The problem of formation of innovative directions in the profession “Architect”

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Abstract. The paper investigates the phenomenon of the impact of innovation on the formation of competencies, specializations and specialties in the profession “Architect”. A research model is proposed that describes the impact on the profession of innovative, architectural and construction factors and the goal-setting factors of innovative knowledge and technologies. The features of the influence of changes in the socio-economic factor of the functioning of Kharkiv (Ukraine) on the formation of new urban areas in architecture are described. An experiment is described to create a cognitive model of the “Novi Doma” housing estate, Kharkiv, in which the authors of the study participated as expert architects. The deep socioeconomic crisis of the housing estate revealed and described in the experiment made it possible to draw conclusions about the parameters of a new scientific and educational direction in urban studies.

1. Relevance
Recently, the profession “Architect” has become a complex combination of many specialities and specializations. Over the past twenty years, under the influence of technological and information revolutions, a large number of innovations have appeared. Some of them, for example, computer literacy, have entered the core of the profession and have become practically mandatory for study by architects. Innovations gave rise to new areas of activity that were previously not inherent in the traditional circle of duties of an architect, which gradually begin to take shape in new specialities and specializations. A vivid example is the new specialization “architect-animator”. This is an unlicensed, yet already highly demanded type of innovative activity of the architect, associated with the animated presentation of architectural design concepts.

An interesting perspective on the phenomenon of the emergence of new specializations in architecture is provided by global statistics on intellectual property accounting. According to the WIPO (World Intellectual Property Organization) annual report on World Intellectual Property Indicators (WIPI), 3.3 million patent applications were filed worldwide in 2018, which shows a steady increase of 5.2% for the ninth consecutive year. Activity in the field of filing applications for registration of trademarks in the world has grown to 14.3 million, and in the field of industrial designs - up to 1.3 million per year.
According to the PCT (The International Patent System) for the period from 1995 to 2019, the number of patent applications in the following areas has increased: 1) Computer technology: 20 times; 2) Environmental technology: 4.5 times; 3) Civil Engineering: 5.3 times [1];

The above data indicate an “explosive” development of innovations that directly affect the formation of architecture and architectural specialties. The statistical approach allowed us to create a model that describes the impact of innovative knowledge and technologies on the formation of new competencies, specializations and specialties in architecture (Figure 1).

Figure 1. A model that describes factors that influence the formation of specializations and innovative competencies in architectural professions.

The model consists of four mutually related blocks: “Professional factors”; “Innovative factors”; “Factors of the goal-setting of innovations”; “Architectural factors”. The model describes the formation of the first block - “Professional factors” under the influence of three others.

The first block - “Professional factors” is the object of study and consists of the following components: Competence, Specialization, Speciality, and Profession. The listed components are formed on the basis of skills, abilities and hidden knowledge. The term “Tacit knowledge” refers to the set of professional knowledge that is passed on from the master to the student and cannot be transmitted only in a verbal way [2]. For architecture, tacit knowledge is one of the significant factors in the formation of a specialist.

The second block - “Innovation factors” consists of the following innovations: technologies, methods, and architectural projects. Which, in turn, are formed under the influence of formal knowledge, tools and products.

The third block - “Factors of goal-setting of innovations” consists of the following hierarchical levels of goal-setting of innovations: local, tactical, strategic. The described levels are focused on achieving goals: environmental, technological and social, both individually and comprehensively.
The fourth block - “Architectural factors” describes the formation of architecture, urban planning and urbanism following the classical triad: form, function, construction.

The developed model made it possible to assess the prospects for the development of innovative areas in the profession and to develop several recommendations on the introduction of innovative training programs for Ukrainian universities.

In 2019, the authors of the study took part in an experiment related to the practical testing of the operability of the methods for modelling the city as a dynamic system developed at the Department of Innovative Technologies of Design of Architectural Environment (ITDAE) of Kharkiv National University of Civil Engineering and Architecture (KNUCEA). The authors' area of responsibility was the formation of multidisciplinary expert groups, as well as the study of social and legislative factors for the modernization of obsolete buildings of the “Novi Doma” residential complex, Kharkiv, Ukraine.

Social problems identified during the experiment became the reason for rethinking the developed model for the formation of architectural specialities. The specificities of the crises experienced by Ukrainian cities indicate that an exclusively technogenic approach is not able to effectively solve the challenges facing the country's architects. The problems identified an urgent need for the formation of a cluster of architects - urbanists capable of designing not only in the context of energy, economic and raw material crises, but also in solving acute social problems. Architects are closely connected with urban communities, living by their interests and able to gain the trust of these communities. This approach forms a cycle of tasks that were not previously solved in the national architectural paradigm.

This article describes the preconditions for the thesis about the need to develop a new direction in the architectural profession - the architect-urbanist, whose professional activity is focused on the formation of an architectural space based on the socio-economic interests of urban communities. The authors conducted research cycles in which the problem of a systemic contradiction of the investor interests and urban communities was identified. Moreover, as a rule, the interests of investors dominate, which periodically harms the city as a system and its brand. An architect - urbanist is able to identify the socio-economic resources of the community, develop on their basis strategic measures to transform the architectural component of the city and motivate the community to make the necessary changes.

2. Research methods
For the first time, the methodological foundations of the program complex for modelling the city as a dynamic system were developed at the ITDAE department of the Kharkiv National University of Civil Engineering and Architecture. They are based on a combination of two trends in modern science: optimizing the functioning of cities and managing large amounts of data about the city. This allows you to explore the dynamics of changes in the city over a certain historical time. The strength of these changes, their speed and acceleration determine the place and parameters of the existence of a particular phenomenon in the system. The totality and mutual influence of all dynamic processes in the system determine the parameters of the existence of the system itself.

The program complex consists of two hierarchically related, but autonomously organized parts: verbal-mathematical and imitation-cumulative. The cognitive-research matrix allows you to create information packages that verbally and statistically describe the principles of functioning of the subsystem “architecture”, as part of the city system. The information storage model is responsible for the function of storing and processing information packets formed by the cognitive research matrix. Based on the accumulated data array, the information storage model displays and predicts in real-time the state of the city system in the Sustainability, Crisis and Catastrophe categories.

The specified model complex can be used as an architectural and urban toolkit for modelling, monitoring and strategic planning of the functioning and development of the city as a dynamic system. This will potentially allow solving a set of problems associated with adapting the architecture of post-industrial cities to modern conditions. The complex nature of this program allows you to take into account the goals of both the “architecture” subsystem and the city system as a whole, and find a coordinated, compromise solution for its optimal functioning and development.
The research put forward the thesis that Kharkiv needs a cluster of architects who are able at the system level to develop strategic solutions for transforming the architectural component of the city in the face of many systemic crises.

The basis for this thesis was the discussion at the interdepartmental seminar at the Academic Council D 64.056.02 of Kharkiv National University of Civil Engineering and Architecture. At the seminar, the report of Danylov S. M. was heard on the results of dissertation research for the degree of Doctor of Architecture “Methodological basis of city modelling as a dynamic system” [3]. The fifth section of the thesis is devoted to: “An experiment to test the performance of a cognitive-research matrix as part of a model complex for analyzing and modelling a city using the example of the “Novi Doma” housing estate in Kharkiv”. The object of the experiment: housing estate “Novi Doma”. Subject: impact of the law of Ukraine “About the energy efficiency of buildings” adopted in 2017 on the dynamics of socio-economic indicators of the “Novi Doma” housing estate.

3. The results of the experiment

During the experiment, more than 350 information blocks were formed and parametrically connected, describing: depreciation of engineering networks and buildings of the district; increased energy consumption of buildings; increase in the welfare of residents of the area; activity ACAB (Association of co-owners of an apartment building) on the rehabilitation of buildings; ageing residents of the area; labour emigration; marginalization of the population; the social activity of the population of the district; increase in deductions for capital repairs of buildings, etc.

A comparison of the graphs constructed on the basis of the information blocks made it possible to identify several crises, the dynamic indicators of which are close to the transition to the pre-catastrophic state. The study revealed a deep social crisis, which is the main factor hindering almost all the measures being developed to increase the stability of the region.

As one of the analytical methods developed in the dissertation research, the concept of the “Site of Problems” was proposed.

The “Knot of Problems” describes conflicts of centripetal and centrifugal efforts that arise in the city system in the processes of functioning. Centripetal efforts arise in response to changes in the conditions of the city’s functioning and are aimed at preserving it as a system. Centrifugal centred on mutations in urban space and aimed at adapting the system to new challenges. As a result of changes in external and internal conditions, the goals of centrifugal and centripetal efforts contradict, provoking how the transition of the functioning processes of the city system from resistance to crisis and in the opposite direction.

The authors of the study took part in the above experiment as experts, forming the “Legislative knot of problems”, which affects the prospects for the modernization of residential buildings in the “Novi Doma” district of Kharkiv. According to the tasks set for Fomenko O. O and Izbash A. M., the “Knot of problems” was formed on the basis of the following features: A) on a hierarchical basis - international agreements in which Ukraine, national legislation and regional acts participate; B) By scope - legislative regulation of the main subsystems of the city of the Ecosphere, Technosphere, Population; C) In the direction of the efforts - centripetal, centrifugal. The study identified 12 legislative acts related to the socio-economic field of implementation of the Law of Ukraine “About the energy efficiency of buildings” (Table 1).

The structure of the formed “Legislative knot of problems” made it possible to determine legislative restrictions and stimulating aspects that ensure the processes of energy modernization of residential buildings in the district and city. The picture below (Figure 2) shows an experiment on graphically displaying the “Legislative knot of problems” indicating the following factors provoked by the analyzed laws in the city system: A) Centripetal efforts. In this case, laws aimed at maintaining the integrity and stability of the city system are considered. For example, the law “About atmospheric protection”, which sets limits on the emissions of harmful substances by architectural objects into the atmosphere during their life cycle; B) Centrifugal efforts. They are aimed at adapting the architectural environment of the city to the new realities of its functioning.
Table 1. The laws and articles of these laws that form the “Legislative knot of socio-economic problems of the “Novi Doma” housing estate” related to the modernization of the housing stock of the district following the requirements of the Law of Ukraine “About the energy efficiency of buildings”.

| №  | The legislative aspect                                                                 | Comments                                                                 |
|----|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 1  | “About protection of atmospheric air”                                                 | Section IV. Article 23. Conditions for the Design, Construction and Reconstruction of Enterprises and Other Objects that Affect or May Affect the Condition of Atmospheric Air |
| 2  | “About the protection of the environment”                                             | Section XI. Article 51. Ecological Requirements for the Placement, Design, Construction, Reconstruction, Commissioning and Operation of Enterprises, Structures and Other Objects |
| 3  | “About alternative energy sources”                                                     | Section II. Article 9. Stimulation of electricity production from alternative energy sources |
| 4  | “About the complex reconstruction of quarters (residential districts) of outdated housing stock” | Article 9. Identified sources of financing of measures for reconstruction of residential quarters of cities. |
| 5  | About Energy Saving                                                                    | Article 14. Areas of Use of Energy Saving Funds                           |
| 6  | About Local Self-Government in Ukraine                                               | Article 26. The exclusive competence of village, settlement, city councils |
| 7  | “About the energy efficiency of buildings”                                            | Article 6. Minimum requirements for energy efficiency of buildings       |
| 8  | “About the peculiarities of exercising property rights in an apartment building”       | Article 12. Costs for managing an apartment building                      |
| 9  | “About the association of co-owners of an apartment building”                         | Article 11. Keeping the residential complex on balance                    |
| 10 | About the Energy Efficiency Fund                                                      | Article 12. Management of indivisible and common property of a residential complex |
| 11 | “Program of partial reimbursement to Kharkiv individuals for interest on energy-saving loans for 2017-2020” | Article 4. Financial support of the Program                              |
| 12 | Energy Saving and Energy Efficiency Program of Kharkiv Housing Fund for 2018-2022. Kharkiv city 2017 | Article 1. The current state of the housing stock in Kharkiv              |

For example, the Law on Energy Efficiency, putting forward requirements to reduce buildings energy consumption due to their modernization; C) Sustainability. A chain of legislative ties that have a positive response in the city system. For example, the National Law “About Energy Saving” has led to the emergence of the National Law “About the Energy Efficiency Fund”, which is the basis for the creation of the regional regulation “ The program of partial interest rate reimbursement to individuals of Kharkiv on energy saving loans for 2017-2020 years”. Taken together, laws create positive efforts to enhance the city’s system; D) Contradictions. In this case, the logical contradictions of the Laws are not meant, but the contradictions arising between the subsystems of the city in the processes of their functioning. In the formed “Knot”, as a potential contradiction, insufficient financing for the modernization of the housing stock of the district from the means of city and state budgets is reflected; E) The crisis. In this case, the potential possibility of provoking a socio-economic crisis by law is displayed. For example,
the National Law “About Energy Efficiency”, through the Law “About features of realization of the property right in the apartment building”, affects the welfare of residents of apartment buildings, obliging them to certain expenses to bring their property into line with the law.

Figure 2. The legislative knot of problems of modernization of obsolete housing in the “Novi Doma” district of Kharkiv.

Thanks to the analysis, it became possible to assess the share of financial participation of the state, investors and residents of the district in the process of modernization of obsolete housing. According to aggregated indicators, the share participation of residents of the “Novi Doma” district in financing measures for the modernization of housing, the owners of which they are, is defined as 70%. Following the order of the Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine, № 172 dated 07.11.2018 “About approval of the Procedure for certification of energy efficiency and the form of energy certificate”, the concept of “Reference building” was used in the experiment.

The study of international experience in the modernization of obsolete residential facilities has identified four prototypes that have become the basis of the “Reference Buildings”. The selected prototypes made it possible to determine the types, nature and cost of modernization of buildings in the range from 160 to 320 US dollars per m² (Table 2) and through them, the average financial burden per inhabitant.

Table 2. Types of reference buildings

| Energetic building class, cost modernization m² | Reference Building/ Address / Architect | Energetic building class, cost modernization m² | Reference Building/ Address / Architect |
|---------------------------------------------|--------------------------------------|---------------------------------------------|--------------------------------------|
| LWG Leinfelden Germany 350 USD/m²           | Tomsk, Russia Komsomolsky ave, 71 LLC SV-Trade 205 USD/m² |
| Kaliningrad, Russia Leninsky ave, 2-4 Arthur Samits and Ilya Kiselev 280 USD/m² | Kharkov, Ukraine ave. Marshal Zhukov, 21 Nikonenko Evgenie 160 USD/m² |

The obtained results made it possible to calculate four possible options for the socio-economic consequences of the modernization of buildings for the population of the “Novi Doma” housing estate. At a round table devoted to the end of the first stage of the experiment, a discussion was held by experts of the Legislative, Social, Technogenic and Economic “Knots of Problems”.

Through the efforts of all experts who took part in the experiment, the Comprehensive Problem Knot was compiled. The “Knot” was compiled by comparing the dynamics of the base growth [4] rate graphs indicators are shown in Table 3.
4. Conclusions from the experiment

The law “On energy efficiency” concerning the obsolete housing stock of the “Novi Doma” district of Kharkiv will not be implemented. The following factors indicate this: According to the data of the Main Department of Statistics in the Kharkiv region in 2015 the provision of housing for Kharkiv residents averaged 24.1 m\(^2\) [5]. From which it follows that the average cost per 1 inhabitant for modernization of housing amounted to about 3856 US dollars following the fourth minimum indicator of the cost of m\(^2\) of modernization of the “Reference Building”. In 2020, the average loan rate for “Warm loans” at the six largest banks in Ukraine amounted to 18% per annum. In accordance with the calculation of the loan calculator minus a 40% share of municipal and state financing, the repayment of loans amounted to 96 monthly payments of 1575 UAH. following the exchange rate on 02/08/2020. The average living wage (including utility bills) is 2270 UAH/ month per person [6]. The average pension is 3019 UAH. (January 2018). The statistical report “The distribution of the population in terms of average total income equivalent (2010-2018)” indicates that 33.7% of the city’s population has an income of less than 3360 UAH. This means that at least a third of the district’s residents are physically unable to take part in financing the modernization of their housing (Table 3. paragraphs 3; 8; 9; 10; 11).

In the last decade, a decrease in the perception of the district’s brand associated with the following factors has been identified: 64% of the district’s buildings are morally obsolete (table 3. paragraph 5); 90% of engineering networks have expired [7]. These factors were reflected in the ranking of Kharkiv districts in terms of the cost of apartments the housing estate has entered the top three districts with the worst rates [8]. As a reaction, according to the results of surveys of real estate agencies, from 25 to 30 residents with an income above the average moved from the estate area every month to more prestigious areas. These data indicate a gradual deterioration in the housing estate situation. Also, almost complete lack of motivation for prompt action to solve the problem of obsolete housing stock among local authorities and investors.

The housing stock of Kharkiv includes 9363 houses with a total area of 41 771.3 thousand m\(^2\). Most of the housing in the city was built on the projects of mass series in the 60-80s of the last century. The
pace of residential buildings obsolescence exceeds the pace of new housing construction, overhaul, modernization and reconstruction combined.

Almost the entire housing stock is characterized by the problem of technical and moral ageing of the engineering equipment of houses - heating systems, hot and cold water supply, sewage, sanitation, electricity, lighting, ventilation, elevator facilities. Hydro and thermal insulation of roofs and walling are worn out, which causes them to leak and freeze. Depreciation or absence of thermal insulation of the heating and hot water pipelines lead to significant losses of thermal energy in the houses [9].

In March 2019, the authors of this study received consultations on the prospects for the renovation of obsolete housing in the city at the city’s chief architect Chechelntsky S.G. and Nikonenko E.V. - the chief architect of the project for the modernization of a five-story residential building in Kharkiv, at the address 21, Ave. Marshala Zhukova (“Novi Doma” housing estate). A complex of design works was carried out on the building's overhaul, attic superstructure, without resettling residents, increasing the building's energy efficiency to class C. The negative experience described by the architect in the process of architectural supervision of the reconstruction of the house gave the study authors a new perspective on the problem of modernizing obsolete housing stock.

The modernization of the building at 21, Ave. Marshala Zhukova was completed by JSC “Zhilstroy-1” in 2001 at the expense of investors and the municipality. Repair and construction work was carried out without the resettlement of residents. This experience was considered as an experiment necessary to develop a socio-economic strategy for the renovation of obsolete housing in the city. The idea was to develop a project that was economically attractive to potential investors. The project payback was supposed due to the attic floor superstructure on five-story buildings with the subsequent sale of new apartments.

The number of efforts to establish constructive interaction with the residents of the house made by the project organizers forced them to reconsider their attitude to this area of economic activity. Architect Nikonenko E.V. describes the social problem of home modernization as an extremely negative experience that he would not like to repeat.

Thus, the basis of the crisis revealed in the experiment lies in acute socio-economic problems blocking all attempts by interested parties to solve the problem of progressive degradation of the technical condition of the housing stock of the “Novi Doma” district. The severity of social problems led to a decrease in the motivation of investors and local governments to almost zero. In Kharkiv over the past 20 years, the authors of the article revealed only one case of the modernization of the building described above. Delaying the solution to this call can lead to irreversible consequences and depopulation of the housing estate.

The facts cited in the conclusions of the experiment prompted the determination of paragraph 14 “Socialization” (table 3) as a crisis threatening the transition of the dynamics of the functioning of the region to a pre-catastrophic state. A study of the causes of the identified crisis showed that similar problems are characteristic of almost all cities of the country.

The study revealed critically low socialization of the population of the district and city. The conducted express survey gave the following results, 100 surveyed residents of the district do not trust: the government - 89%; Banking system - 72%; Local governments - 63%; Residents of the district - 54%; Residents of the house - 49%; Investors - 86%.

One of the results of the experiment was an awareness of the responsibility of architects for the development of new strategic approaches to solving the problem of the obsolete real estate fund of the city. Given the acute shortage of resources, traditional architectural and town-planning approaches to this problem are practically powerless. The main problem associated with the prospects for resolving the identified crisis is the lack of urban communities. The effectiveness of public and private investment programs in the current conditions does not solve the problem. A promising way out of their designated crisis seems to be: A) The revival of territorial communities, presumably based on the ACAB (Association of Co-Owners of an Apartment Building); B) Nurturing a cluster of young, motivated professionals capable of developing effective step-by-step strategies for resolving problems facing communities;
C) Development of methods for overcoming crises due to the rational use of social, technological and natural resources of the city region.

These theses indicate the need to develop innovative, experimental competencies in the speciality “architectural urbanism”.

5. Aspects of the formation of new specializations in architecture.
Analysis and development of strategic models for solving the problems identified in the experiment allowed us to draw the following conclusions: 1) In the city of Kharkiv, from 15 to 25% of the population lives in buildings whose estimated life is over; 2) The level of socio-economic development of Kharkiv does not allow us to hope for a quick and effective solution to the problems of old housing; 3) In the city there is practically no cluster of young managers, scientists and practitioners capable of solving the problems facing the city at the level of strategic management;

A scientific and practical response to the identified challenge was the dissertation research of graduate student Izbash A.M. led by doc. arch. prof. Fomenko O.O. (authors of the article): “The role of innovative technologies in expanding the core of the profession “architect”. This study develops a model for the development of new architectural competencies under the influence of innovations that have come to architecture and construction.

The point of this work is an innovative approach, considering the cluster of architectural urbanists as a compensation buffer in resolving social, technological and environmental systemic conflicts that arise in the formation of the architectural environment of the city and affect the principles of functioning of urban space.

The new strategy for the stable functioning of the city in the conditions of an acute shortage of resources requires not only appropriate innovations, but there are also problems that make it necessary to pay special attention to the idea of educating a cluster of urbanists of a new formation for Kharkiv, among them: 1) Depopulation of the city. Over the past 30 years, the population of Kharkiv has declined from 1,623,000 to 1,441,932 people [10]; 2) Low purchasing power per person - € 1 830 [13]; 4) Stagnation of the city’s economy; 5) The marginalization of the population; 6) Housing stock obsolescence; 7) Degradation of utility networks, etc;

With a high degree of probability it can be argued that traditional architectural approaches based on the active exploitation of raw materials and economic resources will be ineffective. The urgent need to transform the urban space (more than 400,000 people live in buildings whose estimated operating life has been completed or will be completed in the next 10 years), together with the stagnation of the economy and lack of resources, creates a very different “map” of the architect’s activities;

6. Conclusions.
The theses presented in the article indicate the need to consider innovative educational processes as part of the practical activities of architects aimed at adapting the city to new challenges. To do this, it is proposed to develop the following scientific and educational areas: A) Development of a strategy for interaction between the university and local authorities; B) Implementation of the principles of regional environmental management as the basis for the sustainability of the city. This indicates the orientation of the city’s economy to the exploitation of the region’s social, natural and technological resources, and a decrease in dependence on energy and raw materials exports; C) Development of strategies for the participation of the university in the processes of the revival of territorial communities. For Ukrainian cities, the theme of the revival of urban communities is one of the most important factors in increasing their sustainability. During the existence of the USSR, urban communities were almost destroyed. In this case, the term “urban community” means a compactly living community of people united basing on a common ethical, economic, cultural and other interests. Conscious of the community of these interests and defending them;

Calculations of the city’s potential need for urban architects made it possible to determine the following ratio: 1 specialist per 3500-5000 inhabitants. For the city of Kharkiv and the region, this means jobs for 350-600 architects-urbanists. For the universities of the city, the formed need makes it possible...
to open a new scientific and educational field with the prospect of the annual graduation and further employment of 15-25 specialists.

The authors of the article are convinced that the identified problems and crises associated with the architectural component of the city of Kharkiv are characteristic of many cities of the post-Soviet space. The development of scientific, educational and urban strategies for resolving the challenges facing the city are indispensable for its survival. The nature of the revealed crises and their development scenarios indicate the fact that the European experience is in many ways not applicable to local socio-economic realities. For this reason, so much attention is paid to the problems of the revival of urban communities, as a non-alternative factor in the renovation of the city and its architecture.

One of the most important results of the experiment was the awareness of the role and responsibility of architects for the revival of Ukrainian urban communities. Architects have a unique set of competencies that allow them to form multidisciplinary teams, technically accurately calculate the necessary and permissible changes in the architectural fabric of the city and convey the results of their research in aesthetically and emotionally verified forms of architectural visualizations. In practice, today, there are no other professions capable of combining such a wide range of humanitarian and exact sciences.

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