric vehicles increases energy efficiency. But the production and disposal of batteries and accumulators is very harmful.

3. **Discussion of research results**

Summarizing the study, the following important points can be identified.

1. Planning of new cities is based on urban synergy "Creative + Comfort + Smart + Green". Cities based on these principles already exist in different countries. But most of them have environmental pressure. Modern challenges dictate the need to create cities with a low ecological footprint.

2. Author's category "neo-city" implies fundamentally new, eco- and tech-innovative city built on creative design projects and meet the requirements of sustainable development. Such cities began to be built in Arab and Asian countries. The projects of these cities are ambitious. Will neo-cities be comfortable to live in? This depends on availability of a comfortable social infrastructure and quality of urban management.

3. The futuristic design uses the nonlinearity and principles of bionics or bio-tech (direction of architecture, based on copying the forms of nature). Researchers believe that this is architecture of the future, existing in harmony with nature [20, 21]. Presumably, the bionic forms will create a positive aesthetic feelings and positive impact on the health of citizens.

4. Amazing architectural forms and hybridization of urban space are designed to provide comfort to residents and increase the tourist attractiveness of cities of future. Diversification of tourism will form the basis for economic development and increase state budget revenues [22]. The favorable investment image of new cities will allow implementing social and commercial projects in format of public-private partnership.

5. Building of neo-cities is associated with various problems and risks. Despite the fact that concepts of these cities look very promising, none of announced projects have yet been fully realized. The main stop factors at the construction stage are financial, technological and managerial problems. At the stage of urban management, there are difficulties with attracting specialists, providing jobs and social infrastructure objects. It is important to understand who will live in a new city and what life models of "smart citizen" in a new generation city.

4. **Conclusion**

The synthesis of innovative technologies and architectural images under the influence of ecological approach gave rise to a new global style. These are new cities that were designed to be creative, smart, comfortable and eco-friendly. The author's analysis of urban development revealed a new generation of cities (neo-city) with fundamentally new conceptual characteristics of sustainable development. Their infrastructure is designed to create a "healthy lifestyle city" model. It is difficult to predict further development of neo-cities, but it can be argued that futuristic trends will be used in urban planning. Due to limited territories, new cities will be designed as ensembles of skyscrapers, bridge cities and floating
cities. The goal of architecture is to ensure sustainable development of new cities by creating a comfortable, accessible and safe environment that is aesthetically attractive and functional.

A city is a social system, so its development requires social conditions for migration. Comfortable infrastructure, providing jobs and city management are essential elements of modern city. Therefore, designing new cities is a complex multidisciplinary process in the face of global challenges. The development of new generation of cities requires the efforts of various groups of specialists under auspices of public-private partnerships.

5. References

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