Forecasting technology as a method of modeling and building Smart City concept

Natalya Saprykina
The Moscow Architectural Institute (State Academy), 107031 Moscow, Rozhdestvenska Street, 11/4 House, building 1, p. 4, Russia

E-mail: nas@markhi.ru

Abstract. Article is devoted to an actual problem in architecture and construction-identify features of modeling and building Smart city concept based on the future-designing technology (project forecasting) as a method of designing. The purpose of the article is to present the main blocks and progressive stages of the implementation of this method, as well as its techniques and principles: from sketch to construction management. A leading approach to the study of this problem is based on future by designing modeling and predicting the evolution of the social and cultural changes in society, as well as the development of technology and focuses on design innovation, adequate future. Materials, articles and examples in designing parametric modeling may be useful for the theory and practice of forming the space Environment as opens completely new possibilities in architecture und construction.

Keywords: project forecasting, modeling of spatial habitat Environment, new approaches and methods of design, information technology and formation of virtual reality in architecture.

1. Introduction
In architectural activity any project formation Environment of vital activity is a kind of projection. The result of prediction is a complex object, including in accordance with customer requirements: functional structure, specifically shaped the content and consumer properties of the architectural object. Unlike the established methods of modeling urban space for the formation of the concept of Smart city are encouraged to use technology future-design (project forecasting), which is used for the advanced development of new objects and substantive future Environment. This design approach is reflected, on the one hand, in the form of concrete results of designer activity (predictive models and projects-concepts of substantive Environment) and, on the other hand, as a result of projected project activities (process developing new ideas and creative designs).

In this regard, the purpose of this article is to present the main blocks and step-by-step stages of implementation of the method future-design, as well as its techniques and principles: from sketch to construction management Smart city.

Future-design technology (project forecasting) are used in many theoretical and practical developments in various areas of research, such as: project forecasting in the context of the development of the structural outline and contour predictive model [1], theoretical and methodological bases of social forecasting [2], [3], as well as the use of script techniques in architecture, where the architect is a producer-programmer [5]. Project forecasting method is also used when generating a virtual Habitat Environment [6] and in the formation of conceptual architecture objects in a mass media culture, where the elements Environment transformed into a new reality [8].

The relevance of this problem is due to the fact that in this case the connection project and forecast in a single unit. Forecast methodology used the scientific validity of the expected result, but from the design process applies technology innovation and the possibility of utilizing a modeling object. This
problem has attracted many professionals involved in formation of space habitats in the context of the concept of Smart City - provides specific design solutions and numerous development performed within the this concept [12], [13], [14], [15], [16], [17], [18], [19] and [20].

Approach to building Smart cities as new integrated Habitat Environment includes complex environmental problems, to aim at finding new forms of urban space using innovative engineering technologies. This saves resources and use renewable energies. The new paradigm of sustainable urban metabolism (the city as a complex system of metabolic processes) and environmental re-urbanism will require a deep rethinking city and their regions, as well as the planning and how to manage them. In this regard, for an integrated formation of Smart city it is advisable to use future-design technology as a method of project forecasting.

2. Methods
Project forecasting based on future-modeling and predicting the evolution of the social and cultural changes in society, the development of technology and design-oriented innovations, adequate and relevant for the future. This method is useful for design of promising new products and substantive future Environment. According to M.V. Fedorov, the project comprises four forecasting unit, each of which describes a particular slice of project forecasts [1]:

Problem-target block sets a common objective and identifies the object. The basic operation is the analysis of the initial situation (socio-cultural, industrial, economic, structural and typological). It is conducted with the aim of identifying elements and structural links that should be converted to form a brand new facility with new level values.

Conceptual-modeling block forms and represents a logical object model, which has a distinct structure, substantive content and communication. A conceptual model of the object opens its typology identifies the particular classification of the elements, their type, range, etc., and also allows you to submit an object design as functioning consumer complex products.

Prognosis-conceptual block describes patterns and identifies development trends in time object which is considered retrospectively with a view to identifying the main stages of its evolution and transformation of the structure and functions.

Prognosis-project block covers development design, locating the closest object transformation and advanced stages. In this case, the translation is committed logical concepts and definitions in Visual images presented in draft form.

The results of the project design are used for clarification and adjustment of the initial forecast of installations: If the forecast reveals some flaw in the Organization of the subject Environment, the project addresses this deficiency [2]. This concluded the basic contradiction of the project prediction: it is precisely in order to expect poor prognosis could not come true because of negative factors. This will enable the human spatial habitat Environment to acquire functional integrity and harmony.

Design process and involved in it technology has become no less significant than the result. Forecasting design of a spatial prediction Environment, according to P.A. Fathutdinov, includes the following main stages that are several phases [3]:

1. In the first phase, stage before of forecasting orientate as the collection on of work prior to the development of the job forecast. They include: the object definition, aims and objectives of forecasting, prediction period, as well as job development stage on the forecast.

2. The next step is to implement the stage projected flashbacks - the study of the history of the development of the object predicting and predictive scenario, with a view to obtaining their systematic description.

3. In the final phase, stage verification forecast - evaluation of the validity and accuracy of forecast or verification of its validity. Refinement and development of system of forecasting is based on its verification or additional data.

The fulfillment of these striations may, subject to the following principles for the Organization of work under the project prediction: addressed, balance, parallelism, continuity, straight accuracy, adequacy, directly handling, alternative, adaptability [2]. The principle of addressed is fulfilling predictions for strictly certain research or engineering organizations, and the principle of parallelism
between the prediction of the various services are applied to reduce the time initial information gathering and processing, and performing the forecast.

The essence of the principle of **continuity** is the systematic collection and processing of received more information after you perform forecasting and making the necessary adjustments to the forecast as needed. The principle of **straight accuracy** provides strictly appropriate transfer of information from one performer to another along the shortest route and the principle of **automaticity** is one of the principal to reduce the time and cost of gathering and processing the source data and perform predictions. Accurately assess the probability of identified trends in benefits and costs to it helps applying quantitative **adequacy** measurement of quality and cost, economic-mathematical methods and models control.

The principle **alternative** forecasting is the possibility of the development of the object its individual components and technology of manufacture of the product for different trajectories. Important is also the principle of **adaptability** prediction, which is to study and make maximum use of internal and external factors Environment as object system.

System optimization of architectural objects in the current approach to space, as well as the manifestation of sustainability trends in the approach to urban planning and architectural design of important factors are the **reversibility** and **cyclical** systems [2]. In the urban settlement in dynamical systems cycled should include factors such as planning, architectural design, preservation of historical monuments, reusing old buildings adapted recreation cities, the use of underground constructions, etc.

The life cycle of buildings should be seen as a fundamental factor in architecture, where since the design provides for **dismantling** and **recycling of materials**. In the program of the project included the relevant forecast before the design stage. So, the **situation analysis** stage includes identifying sustainable environmental capacity and border Environment, as well as identification of their elements and relationships, to identify possible elements of influencing the future object. At the stage of **design concept** is carried out, the problem formulation of target local inhabited space, compilation of resource-saving program and script operation space, calculation and optimization stage maximizing system [4].

The forecast of resource-saving design of architectural objects is an important stage of the **nomination of the hypothesis**. It includes a selection of optimal technological solutions, design, selection of construction materials and resources required for the construction, design and 3D solutions, infrastructure, transport and planning decisions. At the stage of **testing hypotheses**, as approbation of post-project research activities include comparative phase of economic construction costs, operating costs, monitoring quality and aesthetic evaluation object, making results and characteristics in the normative documentation, assessment of resource-saving capacity of the object in the urban and regional system.

The above methods, techniques and principles of project forecasting with the development of science-intensive technologies find their continuation in the development of researchers and architects acquiring new theories and methods. Development programming has resulted in a new approach to design, where the key is the notion of "**script**" as a program with their own algorithms and processes [5].

In this case, the designer as an architect-director generates no end product, responsible for every detail, and the process of its establishment or of life. It gives a lot of potential, where the opportunity to lay in the design process more data, allows to obtain the maximum project taking into account many factors. In addition, it gives greater efficiency by cutting costs at both the design and the production.

Having the opportunity to zoom in and take into account the different inputs, one "script" can be applied to create different things in different areas of project activities: from development of graphics, new materials, the surfaces of membranes, structures and landscapes and skyscrapers, urban areas [5]. This technology is embedding scheme "script" in the design process consists of the elaboration of project concept, concept creation script and writing the actual "script".

According to E. Hayman using "script technology" has led to the emergence of new trends in architecture, such as **interactive** and **genetic** architecture, based on complex processes and interactions. Depending on the model of "scripts" can be **genetic**, **online interactive** and **interpreting** or have signs
of different models. After creating the virtual models are refining it to project documentation and create material model [5].

With the advent of digital technologies and the creative potential of the use of technology has opened completely new possibilities for architecture. Methods and ways of forming superior cognitive ability of one designer - digital design possibilities are virtually unlimited and act at all stages of project forecasting and creating architectural object: from sketch to construction management.

The use of parametric modeling design opens up completely new possibilities in architecture until the creation of the "living model" - the computer objects that are in a dynamic State, open to constant changes in the range specified by the author of the project, as defined by the parties of the construction process, and combining them [6].

The Foundation of virtually endless possibilities of parametric architecture is: computer programming, modern design, the latest technology and materials [7]. Computer simulation and visualization allow every architect to create and implement your author's idea, despite construction opportunities today. The concept of "virtual", "digital" or "computer" defined new information technologies project forecasting. Virtual architecture is architecture, which only exists in virtual reality. The most common approach to the definition of virtual reality is associated with the development of artificial intelligence and computer technology [8].

According to some researchers, you can create complex objects and systems in almost all areas. The architecture of a new era, where entire complexes, built on the basis of molecular synthesis, will grow up literally on eyes directly on the construction site, and the procedure for their restructuring and adjustment is similar to editing the code. The architecture of a new era, where entire complexes, built on the basis of molecular synthesis, will grow directly on the construction site, and the procedure for their restructuring and adjustment is similar to editing the code. The layout of the city you may purchase anti-geometric shape structure similar to the structure of the molecular chains or neural connections. Seemingly random, irregular, it nevertheless will have their "formula" and obey its laws [9].

One of the methods of creation of such structures can be use developments of nan-technologies and nan-robotics. Creating a robot with Nan-size, capable of "build" of atoms of different objects that you previously specified person will build itself from those same atoms, i.e. "multiply" (replicated). Self-replicated structures can produce their own copies made of the same material as the Replicator [10]. Therefore, to use nan-Robotics and replicators in the formation of the Smart city concept requires technology for creating and managing self-replicated structures, which opens a new direction in the construction industry.

It is expected that obsolete or broken-down infrastructure elements will be repaired and updated through nan-atoms. The consequences of accidents and natural disasters will be "convalesce" like a cut on the skin and the city itself will turn into a second "skin". It will be a mobile, flexible sheath, rapidly evolving and adapts to the needs of its inhabitants, it will have its own ecosystem, linked harmoniously with nature and adequately interpreting signals from outside. Temperature, humidity and road surfaces will be regulated by a whole system of "smart" devices-foggers and Ionizer, controlled by a single computer center. Engineering equipment will be part of an infrastructure network, like the human circulatory system, present initially, since the eruption and "growing" together with sheath [11].

These ways of organizing space habitats are implemented in scientific research and project proposals for the creation of highly ecological Smart cities. So, in the future cities project Hydro-Net for San Francisco provides a symbiosis of city infrastructures that provide critical life functions, where the architectural company Iwamoto Scott Architects has come up with the idea of translating "Ectopic" [12], [13]. In the following example, in the context of the problem is the coastal zone development project of the city of Asana (South Korea) - architectural companies BIG, INABA, MAD and Mass Studies. The main concept of urban plan is a so-called "economies of scale" - the possibility of free and flexible resizing of architectural design in conditions of unstable funding [14].

One of the developments in South-East Asia, focused on the latest scientific and technological achievements, is the Town Center project for Gwangguo, which was designed by Dutch architecture Studio MVRDV [15]. In the project for South Korea's "Seoul commune 2026" architects from Bureau
of Mass Studies used six variants of cells ranging in size from 28 to 33 m in diameter, linked in a fully landscaped volumes and evenly spread on the huge the city [16]. In the project "Ideal city of the future" - Beijing Boom Tower (architect Neville Mars, Holland), as a fragment of Beijing 2020 onwards, an attempt is made to rethink City Environment where he will create separation of transport and human flows and levels removing Stoppers [17].

Synergetic approach is evident in the draft Eco-City of Masdar in Abu Dhabi (architect Norman Foster) - first city in the world with no carbon emissions, no waste and no car [18]. Mazdar City as "Smart City" is intended to serve as an example of the implementation of the principles of live sustainable development [19]. All of this will not only develop, but also introduce innovative technologies [20]. In this group is the city of knowledge in Medina, where all will be devoted to the development of knowledge-based industries. It is expected that after the completion of the King Abdullah city and cities Prince Abdulaziz bin Musaieda they become logistic and industrial center of the region [21]. In Kuwait during the construction of the new City of Silk (Madinat Al-Hareer) design method for prediction and 4 planned urban Center: Business Centre, leisure and entertainment, environmental and cultural, as well as the creation of environmental reserve and a modern sports complex [22].

Future-design (project forecasting) methods offer innovative opportunities for economic, social and cultural development of the now fragmented and not even included the resources of individual countries and regions. Self-organizing start socio-economic and architectural and town-planning processes of space habitats, according to D.B. Pjerveev, can deal with current and future challenges for the integration of the planet respectively on three connecting levels [23]:

Information level - of information and connecting and uniting the entire planet into a single system, regardless of time and space (migration, travel, TV-radio-communication, Internet, space technology, energy and others connecting factors).

Spatial-communication level - communication and connects different geographic relationships persisted space countries, regions, and separated by continents (bridges and roads, tunnels and canals, other engineering structures, and also the Earth, air and water transport).

Socioeconomic and geopolitical level is ideological, socio-economic, cultural, etc. each country's potentials in integration processes (religion, ethno-psychological and socio-geographical community, economy, culture, etc.).

3. Results
In the course of the analysis of existing studies in the field of application of the technology of the project as a method of forecasting, modeling and spatial formation Environment in architecture and urban planning have been identified:

In structure of the project forecasting is composed of four forecasting unit, each of which describes a particular slice of design predictions: problem-target block, conceptual-modeling unit, prognosis-conceptual block, prognosis-project block.

Project forecasting spatial habitat Wednesday includes the following stages: before the forecast guidance, job development forecast, forecast verification, retrospection, the adjustment of the forecast, the synthesis of predictions.

The fulfillment of these striations may, of these striations may, subject to the following principles for the Organization of work under the project prediction: addressed, balance, parallelism, continuity, accuracy, adequacy, and directly handling, alternative, adaptability.

In system optimization of architectural objects in the current approach to space, as well as the manifestation of sustainability trends in the approach to urban planning and architectural design of important factors are the reversibility and cyclical system.

Use of "scripting" technologies has led to the emergence of new trends in architecture, such as interactive and genetic architecture, based on complex processes and interactions. Depending on the model of ‘scripts’ can be genetic, online interactive and interpreting or have signs of different models.

The use of parametric modeling design opens up completely new possibilities in architecture when you create computer objects that are in a dynamic State, open to constant changes within the ranges specified in the author of the project.
When forming the concept of Smart city may use the developments of nan-technologies and nan-robotics, allowing self-replicated structure that can produce their own copies made of the same material, which opens a new direction in the construction industry.

4. Discussion.
Approach future-design (project forecasting) is based on the future modeling and predicting the evolution of the social and cultural changes in society, technology development and focused on design innovation, adequate future and relevant for him. Result prediction in architecture is a complex project forecasting object specifies the transition from the initial situation towards qualitatively new situations and formations, gradually improving its functional structure, specifically shaped the content and consumer properties of the architectural object. This article presents examples of how to use these methods and ways of organizing space habitats that are implemented in scientific research and project proposals for the creation of highly ecological Smart cities.

5. Conclusion
Many architectural designs, modeled with the help of information computer technologies, and remain on paper in his virtual world, if you are not using the above technology project forecasting, where architect designs not the final product, responsible for every detail, and the process of its creation or live activity. This forces the architect used innovative technology from other industries and confronts society new architectural challenges.

Thus, technology future-design (project forecasting) modeling method and the formation of spatial habitat Environment represent a specific value and professional interest, theorists, and practitioners architecture. Project forecasting results can be used for clarification and adjustment of the initial forecast results - if the forecast reveals some flaw in the Organization of the subject Environment, the project addresses this shortcoming. This concluded the basic contradiction of the project forecasting: it is precisely in order to expect poor prognosis did not come true, the negative factors had been neutralized, and human environment spatial Habitat Environment acquired functional integrity and harmony.

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