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JUSTIFICATION OF CRITERIAS SELECTION FOR SUPPORTING DECISION-MAKING IN URBAN PLANNING ZONING OF TERRITORIES BASED ON THE CONCEPT OF SUSTAINABLE DEVELOPMENT

The purpose of this study was to determine the key indicators for assessing the sustainable development of the university campus when choosing its spatial organization and functional planning. Questionnaires are formulated for quantitative and qualitative expert assessment of existing university territories to determine the best option for the interaction of the city with the functional zones of the campus. The main options for the transformation of the university and its adjacent territory are proposed. The main advantages and disadvantages of each of the variants of the spatial organization of the campus are determined. A roadmap has been formed to make a decision for the urban planning placement of an innovative educational environment.

Keywords: *university campus, sustainable campus, sustainable development, functional zoning, evaluation criteria*

Цель данного исследования заключалась в определении ключевых показателей оценки устойчивого развития университетского кампуса при выборе его пространственной организации и функциональном планировании. Сформулированы анкеты для количественной и качественной экспертной оценки существующих территорий университетов для определения наилучшего варианта взаимодействия города с функциональными зонами кампуса. Предложены основные варианты трансформации университета и его прилегающей территории. Определены основные преимущества и недостатки каждого из вариантов пространственной организации кампуса. Сформирована дорожная карта по принятию решения для градостроительного размещения инновационной образовательной среды.

Ключевые слова: *университетский кампус, устойчивый кампус, устойчивое развитие, функциональное зонирование, критерии оценки*

In the context of global environmental and climate change, there has been a growing interest in reducing the negative impact of anthropogenic load on the urban environment, such as by reducing the consumption of natural resources, greening, economics, and rational territorial planning.

The territories of university complexes are an important link in the natural framework of a city in a contemporary urbanized environment. To reduce the negative impact on the environment and optimize environmental management, even at the stage of planning territories for universities, areas must be correctly distributed according to the required functionality and should consider the aims and objectives of sustainable development.

The transformation of the Russian higher education system is underway. In the next decade, at least 30 new world-class university campuses are to be built in Russia.

The changes in universities today represent a global transition from universities as employment agents for industrial production to universities as innovative corporations for the creation and dissemination of modern knowledge. This requires a completely new attitude to architectural and spatial solutions in the creation of university campuses [1].

Analysis of the experience of scientists and designers in creating sustainable innovative campuses enabled us to identify the main pathways of their spatial development [2, 3]. The creation of a network of modern university campuses contributes to the modernization and transformation of individual areas of a city, implying an increase in the number of service infrastructure facilities and an improvement in the quality of public spaces used by citizens every day [4].

However, it must be noted that at the moment, the concept of sustainable development of humanity is not fully considered when making decisions on the spatial organization of university territories and the functional zoning of innovative education-

al environments. Therefore, fundamental criteria that can help find answers to questions about the need to transform the existing territories of universities and their appropriate zoning must be developed as many functions that must be combined in one space must be considered.

Herein, all works were based on a systematic approach. A campus was considered a complex holistic system. The principle of analyzing the interrelationships of environmental, economic, and social factors of sustainable development was fundamental in determining the necessary objects and zones that are part of the campus territory. Accordingly, the criteria for assessing existing campus areas and compliance with the required level were determined.

A world-class campus should be equipped with everything required for a comfortable life. The functional richness and diversity of the environment of a university campus in the city suggest that university students and staff use the city infrastructure continuously and are closely connected with its cultural institutions and services.

To identify rationally functional areas, key indicators for the compliance of a complex of university buildings and structures with the concept of a "sustainable campus" were proposed (Table 1). The indicators were developed on the basis of scientific research in this field, the global ranking of universities UI Greenmetric [5], Alshuwaikhat and Abubakar's Campus Sustainability Framework [6], the UKM Sustainability Program [7], the University of Nottingham Campus Sustainability Indicators [8], and the University of Connecticut Campus Sustainability Indicators [9].

Considering these developed key performance indicators for assessing the sustainable development of a campus and the general normative content required from the perspective of management acts on the territory of the innovative educational environment, functional sites should be distinguished, namely, housing, education, healthcare, catering, recreation, rest, sport, consumer services, trade, car parking, and territories for possible space expansion.

The zones under consideration can be grouped by considering the mandatory aspects of university processes. Consequently, we obtained integrated functions of campus areas, including educational and research functions, housing, retail and recreation, entrepreneurship, and infrastructure (Fig. 1).

Fig. 1. Enlarged functional areas of a campus

Based on the developed enlarged zones and the current regulatory documentation for the design of buildings of educational institutions of higher education (SP 278.1325800.2016), groups of buildings and structures, as well as territories necessary for the university to comply with a world-class innovative educational environment, were identified.

The data obtained were used to draft a university compliance questionnaire necessary for a quantitative assessment of a university's facilities and territory (Table 2). Because of the involvement of experts in this field, as well as students and teachers, data can be obtained to determine insufficient facilities and decide whether the area in question requires transformation or corresponds to the level of a "sustainable campus."

Based on the results of this assessment, functional areas that lack buildings and structures necessary for a comfortable life on a university campus can be determined.

For a qualitative assessment of the territory and objects that are part of a university, an assessment questionnaire was proposed, which includes questions for each functional zone and is necessary in an innovative educational environment (Table 3). The assessment results can help establish the current level of university infrastructure.

On the basis of the data obtained, further options for the development of an innovative educational environment can be determined, and the degree of the required university transformation can be identified.

Considering the territory and budget capabilities, two scenarios can be distinguished: construction (formation) of a new campus (survey results 49% and below) or reconstruction (renovation) of the existing territory. Each of the two options has advantages and disadvantages. The first option involves creating a campus from its inception; most often, this option is characterized by the use of territory on the city periphery or outside it. This approach is justified if the city does not have free land within the existing development or the functions necessary on the campus require specific conditions and a large area. Meanwhile, creating a campus by reconstructing an existing site requires significantly less capital investment than creating a campus from its inception. However, the specific cost rate per building (per specified area) during reconstruction is significantly higher than that during new construction [12].

Notably, during reconstruction, a university does not always have areas for the introduction of new functional sites or the construction of new buildings. In addition, during reconstruction, campus creators are limited by the design features of existing buildings (e.g., bearing capacity of foundations, preservation of main walls, and appearance of facades).

In turn, the option of reconstructing an existing university and its territory has two options:

- densification and development of the built-up areas of the university;
- campus development on sites within close proximity to the university.

When using nearby territories, functional zones should be allocated based not only on the university's needs but also on the needs of the urban community.

In the case of space compaction due to the construction of additional university facilities, public spaces or individual buildings (e.g., libraries, museums, and sports facilities) can be shared with ordinary citizens, which in turn creates points of attraction in the urban environment.

The localization of a university campus or the option of a campus dispersed in the city depends on various factors, such as the historical aspects of university development in the city, the ability and desire of city and regional authorities or business enterprises to participate in this process, the possibility of reconstruction of adjacent territories, and redevelopment.

Despite the chosen option for the spatial development of a campus, city communities must be involved in discussing plans for the development of the university territory and plans for the territory development must be coordinated with city authorities so that the university renewal does not end with spending on infrastructure but instead gives impetus to the development of the city.

When organizing a campus spatially, it should not be too far from existing industrial centers. This is due to the need to ensure contact between teaching and specific industries, which is especially important for technical universities. The created campus thus not only becomes an educational and scientific center but also begins to shape the environment both in aesthetic and investment terms [11].

Thus, the main stages necessary when deciding on the transformation and spatial layout of a campus can be formulated (Fig. 2).

A modern campus can be built using natural laws of development, become part of the ecosystem as a whole, and contribute to the establishment of a balance between nature and man [12].

For modern universities, both the academic function and the opportunity to cooperate with businesses are important. The platform for the formation of innovations in the city and the development of technological entrepreneurship is precisely this interaction between a university and businesses. With the use of such cooperation, innovative businesses are created. In addition, a well-designed campus can become a point of eco-

Table 1

Key performance indicators for campus sustainability assessment

Sustainable development of the campus	**Economic sphere**	**1. Positive impact of infrastructure on achieving sustainable development goals and the growth of the national economy**
		• Implementation of the project significantly affects the regional economy • Promoting long-term and sustainable development of the region's economy
		2. Ensuring economic efficiency throughout the entire life cycle of the project
		• Risk management mechanisms at all stages of the life cycle • Use of innovative technologies
		3. University as a stakeholder organization
		• Active interaction with society • Cooperation among regional authorities, scientific and educational organizations, industrial enterprises, and business communities • Cooperation between nonprofit organizations in all spheres of socioeconomic and public life
	Environmental area	**4. Integration of environmental aspects into the project**
		• Measures to minimize negative impacts on the environment • Measures to reduce anthropogenic impacts on the environment • Measures to save water resources • Recycling • Separate waste collection • Implementation of an energy-saving program • Green construction • Climate change adaptation program
		5. Resistance to natural disasters, emergencies, and other risks
		• Resistance to natural disasters and emergencies • Measures to protect against the consequences of natural disasters and emergencies
		6. Transport and pedestrian road networks
		• Organized pedestrian and promenade networks • Bicycle infrastructure • Use of an environmentally friendly mode of transport
	Social sphere	**7. Integration of social aspects into the project**
		• Providing open access to campus life for all city residents • Introduction of the “smart city” concept on the campus territory (smart campus)
		8. Improving the quality of infrastructure administration
		• Courses on sustainable development • Sustainable development activities • Conducting research in the field of sustainable development • Publications on sustainable development

Table 2

Questionnaire for the quantitative assessment of university facilities and territory

Functional zones	**Functional zone objects**	**Available**	**Absent**
Educational and research functions	Building or complex of buildings with lecture halls	✓	
	Building or complex of buildings with classrooms for small group work	✓	
	Laboratories	✓	
	Library with media library	✓	
	Coworking space	✓	
Residential function	Student dormitory	✓	
	Dormitory for international students	✓	
	Housing for teachers	✓	
	Housing for support staff	✓	
	Housing for short-term stays of students (applicants, students of other universities arriving as part of competitions and conferences)	✓	
	Short-term housing for teachers of other universities	✓	
	Hotel complex	✓	
Retail and leisure functions	Cafe	✓	
	Canteen	✓	
	Cultural center and museum	✓	
	Supermarket	✓	
	Consumer service building	✓	
	Sports areas and related buildings	✓	
Entrepreneurial (commercial) function	Business incubator	✓	
	Business center	✓	
	Bases of the practices of supervising employers	✓	
Infrastructure	Parking space	✓	
	Pedestrian and road network	✓	
	Transport accessibility (public transport stops nearby)	✓	
	Reserve territory for long-term planning of the development of a higher education organization	✓	
Total		100 %	

100 % – The territory fully complies with the standards of an innovative educational environment.
80–99 % – The territory largely complies with the standards of an innovative educational environment but requires minor transformation.
50–79 % – The territory partially meets the standards of an innovative educational environment and requires transformation.
49 % and below – The territory does not meet the standards of an innovative educational environment and requires significant transformation.

Table 3

Questionnaire for the qualitative evaluation of university facilities and territory

Question category according to functional area	Question	Excellent	Good	Bad
Housing	1. Rate the comfort and modernity of our university's student dormitories today	✓		
	2. Rate the comfort and modernity of housing for teachers of our university today	✓		
Education	3. Rate the condition of the educational buildings of our university	✓		
	4. Rate the scientific infrastructure, including laboratories, coworking spaces, and research centers of our university	✓		
Library	5. Rate the state of the library complex of our university	✓		
Healthcare	6. Rate the level and accessibility of medical care facilities in the territory of our university	✓		
Sports	7. Rate the sports infrastructure of our university	✓		
Culture	8. Rate the public and cultural spaces at our university	✓		
Leisure	9. Rate the leisure infrastructure of our university	✓		
Trade	10. Rate the accessibility and level of trade enterprises near our university	✓		
Public catering	11. Rate the level of catering facilities in the territory of our university	✓		
Social and public utility facilities	12. Rate the availability of all necessary social and public utility facilities for student life	✓		
Commercial(entrepreneurial activity)	13. Rate the level and modernity of commercial and entrepreneurial facilities (including business incubators, business centers, and practice bases for supervising employers) in the territory of our university	✓		
Parking lots for vehicles	14. Rate the level of provision of parking spaces for vehicles on the territory of our university	✓		
Reserve territory	15. Does your university have a reserve territory for further long-term planning and development of the educational organization?	✓		
	Total	100 %		

100 % – the territory fully complies with the standards of an innovative educational environment;
80–99 % – the territory largely complies with the standards of an innovative educational environment, but requires minor transformation;
50–79 % – the territory partially meets the standards of an innovative educational environment, but requires transformation;
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nomic growth for the territory where it is located.

All of the above indicate a clearly expressed need for rapprochement and a combination of education and city development, the disconnection of different cultural forms and institutions, and the formation of an open, well-stocked educational space that creates conditions for different educational trajectories.

Conclusions. 1. This research enabled us to develop criteria and indicators for assessing university territories, considering the concept of sustainable development. The indicators correspond to three fields (environmental, economic, and social).

2. Considering the mandatory aspects of university processes, the enlarged functional zones of innovative educational environments were identified: educational and research, housing, retail and recreation, entrepreneurial activities, and infrastructure.

3. Questionnaires were generated for the quantitative and qualitative assessment of university facilities and territories. The information obtained can be used to determine which aspects require transformation and how large their scale should be.

4. Various options for spatial organization of university campuses were analyzed, and the advantages and disadvantages of each option were identified.

5. A roadmap was proposed for choosing an option for the spatial organization of an innovative educational environment, which can be used by universities as a guide for transforming objects and territories into a sustainable campus.

Fig. 2. Roadmap for decision-making in urban planning locations of university campuses

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