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Prospects for the Development of University Campuses Integrated into Urban Environment in Russia and Kazakhstan

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Abstract Many university campuses in Russia and Kazakhstan were built around 50-100 years ago. At present, educational campuses face a lack of opportunities for the expansion of existing buildings and the erection of new ones without harm to the urban planning of the city, which has a negative impact on the prospects of their development. In this light, the problems of the prospective development of university campuses integrated into the urban environment gain special importance. The study aims to identify effective techniques of urban planning development for existing university campuses integrated into the city environment. To achieve the goal of the study, the authors utilize the qualitative-quantitative approach. As a result, the study identifies techniques of urban development of university campuses both within the structure of the city and within the campus area. The possible techniques include 1) reconstruction and renovation of areas adjacent to the university complex; 2) cooperation or co-leasing of several universities and research centers in an autonomous educational and research center to extend the area of the university; 3) rational use of campus areas. The paper also describes the basic requirements for the development of university campuses in the formation of the urban environment: socio-economic, architectural and urban planning, and environmental.

Keywords University Campus, University, Urban Environment, Urban Development

1. Introduction

Modern universities present a variety of urban complexes differing by their professional profile, size of

the territory, number of students, features of urban planning organization, and location in the city structure [1]. The operation of universities assumes various life processes, i.e. educational, research, cultural, recreational, sports, and household, which are usually provided for by the urban organization of specific territories in the structure of the city [2]. The dynamics of modern life and sociocultural trends are stronger than ever, influencing the need for organizing new forms of accommodation, educational and research activities, leisure time, and sports and recreational activities for students [3, 4].

Y. Le et al. [5] identify two main characteristics of the urban planning organization of classic campuses. The first type includes localization of the object in the city or on its periphery; zoning of the object into the recreational, educational, administrative, residential, household, and sports areas; protection of the campus, the presence of clear borders of the object; autonomy from urban structures; availability of infrastructure on campus (pedestrian, transport connections); the presence of hierarchical composition structure – pronounced center, connections of the center with other elements of the campus.

The second type of urban organization refers to integrated universities, the most characteristic of European countries erected in the 18th-19th century in city centers. In addition, these are universities whose development in the historical environment had a compositional and territorially disjointed character [6].

There is a mixed type of urban planning organization, for example, the Lomonosov Moscow State University campus in Moscow, Russia. It consists of several autonomous campuses located in the central districts of Moscow; some buildings are highly accessible by public transport, and some are located in remote areas.

Given that most university campuses in Russian and Kazakh megacities (Moscow, St. Petersburg, Almaty, and others) were constructed a long time ago, now they are facing a lack of opportunities for unobstructed expansion, which diminishes their development prospects. At the same time, there is a program in Russia to create at least 25 campuses by 2030.

In these circumstances, to ensure a comfortable environment for learning, household, and extracurricular activities, university campuses have to be either moved to the peripheral areas of the city [7] or somehow developed within the urban environment using appropriate techniques and following the requirements imposed on university campuses [8]. The complexity of design and construction in megacities lies in their established integral environment, deeply rooted in cultural traditions and uniting monuments, parks, historical sites, protected areas and historical memory, religious and worldview values, norms of behavior, and moral and ethical rules. Our research focuses on finding possible methods to develop campuses integrated into the urban environment that have developmental issues due to restrictions.

In this light, the research questions were posed as follows:

What are the prospects for the development of university campuses? What techniques and basic requirements of urban development are important to consider for the development of existing university campuses integrated into the urban environment in Russia and Kazakhstan?

The aim of the study is to determine prospects for the development of university campuses integrated into urban architecture based on the example of Russia and Kazakhstan.

2. Literature Review

2.1. Organization of Urban Planning in University Campuses and Methods of their Development

Researchers distinguish the following main restrictions affecting the development of university campuses: restrictions concerning campus expansion by increasing its territory (for example, when dense development prevails, and the opportunities for territorial development of existing campuses are limited), historical context (for example, the historical form of campus characterized by spatial integrity and relative autonomy in the city structure [9]), campus location, the public's position on campus expansion, and urban plans for future expansion.

Depending on the prevailing restrictions, for a particular case, researchers distinguish various optimization methods and techniques. M. Hebbert [10] describes the ways to optimize the functional-planning development of university campuses, the main of which are: improving the architectural and planning solutions of educational and residential buildings; densification of the territory [11]; formation of educational-research organizations; clustering and cooperation of educational institutions of different levels and educational profile; integration of educational institutions with citywide community centers.

Based on the study problem, we believe that when designing university campuses it is necessary to pay attention to spatially integral and spatially partitioned methods of urban development. Each approach offers unique advantages and limitations.

2.1.1. Methods of Spatially Integral Urban Development

The spatially integral approach to urban development sees a campus as an interconnected, organic whole [12]. It is common for this approach to prioritize pedestrian-friendly design and landscape and shared public spaces. The methods used in this model contribute to a comprehensive, integrative vision of spatial planning. Integral urban development of campuses can lead to increased social engagement and improved students mental health as it promotes greater interaction and offers ample green spaces for recreation and entertainment.

However, the integral approach can limit expansion if not carefully planned, as these methods can create problems when new buildings are added or the campus layout is disrupted.

2.1.2. Methods of Spatially Partitioned Urban Development

The spatially partitioned approach considers a campus a collection of separate individual units [13]. Each building or area serves a specific function, and there is less focus on integrating different types of spaces. The partitioned model is often found in urban campuses where land availability is limited and buildings may be scattered throughout the city. This approach provides flexibility for future expansion and modification as individual blocks can be changed without significant impact on the entire campus. A potential disadvantage is that this can lead to a sense of disconnection between students and staff due to the physical separation of the buildings.

Both methods and their modifications are used in modern practice, which suggests that there is no universal solution for campus development. University management should carefully evaluate their needs and resources and choose effective mechanisms that contribute to campus development in an integrated urban environment.

2.2. Mechanisms for the Development of University Campuses Integrated into the Urban Environment

Methods of the urban development of university campuses, both in the structure of the city and within the campus area depend on the mechanisms involved.

1. The reconstruction and renovation of outdated and uninhabitable areas. Spatial development through the reconstruction and renovation of outdated and uninhabitable areas is widely used [14,15]. The idea of territorial growth of the university through the reconstruction of nearby areas solves the architectural, urban planning, social, cultural, and economic problems not only of the university but also of the city [16]. A significant organizational limitation of this mechanism lies in the comprehensive interest of city authorities and district residents in the implementation of this urban planning approach. This approach is applicable when each of the parties has a certain resource of influence, and all participants can agree on favorable terms for each of the parties.
2. The cooperation of several universities and research, educational, and recreational centers. These centers appear on university campuses or in the structure of the city, where branches of universities and research organizations are located, and they are built at the expense of funding of these organizations and universities [17].
3. Rational use of campus area: utilization of building roofs and terraces, organization of passageways between buildings to act both as interconnecting pedestrian routes, and additional space for the cultural, leisure, and information communication functions of the campus.
   Researchers also note the use of the method of rational use of land resources by compacting functions, as the exploitation of rooftops as a place of public use for recreation and communication is provided [16]. The technique of landscaping and exploitation of the roof, the use of wide terraces for informal communication, recreation, and extracurricular learning activities is actively used in many modern campuses [18]. Such a rational use of land resources makes it possible to reduce the area of the university complex in the conditions of dense development of the central city districts [19]. The redevelopment (if university resources allow it) of campuses into multifunctional vertical complexes to reduce the occupied territory is considered quite relevant [18].
4. The use of modern technology for saving natural resources in new construction or reconstruction of the university campus to improve its sanitary and hygienic parameters.
   Great popularity is also enjoyed by the systems of renewal of traditional energy sources in new construction and renovation of old buildings [20]. All over the world, energy conservation systems are applied: installation of solar panels and wind engines, application of biological drainage channels, solar collectors for water heating, installation of permeable facades to provide natural light, and introduction of eco-materials [10, 20]. This method helps improve the sanitary and hygienic parameters of the territory and the ecological state of the environment [21].

Thus, our analysis of techniques and mechanisms of the urban planning development of university campuses allows us, as shown in studies by P.IU. Povalko et al. [22], N.V. Borisova and K.A. Sulimov [23], and E.S. Palei [24], to develop university campuses integrated into the urban environment in compliance with requirements for the architectural, planning, and functional organization of territories and buildings.

Despite the considerable body of research into the general development of university campuses, the problem of their development in Russia and Kazakhstan, as well as their influence on the formation of the urban environment and attracting human capital remains understudied.

3. Methods

3.1. Research Design

To achieve the purpose of the study, we adopted a qualitative-quantitative approach. Desk research involved the analysis of scientific literature on the problem of the development of university campuses, which demonstrates that the influence of campuses on the formation of the

urban environment depends on their urban planning development, as well as the requirements they need to satisfy.

Next, according to the purpose of the study, we analyzed the online sources of the largest Russian universities to select the employees of Russian and Kazakh universities responsible for the maintenance of university grounds (campuses). Each expert selected by us to participate in the survey had to meet the following criteria: a) at least 5 years of experience in a position related to decision-making in university campus management; b) at least 10 years of experience in university campus development.

3.2. Expert Survey

At the first stage of the study, 52 experts were sent emails describing the goal and program of the study. Out of these, 40 experts from 15 universities in Russia and Kazakhstan agreed to take part in the study (Table 1).

The survey of university staff was conducted from January 15 to February 15, 2023. The questionnaires were forwarded via email and contained two sections with questions:

Section 1. Questions related to techniques of urban planning for already existing universities that can be used in Russia and Kazakhstan.

Section 2. Questions related to basic requirements that need to be established for the development of university campuses in Russia and Kazakhstan.

At the second stage, after processing the results of the first stage, the experts were asked to rank the previously identified techniques of urban planning of university campuses and basic requirements for the development of university campuses in the formation of an urban environment.

3.3. Data Analysis

The agreement of expert opinions in the survey was assessed using Kendall's concordance coefficient (W) calculated in SPSS. The information obtained through expert ranking was then processed to determine the weight of expert opinions.

4. Results

In accordance with the types of urban planning organization of university campuses, the surveyed experts identified several techniques for the development of campus layout structure.

For the first, spatially integral type of campus, the experts proposed the following techniques (Table 2).

Table 1. Expert sample characteristic

No.	University	Number of experts
1	Moscow State University (Moscow, Russia)	3
2	Peoples' Friendship University of Russia (Moscow, Russia)	3
3	Moscow State University of Civil Engineering (Moscow, Russia)	2
4	Higher School of Economics (Moscow, Russia)	3
5	Bauman Moscow State Technical University (Moscow, Russia)	3
6	Russian Technological University (MIREA) (Moscow, Russia)	2
7	Plekhanov Russian University of Economics (Moscow, Russia)	3
8	National University of Science and Technology (Moscow, Russia)	2
9	Saint Petersburg State University (Saint Petersburg, Russia)	3
10	Kazan Federal University (Kazan, Russia)	2
11	Siberian Federal University (Krasnoyarsk, Russia)	3
12	Novosibirsk State University (Novosibirsk, Russia)	3
13	Ammosov North-Eastern Federal University (Yakutsk, Russia)	2
14	Narxoz University (Almaty, Kazakhstan)	3
15	Al-Farabi Kazakh National University (Almaty, Kazakhstan)	3
Total		40

Table 2. Techniques for urban development of university campuses of the spatially integral type

Technique	Rank	Weight
Technique 1. Intensified use of the territorial resources of the campus through higher building density (within normative requirements) and the level of territory improvement (creation of landscaping and recreation areas)	1	0.42
Technique 2. Improvement of internal connections between the campus functional blocks by means of developing the pedestrian network and creating covered walkways	2	0.33
Technique 3. Enhancement of the transport connectivity of the campus by means of creating bicycle paths and car and bicycle parking spots both on campus and in surrounding areas	3	0.25

Note: compiled based on the expert survey; the value of the concordance coefficient $W = 0.73$ ($p < 0.01$), indicating a strong agreement of expert opinions

Table 3. Techniques for urban development of university campuses of the spatially partitioned type

Technique	Rank	Weight
Technique 1. Adjoining the surrounding territory by means of cooperation or leasing areas or buildings to elevate the planning integrity of the university campus	1	0.34
Technique 2. Compacting or increasing the number of objects in one section of the campus and reducing the number of small objects in its structure in other sections	2	0.28
Technique 3. Increasing the overall comfort by cooperating individual functional units accompanying the campus with city infrastructures	3	0.21
Technique 4. Formation of areas for students' activity with city infrastructures	4	0.17

Note: compiled based on the expert survey; the value of the concordance coefficient $W = 0.71$ ($p < 0.01$), indicating a strong agreement of expert opinions

Table 4. Basic requirements for the development of university campuses in the formation of an urban environment

Basic requirements		Rank	Weight
Socio-economic	Improvement of the accessibility and comfort of campuses for students and teachers and the significance of campuses for residents and tourists	1	0.24
Architectural and urban planning	Layout compactness	3	0.15
	Functional expediency	5	0.09
	Compositional expressiveness and high aesthetic quality	4	0.12
	Possibility of urban development of the university	7	0.06
	Internal and external pedestrian and transport connectivity	9	0.03
Environmental	Organization of the recreation zone	6	0.08
	Connection between the university and city landscapes	2	0.19
	Compliance with hygiene standards	8	0.04

Note: compiled based on the expert survey; the value of the concordance coefficient $W = 0.69$ ($p < 0.01$), indicating a strong agreement of expert opinions

For the second, partitioned campus type the experts recommended the following techniques (Table 3).

The expert survey was also used to identify key requirements for the development of university campuses in the formation of an urban environment (Table 4).

5. Discussion

Speaking about the methods of urban development of the planning structure of spatially integral university campuses (Table 2), the experts noted that due to the fact that the integral type of campus occupies large enclosed areas (from 10 ha), most of its sites are not used rationally. These are mainly recreational areas that are placed between the economic blocks or away from the main pedestrian transit routes on campus. The reasons for this are that the origins of many modern campuses in Russia and Kazakhstan were laid in the period of socialism primarily focused on the speed of urban development rather than the efficiency of resource use.

For such territories, according to studies [23, 25], there are the following p*ossible measures for improvement for the sake of protecting their natural potential: creating a system of interconnecte*d open spaces; developing areas for leisure or social communication; highlighting the main and secondary pedestrian routes with landscaping elements; creating landmarks in the form of separate areas with fountains or sculptures; providing exposure of the central entrance and facades of university buildings; organizing mini-parks on campus; forming systems of vertical landscaping and equipment of building roofs; decorating technical structures, small areas, and gaps in construction, etc. with various greenery.

Furthermore, on campuses with low construction density, free unequipped plots can be used for construction considering the normative indicators of building density for a particular type of university in its industry [26].

Improvement of internal pedestrian connections between the functional blocks of the campus on its territory is realized by creating fast and comfortable paths for students and faculty to reduce travel time and, in turn, increase time for work, study, and rest. In addition, the use of landscaping techniques for pedestrian paths will increase the hygienic conditions and psychological comfort of the campus area [5]. The organization of covered passageways between buildings and blocks is a solution to the inconvenience of walking between blocks in cold and rainy weather.

For all university campuses represented by the experts, it is important to create and improve external pedestrian connections between campus facilities, transportation stops (subway, busses, trams, etc.), and public service

infrastructure located in areas of student activity.

Today, increasing attention is paid to the effective organization of shuttle busses from the academic and administrative core of the university to subway stops, the creation of bicycle paths parallel to the transport routes, the provision of the availability of bicycle parking on campus and near the main transport hubs, and the organization of car parking based on the normalized indicator of parking spaces per daytime population of the campus.

Considering the spatially partitioned type of university campus (Table 3), the experts noted that the accession of adjacent areas solves the problems of urban development in the structure of the modern city for this type of campus. This territorial expansion is carried out as a result of several urban planning decisions.

Second, according to the experts, the urban development of the university campus is implemented more efficiently by one or several universities or other urban research and production organizations renting buildings adjacent to the largest of the institutions. The experts consider this method the most promising, but subject to the solution of organizational issues with the city authorities. The most acceptable conditions for universities can be obtained with the support of city authorities. In the latter case, this solves the problems of spatial expansion for campuses that have small development budgets.

Urban development to adjacent areas will enhance the planning integrity of the campus and strengthen its functional core [6].

For a campus with a very fragmented structure, one solution to the issue of structural compactness and integrity is to compact the facilities in one section of the campus and reduce the number of smaller facilities in other sections, as often unresolved organizational issues related to the interests of various municipal administrative authorities, universities, and the owners of premises prevent the effective application of this approach in practice.

Let us now look in more detail at the basic requirements for the development of university campuses (Table 4).

On the one hand, universities are at the center of the process of knowledge generation and translation and the reproduction of a country's intellectual potential, as they perform an integrating role for different branches of knowledge and thus influence the cultural situation. On the other hand, the effectiveness of university development increases if the availability and comfort of campuses for students and teachers and the importance of campuses for residents and tourists increase.

All experts point out the influence of university campuses on the economic development of the urban environment that manifests itself in two ways. First, universities generally increase economic activity in cities, especially in innovative industries, through the creation of science parks. In addition, universities are significant tourist resources, both as historic buildings and as sites for scientific tourism. Second, students, who are characterized by a distinctive lifestyle, form a corresponding demand for service establishments, particularly cafes, bars, sports, entertainment venues, and the like.

We agree with [27] that the principles and mechanisms for the optimization of the spatial development of university campuses in the structure of the city may differ but should be aimed at increasing compactness. University campus management should consider the possibility of communication with industry research organizations, accessibility of the university campus to the citywide community centers and other building elements, and integration with city plans to participate in cultural and social city events. It should develop functional and spatial integration of the campus and comply with the principles of environmental friendliness [28].

We believe that the orientation of the development of university campuses based on state request is characteristic of Russia and Kazakhstan. Therefore, it would be advisable to apply the block-modular method for the development of spatially partitioned campuses. This approach allows for their constant and continuous development while preserving the integrity of the compositional structure. We agree with [29] proposing requirements for the location of university campuses depending on their industry affiliation in the structure of the city and the provision of necessary links with specific facilities of the city. For example, it is suggested to form specific types of university campuses in different districts of the city. In the central districts of the city, it is recommended to locate the campuses of universities of culture and the arts. In residential areas, it is advised to locate the campuses of, for example, economic universities. In the industrial zone, it is worth placing the campuses of technical universities that are part of a large complex. Campuses of polytechnic universities should be situated near industrial and park areas. It is also advisable to locate campuses of physical education universities in the recreational zone and medical campuses in the zone of hospitals and clinics of the city. It is necessary to develop campuses of agricultural universities focusing on their access to agricultural land.

It should be noted in particular that in small and medium-sized cities, universities have an urban-forming function [30]. Under such conditions, cities and university campuses are distinguished by complex interconnections and interdependencies that appear through features of social and economic processes, urban everyday life, urban quality of life, urban planning, and urban governance.

6. Conclusions

As a result of our study, we conclude that for the development of existing university campuses integrated into the urban environment, it is necessary to use urban development techniques depending on the spatially integral or spatially partitioned type of the university campus. In addition, it is necessary to develop national requirements for the development of university campuses.

The limitation of the study relates to the limited sample of experts in terms of the representation of universities, which does not allow for a broader extrapolation of findings. Another limitation is that Russian and Kazakh university campuses were built within the framework of 20th-century Soviet architecture, as well as in large cities located in a temperate and sharply continental climate.

Further research can focus on the development of recommendations for the urban development of university campuses in the structure of a specific large city.

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