UDC 72.036
IRSTI 67.07.03
RESEARCH ARTICLE

PRIORITY DIRECTIONS FOR THE DEVELOPMENT OF REGIONAL ARCHITECTURE IN KAZAKHSTAN IN THE 21ST CENTURY

G.S. Abdrassilova[1], L.M. Aukhadiyeva[1,*]

[1]International Educational Corporation, 050043, Almaty, Kazakhstan

Abstract. *The article offers an in-depth analysis of the key directions in the development of regional architecture in Kazakhstan in the 21st century. Modern architecture evolves under various factors, including environmental conditions, technological advancements, socio-economic realities, and cultural-historical contexts. The late 20th and early 21st centuries have also brought global challenges such as globalisation, environmental crises, technological and anthropogenic disasters, and military conflicts. This research, with its comprehensive approach, plays a crucial role in identifying the factors influencing contemporary architecture in Kazakhstan and determining the future directions for its development. The methodology included comparative analysis, systematisation of information from literary sources, project modelling, and surveys, ensuring the robustness and reliability of the findings. The primary data sources were the works of leading architecture specialists, complemented by an analysis of governmental policy documents, which provided insights into the main state policy directions in architecture. The study identified several critical directions in the development of architecture in Kazakhstan: sustainable development and "green" architecture, the digitalisation of the architectural and construction sector, the adaptive reuse and repurposing of existing buildings, participatory design, and the strengthening of architectural identity, which is crucial in the context of growing globalism. The findings of this research can serve as a foundation for developing new theoretical concepts in regional architecture and can be integrated into architectural educational programmes. These results will also benefit projects related to preserving and restoring architectural monuments, conserving cultural heritage, and adapting it to contemporary needs, enhancing both these objects' functional appeal and economic value.*

Keywords: *sustainable development, digitalisation of architecture, adaptive architecture, participatory design, architectural identity*

***Corresponding author**
Laura Aukhadiyeva, e-mail: laukhadiyeva@gmail.com

https://doi.org/10.51488/1680-080X/2024.3-01
Received 10 May 2024; Revised 15 July 2024; Accepted 26 August 2024

ӘОЖ 72.036
ҒТАМР 67.07.03
ҒЫЛЫМИ МАҚАЛА

ҚАЗАҚСТАННЫҢ XXI ҒАСЫРДАҒЫ ӨҢІРЛІК СӘУЛЕТІН ДАМЫТУДЫҢ БАСЫМ БАҒЫТТАРЫ

Г.С. Абдрасилова[1], Л.М. Аухадиева[1,*]

[1]Халықаралық білім беру корпорациясы, 050043, Алматы, Қазақстан

Аңдатпа. *Мақалада XXI ғасырдағы Қазақстанның өңірлік сәулетін дамытудағы негізгі бағыттардың талдауы жүргізіледі. Заманауи сәулет, бұрынғыдай, көптеген факторлардың, соның ішінде табиғи-климаттық жағдайлардың, технологиялық жетістіктердің, әлеуметтік-экономикалық шындықтардың және мәдени-тарихи контексттің әсерінен үздіксіз дамып келеді. XX ғасырдың аяғы мен XXI ғасырдың басында адамзат жаңа сын-қатерлерге тап болды: жаһандану, экологиялық мәселелер, техногендік және антропогендік апаттар, әскери қақтығыстар. Мақаланың мақсаты – заманауи сәулетті сипаттайтын факторларды анықтау және оның әрі қарайғы даму жолдарын белгілеу. Бұл мақсатқа жету үшін салыстырмалы талдау, әдеби дереккөздерді жүйелеу, жобаларды модельдеу және сауалнамалар жүргізуді қамтитын кешенді тәсіл қолданылды. Негізгі дереккөз ретінде сәулет саласындағы жетекші мамандардың ғылыми еңбектері пайдаланылды. Сонымен қатар, мемлекеттік сәулет саласындағы мемлекеттік саясаттың негізгі бағыттарын анықтауға мүмкіндік берген бағдарламалық құжаттар талданды. Зерттеу нәтижелері XXI ғасырдағы Қазақстан сәулетінің дамуының бірнеше негізгі бағыттарын анықтауға мүмкіндік берді. Олардың ішінде тұрақты даму және «жасыл» сәулет, сәулеттік-құрылыс саласын цифрландыру, қолданыстағы ғимараттарды бейімдеп қайта пайдалану және қайта бейіндеу, партисипативті жобалау, сондай-ақ жаһандану жағдайында сәулеттік бірегейлікті нығайту сынды маңызды бағыттар ерекше орын алады. Алынған нәтижелер «Сәулет» білім беру бағдарламасы бойынша оқу пәндеріне интеграциялануы мүмкін. Нәтижелер сәулеттік ескерткіштерді қорғау және қалпына келтіру, мәдени мұраны сақтау және оны қоғамның қазіргі қажеттіліктеріне бейімдеу бойынша жобаларда пайдалы болады, бұл нысандардың функционалдық тартымдылығы мен экономикалық құндылығын арттыруға ықпал етеді.*

Түйін сөздер: *тұрақты даму, сәулетті цифрландыру, бейімделген сәулет, бірлескен дизайн, сәулеттік сәйкестік.*

***Автор-корреспондент**
Лаура Аухадиева, e-mail: laukhadiyeva@gmail.com

https://doi.org/10.51488/1680-080X/2024.3-01
Алынды 10 мамыр 2024; Кайта қаралды 15 шілде 2024; Қабылданды 26 тамыз 2024

УДК 72.036
МРНТИ 67.07.03
НАУЧНАЯ СТАТЬЯ

ПРИОРИТЕТНЫЕ НАПРАВЛЕНИЯ РАЗВИТИЯ РЕГИОНАЛЬНОЙ АРХИТЕКТУРЫ КАЗАХСТАНА В XXI ВЕКЕ

Г.С. Абдрасилова[1], Л.М. Аухадиева[1,*]

[1]Международная образовательная корпорация, 050043, Алматы, Казахстан

Аннотация. *В статье проводится анализ ключевых направлений развития региональной архитектуры Казахстана в XXI веке. Современная архитектура, как и прежде, непрерывно эволюционирует под влиянием множества факторов, включая природно-климатические условия, достижения технического прогресса, социально-экономические реалии и культурно-исторический контекст. Конец XX – начало XXI века поставили человечество перед лицом новых вызовов: глобализация, экологические проблемы, техногенные и антропогенные катастрофы, военные конфликты. Цель статьи – выявить факторы, сопровождающие современную архитектуру и обозначить траектории ее дальнейшего развития. Для достижения поставленной цели использовался комплексный подход, включающий сравнительный анализ, систематизацию информации из литературных источников, моделирование проектов и анкетирование. В качестве основного источника данных использовались научные труды ведущих специалистов в области архитектуры. Дополнительно были проанализированы государственные программные документы, которые позволили выявить основные направления государственной политики в области архитектуры. Результаты исследования позволили выделить несколько ключевых направлений в развитии архитектуры Казахстана в XXI веке. Среди них можно выделить устойчивое развитие и «зелёную» архитектуру, цифровизацию архитектурно-строительной сферы, адаптивное повторное использование и перепрофилирование существующих зданий, партисипативное проектирование, а также укрепление архитектурной идентичности, что особенно важно в условиях нарастающего глобализма. Полученные результаты могут быть интегрированы в учебные дисциплины по образовательной программе «Архитектура». Результаты будут полезны в проектах, связанных с охраной и реконструкцией памятников архитектуры, сохранением культурного наследия и его адаптацией к современным потребностям общества, что способствует повышению функциональной привлекательности и экономической ценности объектов.*

Ключевые слова: *устойчивое развитие, цифровизация архитектуры, адаптивная архитектура, соучаствующее проектирование, архитектурная идентичность.*

*** Автор-корреспондент**
Лаура Аухадиева, e-mail: laukhadiyeva@gmail.com

https://doi.org/10.51488/1680-080X/2024.3-01
Поступило 10 мая 2024 г.; Пересмотрено 15 июля 2024 г.; Принято 26 августа 2024 г.

1 INTRODUCTION

The development trends of regional architecture in Kazakhstan during the second half of the 20th century and the early 21st century were shaped by significant changes brought about by globalisation. Globalisation, encompassing economic, political, cultural, and religious aspects, has led to worldwide integration and uniformity, posing a threat to the unique architectural identity of Kazakhstan. In a multipolar world, it is crucial to identify the directions for developing Kazakhstan's architecture as part of Central Asia to preserve its national characteristics. The "Strategic Development Plan of the Republic of Kazakhstan until 2025" forecasts that the country's spatial development will focus on increasing economic and demographic density and strengthening internal connectivity by creating "economic corridors". These measures are intended to ensure the sustainable development of architecture while preserving its regional distinctiveness. **(The Strategic Development Plan until 2025, 2021)**. Table 1 demonstrates that Kazakhstan's spatial development policy until 2025 aims to create a resilient settlement framework based on strategically essential directions.

Table 1
The Main Directions of Spatial Development Policy in Kazakhstan until 2025.

Key Directions	Description
Focus on "Growth Points"	Emphasis on urban agglomerations, large cities (regional centres), mono-towns with a population of over 50,000 people, small towns near large cities and border areas, and key rural settlements.
Formation of "Economic Corridors"	Development of industrial potential in the country's northern, southern, and southeastern regions.
Unleashing the Industrial Potential of Regions	Development of industrial potential in the country's northern, southern, and southeastern regions.
Reformatting Industry	The transition from resource-based to processing industries in the western, central, and central-eastern regions for sustainable economic development.

A strategically sound and systematic urban development policy will undoubtedly enhance living environments and the material space of settlements in Kazakhstan. As a crucial component of the material environment, architecture encompasses buildings, structures, infrastructural facilities, and their complexes, which play a pivotal role in shaping the urban landscape. Throughout history, architects have aspired to forecast the future, designing "ideal" cities and creating unique structures incorporating the latest technologies. When analysing the trends in regional architecture in Kazakhstan, it is impossible to overlook the connection with the concepts of region, regionalism, and regionality, as well as their opposite phenomena, such as globalisation and the emergence of a new global order. These processes, unfolding in the early 21st century, inevitably influence the formation of global architecture, reflecting new forms of interaction between local and global contexts **(Beck, 1999)**.

In contemporary globalisation, many local cultures strive to revive and preserve their traditions, emphasising their uniqueness and distinctiveness. This serves as a counter-reaction to globalisation, which often leads to the levelling and unification of cultural characteristics. The paradox of mass culture lies in the fact that, as standardisation processes intensify, interest in ethnic specificity grows. Thus, ethnocultural elements become tools for preserving identity and valuable resources in the global economy, illustrating society's desire to maintain uniqueness in an increasingly globalised world **(Malinovsky, 2013)**.

2 LITERATURE REVIEW

The current state of global architecture is significantly shaped by the prognostic research of leading scholars. This work draws on the contributions of contemporary authors who comprehensively understand current architectural trends and concepts.

One critical source is Jakub Wuek's "Myths and Utopias of 20th Century Architecture" (1990). In it, the author analyses architectural concepts and trends in the 20th century, establishing parallels with the sociocultural changes that influenced these practices.

N.A. Saprykina's monograph "Foundations of Dynamic Form Formation in Architecture" (2005) analyses contemporary trends in architecture related to the adaptability of architectural forms to societal demands. The author examines both historical and modern examples of architectural projects capable of adapting to environmental conditions through dynamic spatial adaptation. The work also identifies key features of dynamic form creation and approaches to organising artificial environments using the latest technological innovations.

The works examine the development pathways of residential architecture, considering typology and socio-economic requirements **(Generalov, 2009).**

The document "Forecast for the Development of Fundamental Research in the Field of Architecture, Urban Planning, and Construction Sciences until 2030", was published by RAASN and developed with the participation of leading specialists in architecture **(Illichev et al., 2009; Rappoport et al., 1990; Khan-Magomedov, 2009),** outlines the main directions for fundamental research in architecture and urban planning. The document also proposes solutions to global ecological and energy problems through the application of architectural and urban planning systems.

A significant contribution to understanding contemporary problems and trends in architecture has been made in the works of Esaulov G.V., particularly in the article "Contemporary Problems and Trends in Architecture" **(Esaulov, 2013)**, the author addresses issues such as the development of new typologies and the creation of humane environments, the construction of new types of buildings for various population groups, the transition to rating systems for assessing building quality, project management technologies, the formation of service systems for the population, heritage conservation, the enhancement of energy efficiency and environmental sustainability of buildings, as well as the impact of computers as a design tool on architectural creativity.

The article, which focuses on the image characteristics of architecture under innovative technological solutions, provides a detailed analysis of contemporary architectural constructions, including examples from both foreign and domestic authorial architecture **(Issabayev, 2022)**. The work emphasises the unique features and innovative approaches applied in architectural structures, allowing for the identification of key trends and directions in the development of modern architecture.

In the article "Challenges of Modernity and the Contours of Future Architecture" **(Baitenov, 2023)**, predicts the emergence of a self-adjusting morphological framework capable of not only responding to various challenges but also anticipating them through preventive measures. E.M. Baitenov suggests that this concept may become a characteristic feature of post-architectural reality and could, in the future, evolve into a global universal self-adjusting system encompassing all aspects of life support.

E.M. Generalova's dissertation "The Concept of Forming the Architecture of High-Rise Buildings and Symbiotic Complexes" **(Generalova, 2023)** presents a comprehensive analysis of modern trends and approaches to high-rise architecture. The research addresses the theoretical foundations of compact city development, supported by statistical data showing significant urban population growth. The author highlights the uneven distribution of these indicators across countries and regions, emphasising the importance of an individualised approach to urban planning. Special attention is given to the classification of high-rise buildings and complexes based on their functional purpose, facilitating more precise architectural design and implementation. The

satisfaction of material, spiritual, and social needs within high-rise structures is considered critical in determining quality of life.

These works, along with many other publications, collectively provide a theoretical and practical foundation for understanding the current challenges and prospects in the field of architecture.

3 MATERIALS AND METHODS

The methodology of this study examines and theoretically substantiates contemporary approaches in regional architecture, focusing on identifying trends in the socio-economic sphere and their impact on the development of architecture in Kazakhstan. The foundation of the research was an analysis of practical examples of regional architecture, taking into account current trends. Methods such as comparative analysis, systematisation of data from literary sources, project modelling, and surveys were employed to achieve the research objectives. These methods enabled a deeper understanding of the factors shaping the development of modern architecture in Kazakhstan. They facilitated forecasting its future trajectories, considering global and local influences.

4 RESULTS AND DISCUSSION

As both a science and a practice of shaping living environments, architecture is intricately connected to the changes occurring within socio-economic, cultural, and political spheres. Despite the systematic nature of design and construction processes, researchers continually strive to forecast specific trends in architectural development. The comparison, systematisation, and synthesis of various theories allow us to draw conclusions that help to chart the future trajectory of architecture in Kazakhstan. Our research identified five factors that will exert the most significant influence on the formation of modern regional architecture in Kazakhstan: sustainable development and “green” architecture, the digitalisation of the architectural and construction sector, adaptive reuse and repurposing of buildings, participatory design and the strengthening of architectural identity in contemporary conditions.

4.1 SUSTAINABLE DEVELOPMENT AND “GREEN” ARCHITECTURE

Kazakhstan’s state programmes have declared that “the policy in the field of ‘green’ economy and environmental protection is aimed at improving the quality of natural resources, developing alternative energy sources, adapting to climate change, and decarbonisation and enhancing the economy’s energy efficiency. The main outcome will be an improvement in the quality of life for the population, environmental safety, reduced environmental risks and deficits, sustainable development, and increased competitiveness” **(Government of the Republic of Kazakhstan, 2019)**.

From 2015 to 2024, the UNDP, in collaboration with the Ministry of Industry and Construction of Kazakhstan and with support from the Global Environment Facility, implemented a project to improve energy efficiency in the housing and utilities sector, which consumes 34 per cent of all energy in the country. The modernisation of multi-apartment residential buildings, approximately 60,000 of which require enhanced energy efficiency, will necessitate investments of $5-10 billion. Most of these buildings were constructed between 1960 and 1990, and their restoration is crucial for the sustainable development of cities **(United Nations Development Programme, 2023)**.

Kazakhstan’s state policy on energy efficiency implementation, not only at the operational stage of buildings but also during design and construction, is focused on improving the sustainability of buildings and structures, the level of comfort in living environments, reducing greenhouse gas emissions, improving the ecological situation, and, overall, enhancing the quality of life for the country’s population. One widely recognised factor impacting the natural environment is

the built environment of settlements. Globally, it is acknowledged that sustainable development can be bolstered by the use of “green” technologies in architecture and construction.

Buildings constructed using green technologies enable owners to save up to 90% on utility costs and increase business margins. However, in Kazakhstan, there are very few genuinely eco-friendly buildings. Among these are the 6-story eco-office of the “Uchet” group of companies in Almaty **(Belyalov, 2019)**, and three “green” buildings managed by Global Development (Talan Towers in Nur-Sultan, Park View Office Tower, and PRIME Business Park in Almaty) **(Global Development Center, 2024)**.

At the end of 2020, Knight Frank estimated that more than 120,000 buildings worldwide were certified according to green standards. Leading cities include Abu Dhabi (22,400 buildings), Chicago (4,400), and London (3,000). The British BREEAM and American LEED standards are the leaders in “green” certification in Kazakhstan and globally. These construction assessment methodologies, which emerged in the 1990s, primarily aim to reduce environmental impact.

The American WELL and FitWel certificates appeared in the 2010s, focusing on how constructed buildings affect people’s well-being. For instance, these standards require developers to ensure that each office zone has natural light at a specific angle and also dictate the types of food that should be served in buildings (e.g., foods without trans fats and with minimal sugar) **(Kachalova, 2021)**.

Unfortunately, there are still under twenty projects with BREEAM or LEED certifications in Kazakhstan. Typically, these business centres target foreign tenants whose corporate standards require renting "green" offices.

Kazakhstan attempted to develop its own “green” certificate in the run-up to EXPO-2017: market participants formed the non-profit organisation KazGBC, which became part of the global World Green Building Council (WorldGBC). With the support of international experts, KazGBC developed the domestic environmental assessment system “Өмір” (“Life”). By 2020, it was planned to certify 200 buildings and train a thousand specialists in green construction. However, by 2021, only four buildings had received the pilot domestic certificates—Park View Office Tower, Green Tower, MEGA Silk Way, and Ergodom. The project was later suspended due to insufficient funding.

In the European Union and the United States, the driving forces behind green progress are the high cost of electricity and government policies. Governments in many countries require developers to certify buildings to minimum standards and provide low-cost financing for green projects.

In Kazakhstan, the relatively low cost of energy and the absence of legislative requirements allow investors and designers to overlook the construction of energy-efficient buildings. Transitioning to eco-standards must become economically attractive for investors, and government support is essential. Both new incentive programs and adjustments to existing legislation are needed to ensure effective collaboration.

Experts believe that a programme requiring all municipal buildings to be energy-efficient, at least to a minimal standard, could spur the development of green technologies in the country. Currently, two-thirds of municipal projects are constructed as cheaply as possible, forcing contractors to eliminate technological solutions from their designs. According to market participants, if the Kazakh authorities begin actively promoting green projects now, the country will see results in 10–15 years **(Kachalova, 2021)**.

4.2 DIGITALIZATION OF THE ARCHITECTURAL AND CONSTRUCTION INDUSTRY

The concept of the digital economy is increasingly gaining traction worldwide, influencing the development of architecture. Based on an analysis of design practices, the use of digital technologies in architecture can be categorised into two groups: software tools as design instruments and digital technologies as elements of structural, technical, functional, and form-shaping characteristics of buildings and structures **(Abdrassilova et al., 2019)**.

In 2018, Kazakhstan identified vital points in the comprehensive “Digital Kazakhstan” programme to address urban planning and urban regulation challenges: “Modern technologies offer effective solutions to the problems of rapidly growing megacities. It is essential to comprehensively implement urban environment management based on the Smart City concept and develop competencies for those moving to cities. Globally, there is an understanding that cities, rather than countries, compete for investors. They choose not a country, but a city where it is comfortable to live and work. Therefore, based on Astana’s experience, it is necessary to establish a ‘benchmark’ standard for Smart City and begin spreading best practices and sharing experiences among the cities of Kazakhstan”.

The “Digital Kazakhstan” programme outlines what needs to be done for successful navigation and adaptation in the new world—the world of the Fourth Industrial Revolution in the context of the digital economy. Experts define the digital economy as one in which “a cyber-physical system serves as the production complex, a production system that creates products and services, ensuring human life and comfort” **(Digital Economy – New Opportunities for Business, 2024)**.

Today, it is difficult to imagine design work without software products, which are widely used not only in architectural design but also in all related technical fields (building and structure calculation and design, engineering systems, etc.).

Widely used virtual tools for architectural design include AUTOCAD, a two—and three-dimensional computer-aided design and drafting system developed by Autodesk; Rhinoceros, a commercial software for three-dimensional NURBS modelling; and REVIT, a software package implementing the principle of Building Information Modelling (BIM). All elements of virtual design are integrated into modern systems, such as BIM **(Autodesk, 2022)**.

Projects for modern buildings and complexes in the digital economy typically include elements of innovative technologies, such as Smart House and Smart City.

The concept of a Smart House includes a well-organized internal space and a system for managing life processes.

A high concentration of “smart buildings” allows for the creation of a Smart City—a planning unit with a high level of architecture, construction, and a comfortable spatial environment.

In 2019, the “Benchmark Standard for Smart Cities of the Republic of Kazakhstan” was developed and approved, which contains recommendations and establishes unified approaches to building smart cities using information and communication technologies **(Digital Kazakhstan, 2022)**.

The “National Development Plan of the Republic of Kazakhstan until 2025” specifies that “Digital technologies will be integrated into urban life, including education, transportation, housing and communal services, healthcare, security, social services, city management, construction, business development, tourism, and environmental protection” **(The Strategic Development Plan until 2025, 2021)**.

Since 2023, Kazakhstan has enforced requirements for the mandatory use of BIM in the design of technologically complex objects and the digitalisation of public construction services **(Digitalization of Construction in Kazakhstan 2023: Transitioning to BIM)**.

The transition of the construction industry to BIM was declared in Kazakhstan in 2015, and a seven-year preparatory work was carried out, including the adaptation of legislation to the introduction of Building Information Modelling (which in Kazakhstan is referred to as TIMSO—Technology of Information Modelling of Construction Objects). In January 2023, requirements for the mandatory use of BIM in designing technologically complex objects came into force: many construction market participants have already restructured their business processes in anticipation of the introduction of information technologies. Initially, this list included 24 types of objects, such as high-rise multifunctional complexes and residential buildings requiring special design solutions, clinics, schools, and kindergartens of specific parameters. It is expected that as a result of the implementation of pilot projects, by 2025, the transition to TIMSO will become mandatory for

technically complex objects. A “State Bank of Information Models” has been created to collect and store data related to TIMSO objects.

According to a survey conducted in February 2024, 48% of companies use 3D modelling, and 12% plan to use it. However, 40% of companies are not yet ready to implement information modelling. The main software used in Kazakhstan for creating 3D models includes AutoCAD, modelling, and 12% plan to use it, but at the same time, 40% of companies are not yet ready to implement information modelling readiness to transition to an information system, and 70% of companies have the necessary equipment to work with 3D models **(Digitalization of Construction in Kazakhstan, 2024)**.

Kazakhstan's significant achievements include electronic services implemented in the construction sector: “Unified Geoportal of Infrastructure Data of the State Urban Planning Cadastre”, “E-PSD”—a system designed for interaction between customers and expert organizations based on the “one-stop-shop” principle, “e-QURYLYS”—a tool for improving quality control and transparency in construction in the country, “e-SHANYRAQ”—a system for increasing the transparency and efficiency of the activities of housing and communal services, the online platform for building materials “material.kz”, “Tokenization of the real estate market and blockchain” and “Internet of Things (IoT)” **(Digitalization of Construction in Kazakhstan, 2024)**.

By 2025, the government of Kazakhstan aims to be among the top 20 in the UN's e-Government Development Index, the top 50 in the B2C (Business to Consumer) e-Commerce Index, and the top 40 countries in the Information and Communication Technology Development Index **(Digital Kazakhstan, 2022)**.

One of the latest data management technologies is “the development and implementation of machine learning (self-learning systems) and neural networks, which are the first step towards the creation of artificial intelligence” (Government of the Republic of Kazakhstan, 2019). Currently, just a few years after this declaration, we are all witnessing that ChatGPT is being used not only by university students but also by schoolchildren to create architectural and graphic sketches with artificial intelligence.

4.3 ADAPTIVE REUSE AND REPURPOSING OF BUILDINGS

A significant portion of the buildings constructed over the past decades constitute the material fabric of settlements. Despite their physical durability, many of these structures have become obsolete, failing to meet modern functional requirements and societal needs. In some cases, it may be more economical to demolish a building and construct a new one. However, from an environmental perspective, the demolition of all old buildings is not feasible; it is more sustainable to adapt these structures to new conditions, integrate them into the modern urban context, and repurpose them for new functions. This approach allows for the preservation of their historical value while simultaneously meeting contemporary demands.

Efforts to adapt buildings to new functions contribute to the enhancement of the urban environment, revitalizing peripheral areas and creating new compositional focal points. Adaptation is carried out in close alignment with the existing urban context, ensuring coherence with the development of the surrounding residential and public spaces. The adaptation process involves extensive preliminary research and must comply with current regulatory standards concerning the structural integrity of existing constructions, as well as fire safety, seismic resilience, environmental sustainability, accessibility for all population groups, and other considerations.

The term “adaptive architecture” was first introduced in the late 1960s when spatial design challenges began to be addressed using cybernetics **(Negroponte, 2014)**. Adaptive architecture entails the incorporation of interactive systems into the core structural elements and the close integration of related fields, such as building energy efficiency theory and the dynamics of architectural objects: “By embedding responsive technologies into the building’s structural framework, architects can directly link the building’s form to environmental changes. This approach

allows for a rethinking of traditional principles in the creation and subsequent operation of architectural objects" **(Interactive Architecture: Adaptive World, 2016)**.

The contemporary understanding of architectural adaptability extends beyond merely adapting to new functions; it involves a deep recognition of the potential of such buildings, whose structure is permeated with interactive technologies. An example of this concept is the "Hypercube" project, a building constructed in the Skolkovo Innovation Centre in 2012, designed by architect Boris Bernaskoni **(Creator of the Hypercube, 2013)**.

Adaptive buildings challenge conventional principles of architectural creation and their future use **(The Goal Is to Create an Immortal Building: In Conversation with Boris Bernaskoni, 2019)**.

4.4 PARTICIPATORY DESIGN

One of the most effective tools in contemporary design is the active involvement of the public in the discussion, modification, and development of new projects. Citizen participation is facilitated through various means, such as sociological surveys, meetings between designers and residents, and interactions between volunteer organizations and the community.

"...In Kazakhstan, there is still no system for analysing public opinion in the field of architecture and urban planning. As a result, insufficient attention is given to the issue of public involvement in urban planning decisions", noted one of the authors of this article nearly a quarter of a century ago **(Abdrassilova, 2015)**.

Currently, methods for gathering public opinion, such as surveys and resident meetings, are becoming increasingly common in Kazakhstan to better understand the preferences of the population on pressing urban issues.

The participatory design methodology was employed by one of the authors of this article during the development of a project for the reconstruction of the facade of the "Three Heroes" residential complex, organized by the Almatygenplan Research Institute, in 2024. Students from two universities—KazGASA and AlmaU—under the guidance of mentors conducted a pre-project study of the site and developed a design proposal. This event stands out in contemporary architectural practice in Almaty due to its uniqueness, as it not only provided an opportunity to engage with research methods but also created a platform for active exchange of ideas and experience in architectural design **(Three Heroes, 2023; The Village Kazakhstan, 2019)**.

The opinions gathered during the survey became the foundation of the project and significantly enhanced the understanding of the residents' expectations and needs. In the first phase of the study, conducted by the Q-Lab department of the Almatygenplan Research Institute using a detailed questionnaire, it was revealed that almost all residents of the complex (95.5%) supported the idea of reconstruction.

The most daring ideas for the reconstruction emerged within Q-Lab. Residents, delegates, architects, urban planners, designers, and students from KazGASA and AlmaU expressed their thoughts on the potential for creative concepts: glazing of the three towers, adding murals on certain surfaces, creating public space on the roof, and more.

Overall, the results of the analysis and the development of the reconstruction project for the "Three Heroes" residential complex in Almaty demonstrate the value of participatory design as a key component of a comprehensive and balanced approach within the interconnected relationship between designers and users.

4.5 FORMATION OF ARCHITECTURAL IDENTITY IN MODERN CONDITIONS

Architecture in the 21st century is enriched by new types of buildings and structures. Unconventional solutions in modern architecture enhance the perception of forms and grant architectural objects the special status of "new symbols" within the urban landscape.

An analysis of projects that have gained recognition within the professional community reveals that regional characteristics are becoming increasingly evident in modern Kazakhstani architecture, reflecting the country's natural and climatic features as well as its cultural traditions **(Abdrassilova, 2022)**. A striking example of how contemporary architecture embodies spiritual and cultural values through artistic expression, forms, details, and metaphors can be seen in the works of Bek Ibraev, Saken Narynov, and other modern Kazakhstan's architects **(Abdrassilova & Aukhadiyeva, 2021)**.

The architecture of independent Kazakhstan is integrated into the global creative process while striving to preserve its regional uniqueness. This requires a comprehensive approach to environmental development, ensuring the unity of architectural solutions for buildings and elements of the urban space that carry regional cultural significance.

In the work of G. S. Abdrassilova and E. T. Danibekova, a comparison was made between large public buildings from the Soviet era, which significantly shaped the architectural appearance of Kazakhstani cities, and post-Soviet structures with similar functional purposes. The comparison between these two periods highlighted the distinctive features of the architectural language. During the Soviet period, the politicization of all aspects of life, including architecture, influenced the design of public buildings—traditionally grand, employing standardized construction techniques and elements. Only a few unique structures received architectural treatment that incorporated national motifs, such as domes, pylons, ornamental grids and stained glass, decorative elements, and stylized stalactites, which were "replicas" of regional construction techniques **(Abdrassilova & Danibekova, 2021)**.

The study showed that "the stimuli for the transformation of Kazakhstani architecture at the turn of the 20th and 21st centuries were socio-economic and cultural-historical changes. A comparison of Kazakhstani architecture from the Soviet and post-Soviet periods demonstrates significant changes in the field, driven by economic and technological innovations, leading to typological and artistic transformations" **(Abdrassilova & Danibekova, 2021)**.

G. S. Abdrassilova notes: "In the context of global trends, architectural responses stimulated by self-identification processes may manifest in various forms:

- the first scenario involves the creation of artistic images in the form of historical tradition, utilizing the attributive characteristics of local architecture;

- the second scenario entails the creation of architectural objects as new phenomena previously uncharacteristic of a particular city or country" **(Abdrassilova, 2022)**.

The migration of architectural ideas in the context of globalization facilitates the "adaptation" of the local cultural context's language to the "visualization methods" of innovative technologies. A new trend involves the creation of unique structures in various parts of the world with architecture that was previously uncharacteristic of the respective country: regional identity manifests in architectural works whose artistic image is associated not with national elements, but with symbols—whether visual (a new interpretation of decor) or spiritual (legends, myths, etc.).

In this case, architectural identity is declared at the highest technological level, serving as a driver of innovative processes in the country's economy. In architecture, the response to such processes is evident in the emergence of a new "language" of form, representing the images of buildings and structures:

- Artistic images in architecture manifest in the form of historical tradition, utilizing the attributive characteristics of local architecture;

- Architectural objects are created as new phenomena, shaping the modern image of a city or country through innovative forms **(Abdrassilova & Aukhadiyeva, 2021).**

The further advancement of architecture is based not only on external features but also on a qualitative change in approaches to the design and construction of residential and public buildings, taking into account modern technologies.

Architecture plays a crucial role in visual images that serve as "icons" of citizens' self-identification. Architectural identity is visualized through morphology—a system built on the

patterns of form generation of structural elements and their combinations as a stable set of relationships.

Architectural form generation is the process of creating an architectural object that takes into account utilitarian, structural-technical, and aesthetic properties. The focus is on the challenges of organizing the architectural object as a work of art **(Rappoport & Somov, 1990)**. "...Form-generating factors include both material and mental phenomena: in the organization of material morphology—through technological and engineering principles—and in the formation of the informational and emotional impact of the architectural object and its artistic image—through the reflection of many mental phenomena and based on artistic semantics" **(Abdrassilova, 2015)**.

Form generation does not emerge "out of nowhere"; it synthesizes "typical features inherent in socially significant objects of its time", while simultaneously seeking a new, individual image. "The characteristic features of the environment, figurative, regional, and national traits of architecture provide the basis for creating the typical, while many characteristic factors of material morphology formation and specific site features contribute to achieving individuality. Both groups of features historically transform into each other" **(Rappoport & Somov, 1990)**.

Form necessarily exists within the contexts of environment and culture. Speaking about the form of an architectural object, A. Ikonnikov noted that "form acts as both a material embodiment of information essential for practical activities and spiritual life, and as a carrier of aesthetic value and ideological-artistic content of architectural works" **(Ikonnikov, 1986)**.

In the context of a specific region, the form of architectural structures transmits ideological and artistic content from generation to generation. This cultural "memory" is as important as the utilitarian functions of architecture, contributing to the practical orientation of people, shaping their psychological attitudes, and fostering personal development.

Discussing the importance of the concept of "form generation" for architectural activity, B. Balykbaev emphasises that architecture, unlike other forms of art, is inherently linked to the creation of real objects that provide conditions for human life. In form generation, various properties of an architectural object are complexly correlated, "making it convenient, comfortable, durable, long-lasting, technologically feasible for construction, economical, and, finally, turning it into a work of art. The central theoretical problem of form generation is the relationship between its utilitarian-practical and artistic-image components" **(Balykbaev, 2004)**. The factors of place and time serve as the "nourishing mechanism", the organising principle for creating a harmonious living environment, and the key to preserving nature. The search for a modern architectural form "...presupposes a profound knowledge of the region's cultural traditions" **(Balykbaev, 2004)**.

The form generation process in Kazakhstan's architecture has evolved from ancient times to modern high-tech types of buildings and structures. "Even today, traditional concepts of the local population are reflected in architectural forms, complemented by new combinations, developing and changing following the current demands of culture and technology" **(Abdrassilova, 2015)**.

In the 21st century, form generation will undoubtedly be one of the main trends in the development of regional architecture in Kazakhstan. The architect plays one of the most important roles in this complex process as the professional "source" of new ideas and concepts realised in general development trends. Without delving into the issues of creativity within the confines of this article, we pay tribute to the creative genius of all architects worldwide, particularly Kazakhstan's architects, who make a tremendous contribution to shaping the identity of our country through the architecture of independent Kazakhstan **(Figure 1)**.

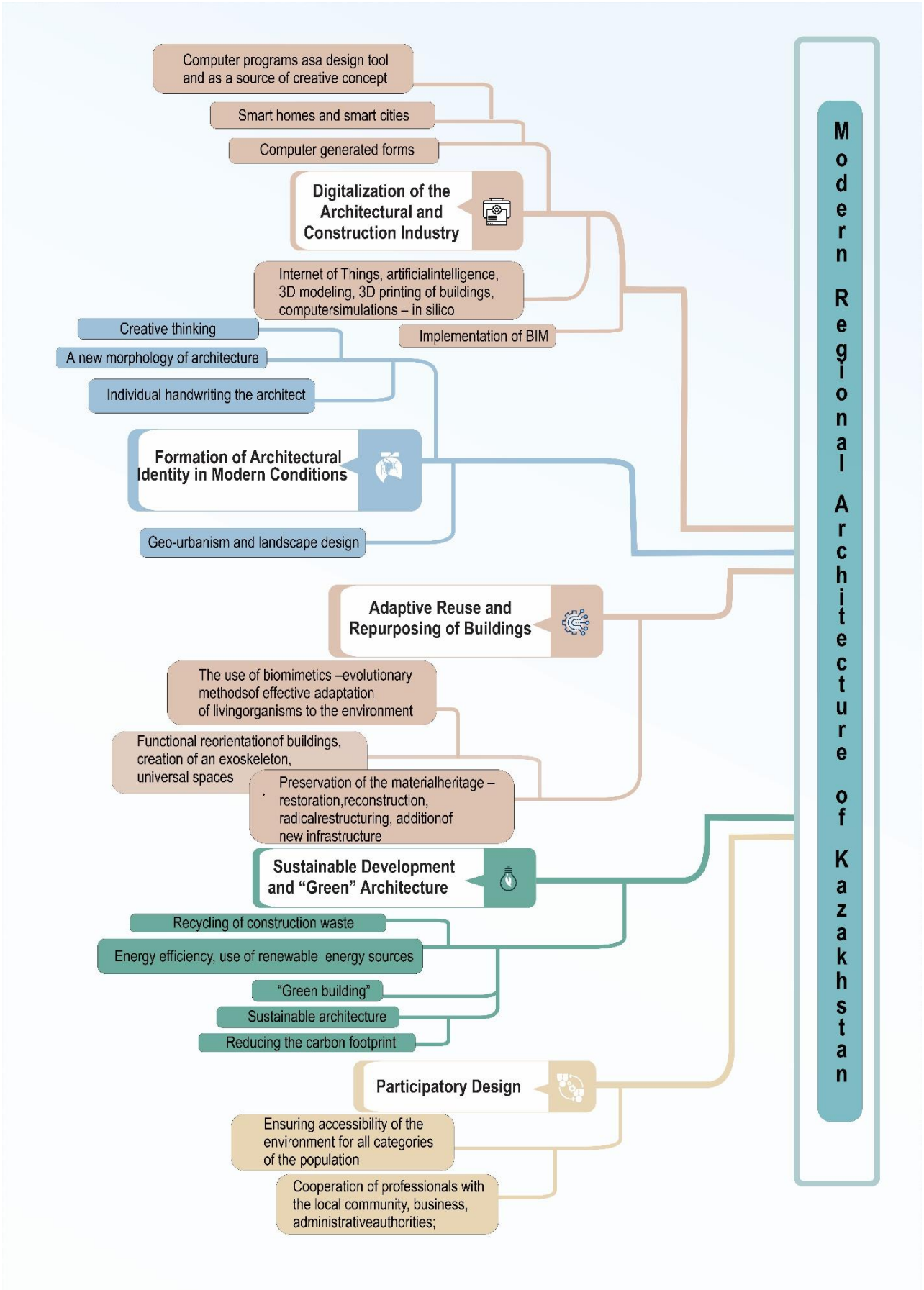

Figure 1 – Prospects for development (author’s material)

5 CONCLUSIONS

International architect communities and UN commissions predict trends that may shape architecture in the near and distant future. By comparing and analysing factors such as the implementation of Kazakhstan's state policy in architecture and architectural activities; professional efforts to create a comfortable living environment; the results of intellectual creativity expressed in completed projects of buildings, structures, and complexes of social and cultural value; integration into international sustainable development programs; and the commitment of the architectural community to the principles of humanity and professional ethics, it becomes possible to identify the future development trends of architecture in Kazakhstan.

In the first quarter of the 21st century, several directions have emerged on the global architectural stage. It is evident that Kazakhstan's architecture, which develops in synchrony with global trends yet incorporates local features, has the potential to advance along these same lines.

These general directions can be further broken down into multiple components, reflecting the complexity of the challenges associated with the prospective development of processes and phenomena in contemporary Kazakhstan's architecture.

In summary, the trends in the development of regional architecture in Kazakhstan may continue to shape this field in the future along several vectors, which in turn branch out into several constituent components:

- Design and construction of environmentally safe buildings that use resources efficiently (sustainable architecture, "green" construction, energy efficiency, use of renewable energy sources, recycling of construction waste, reduction of carbon footprint);
- Digitalization of design processes (computer programs as tools for design and sources of creative concepts, computer-generated forms, implementation of BIM, "smart homes" and "smart cities", the Internet of Things, artificial intelligence, 3D modelling, 3D printing of buildings, computer simulations – in silico);
- Adaptive reuse of buildings (preservation of material heritage – restoration, reconstruction, radical restructuring, addition of new infrastructure; functional repurposing of buildings, creation of exoskeletons, universal spaces; use of biomimicry – evolutionary methods of efficient adaptation of living organisms to the environment);
- Participatory design (collaboration between professionals and the local community, business, and administrative bodies; ensuring accessibility of the environment for all population groups);
- Expression of regional identity through designing and constructing unique buildings that reflect local specificity while incorporating global technological innovations (architect's individual signature, creative thinking, new morphology of architecture, geo-urbanism, and geo-landscape design).

Architecture embodies the entire civilisational experience of humanity, the genius of the creative architect, and a complex integration of related fields of knowledge—engineering, technical, technological, socio-economic, cultural, and historical. Regardless of how architectural trends evolve or how mechanised and digitised the design and construction processes become, at the core of any architectural concept lies the Idea born from the genius of the Architect. This living thought any software or artificial intelligence cannot replace process. It is only the boundless potential of human intelligence that can create humane architecture and living environments for Homo sapiens and the living world around them.

REFERENCES

1. **National Development Plan of the Republic of Kazakhstan until 2025** [cited December 27, 2023] URL: https://www.gov.kz/memleket/entities/aspr/documents/details/200083
2. **Beck, U.** (1999). What is Globalization? Cambridge: Polity Press.

3. **Malinovsky, A.S.** (2013). Cultural globalization (glocalization). Local and transnational [Kul'turnaya globalizatsiya (glokalizatsiya). Lokal'noye i transnatsional'noye]. Vestnik TSPU, 1(129). Retrieved from: https://cyberleninka.ru/article/n/kulturnaya-globalizatsiya-glokalizatsiya-lokalnoe-i-transnatsionalnoe (In Russ.).
4. **Wuek, Ya.** (1990)**.** Myths and Utopias of 20th Century Architecture [Mify i utopii arkhitektury XX veka] (M. Predtechensky, Trans.; V. Glazychev, Ed.). Moscow: Stroyizdat. (In Russ.).
5. **Saprykina, N.A.** (2005). Fundamentals of Dynamic Form Formation in Architecture. [Osnovy dinamicheskogo formoobrazovaniya v arkhitekture]: A Textbook for Universities. Moscow: Arkhitektura. (In Russ.).
6. **Illichev, V.A., & Esaulov, G.V., et al.** (2009). Forecast of the development of fundamental research in the field of architecture, urban planning, and construction sciences until 2030: A summary [RAASN «Prognoz razvitiya fundamental'nykh issledovaniy v oblasti arkhitektury, gradostroitel'stva i stroitel'nykh nauk do 2030 goda»]. Academic Bulletin UralNIIProject RAASN, 3. Retrieved from: https://cyberleninka.ru/article/n/raasn-prognoz-razvitiya-fundamentalnyh-issledovaniy-v-oblasti-arhitektury-gradostroitelstva-i-stroitelnyh-nauk-do-2030-goda (In Russ.).
7. **Generalov, V.P.** (2009). Specifics of designing high-rise buildings [Osobennosti proyektirovaniya vysotnykh zdaniy]. Samara: Samara State Technical University. (In Russ.).
8. **Esaulov, G.V.** (2013). Modern problems and trends in architecture [Sovremennyye problemy i tendentsii v arkhitekture]. Housing Construction: Scientific, Technical and Production Journal, 11, 20-26. Retrieved from: https://cyberleninka.ru/article/n/sovremennye-problemy-i-tendentsii-v-arhitekture (In Russ.).
9. **Issabayev, G.A.** (2022). Cantilever architectural structures of modern buildings and structures with a unique image of overcoming gravity [Konsol'nyye arkhitekturnyye konstruktsii sovremennykh zdaniy i sooruzheniy s unikal'noy obraznost'yu preodoleniya gravitatsii]. Vestnik KazGASA, 4(86), 7-18. https://doi.org/10.51488/1680-080X/2022.4-01 (In Russ)
10. **Baitenov, E.M.** (2023). Modern challenges and the outline of the future of architecture [Vyzovy sovremennosti i kontury arkhitektury budushchego]. Vestnik KazGASA, 2(88), 17-26. https://doi.org/10.51488/1680-080X/2023.2-03
11. **Generalova, E.M.** (2023). Kontseptsiya formirovaniya arkhitektury vysotnykh zdaniy i kompleksov simbioticheskogo tipa **[**Concept of forming the architecture of symbiotic-type high-rise buildings and complexes] [Doctoral dissertation, PDF file]. Retrieved from http://surl.li/shjnxq
12. **Government of the Republic of Kazakhstan.** (2019). Strategic Development Plan of the Republic of Kazakhstan until 2025. [cited April 24, 2020]. URL: https://primeminister.kz/ru/documents/gosprograms/stratplan-2025
13. **United Nations Development Programme.** (2023). An effective financing model for the modernization of multi-apartment residential buildings introduced in the capital. [cited April 14, 2024]. URL: https://www.undp.org/ru/kazakhstan/press-releases/effektivnuyu-model-finansirovaniya-dlya-modernizacii-mnogokvartirnykh-zhilykh-domov-vnedrili-v-stolice.
14. **Belyalov, O.** (2019). Luchshiy ekoofis v Almaty i Kazakhstane **[**The best eco-office in Almaty and Kazakhstan]. [cited May 24, 2023]. URL: http://esgrs.org/?p=26066. (In Russ)
15. **Global Development Centre.** (2024). Global Development. [cited May 23, 2024]. URL: https://gdc.kz/ru/.(In Russ)
16. **Kachalova, N.** (2021). Kogda v Kazakhstane prorastet «zelenoye» stroitel'stvo [When will “green” construction take root in Kazakhstan?]. [cited April 20, 2024]. URL: https://kazgbc.kz/articles/kogda-v-kazaxstane-prorastet-zelenoe-stroitelstvo. (In Russ)

17. **Abdrassilova, G.S., Umnyakova, N.P., & Kakimzhanov, B.** (2019). Digitalization of the economy and the digital environment of modern architecture. Biosphere Compatibility: Human, Region, Technologies, 1(25), 3-13
18. **Digital Economy – New Opportunities for Business.** (2024). Retrieved from http://kak-bog.ru/cifrovaya-ekonomika-novye-vozmozhnosti-dlya-biznesa.
19. **Autodesk.** (2022). Building information modeling. Retrieved from https://www.autodesk.com/solutions/aec/bim
20. **Digital Kazakhstan.** (2022)**.** Retrieved from https://egov.kz/cms/ru/digital-kazakhstan.
21. **Digitalization of Construction in Kazakhstan 2023: Transitioning to BIM.** (2023). Retrieved from https://www.planradar.com/ru/cifrovizaciya-stroitelstva-kazahstana-perekhodim-na-bim/#:~:text=.
22. **Digitalization of Construction in Kazakhstan 2023: Transition to BIM.** Retrieved from https://cadsystems.kz/tpost/ef8hjse751-tsifrovizatsiya-stroitelstva-kazahstana.
23. **Negroponte, N.** (2014). A 30-year history of the future. Retrieved from https://www.ted.com/talks/nicholas_negroponte_a_30_year_history_of_the_future/transcript?subtitle=en
24. **Interactive Architecture: Adaptive World.** (2016). Princeton Architectural Press.
25. **Creator of the Hypercube** (2013). Skolkovo Foundation. Retrieved from https://sk.ru/news/b/press/archive/2013/09/04/sozdatel-giperkuba.aspx
26. **The Goal Is to Create an Immortal Building: In Conversation with Boris Bernaskoni.** (2019). Retrieved from https://www.archdaily.com/930066/the-goal-is-to-create-an-immortal-building-in-conversation-with-boris-bernaskoni.
27. **Abdrassilova, G.S.** (2015). Osnovy regional'noy arkhitektury Kazakhstana [Fundamentals of regional architecture of Kazakhstan].: Monograph. Almaty. (In Russ)
28. **Three heroes.** (2023). Retrieved from https://qlab.city/threeheroes.
29. **The Village Kazakhstan.** (2019). I live in “Three Bogatyrs” [Website]. Retrieved from https://www.the-village-kz.com/village/city/where/6919-ya-zhivu-v-treh-bogatyryah (In Russ)
30. **Abdrassilova, G.S.** (2022). The potential of architecture in the formation of regional identity: From stimulus to reaction. Architectural Heritage of Karabakh and Eastern Zangezur. Problems of Restoration, Protection, and Reuse. International Scientific and Practical Conference, Baku, 18 April 2022. https://doi.org/10.58225/sw.si.2022.1.163-169
31. **Abdrassilova, G.S., & Aukhadiyeva, L.M.** (2021). The role of regional identity in shaping the architecture of the 21st century. International Scientific Journal of Urban Planning and Sustainable Development, 26, 1-9.
32. **Abdrassilova, G., & Danibekova, E.** (2021). The transformation of modern architecture in Kazakhstan: From Soviet “internationalism” to a post-Soviet understanding of regional identity. SPATIUM, (46), 73-80. https://doi.org/10.2298/SPAT2146073A
33. **Abdrassilova, G.S., & Aukhadiyeva, L.M.** (2021). The role of regional identity in shaping the architecture of the 21st century. International Scientific Journal of Urban Planning and Sustainable Development, 26, 1-9.
34. **Rappoport, A.G., & Somov, G.Yu.** (1990). Forma v arkhitekture. Problemy teorii i metodologii [Form in Architecture. Problems of Theory and Methodology]. Moscow: Stroyizdat (In Russ)
35. **Ikonnikov A.V.** (1986) Funktsiya, forma, obraz v arkhitekture [Function, form, image in architecture]. Moscow: Publ. Stroyizdat (In Russ)
36. **Balykbaev, B.T.** (2004). Zakonomernosti slozheniya formy v arkhitekture [Laws of Form Composition in Architecture]. Preservation and Development of Historical and Cultural Environment in Natural and Urban Conditions of Modern Central Asia, 31-34. Almaty: Print-S. (In Russ)