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# Innovative technologies in the field of topography, land management, territorial planning, construction and architecture

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**Abstract.** The urgency of the problem under investigation is conditioned by the association of educational institutions in clusters held in Moscow, by the example of the State Budgetary Educational Institution of Moscow "The First Moscow Educational Complex" (1 IOC) within its statutory powers and entrusted territory. The article is aimed at the disclosure of the problem of forming the living environment of the IOC, as a territorial-social organization (TSO), consisting of seven educational institutions, on the basis of the developed model of spatial-temporal development of the cluster and three-dimensional representation of the topographic plan of the territory with three-dimensional models of existing objects, project) into a new quality for the subsequent territorial and economic development of this training cluster. The leading methodological approach to the study of this problem is the use of modern innovative systems of ground-based laser imagery, which allows to reveal huge volumes of information about the environment by innovative software and hardware technologies, to process this information and to obtain on the basis of architectural mapping various types of documents in the field of topography, land management, territorial planning, construction and architecture for a territorial-social organizations (TSO) of different levels. The main results of the article show that the use of laser scanning of the territory as one of the foundations of architectural mapping forms the database of the current state of the environment for the TSO management system, justifies pre-design solutions and allows performing complex architectural and landscape arrangement and modeling of the educational cluster on the basis of its three-dimensional representation. On the example of educational cluster 1 of the MOC in practice, the technology of the formation of these documents has been tested. The model of spatial-temporal development on the basis of the three-dimensional topographical plan of the cluster territory has allowed to successfully create a living environment and to determine the territorial and economic development of TSO, differentiated approach to the accounting of social, financial, legal, and other aspects of urban planning. The materials of the article can be useful for city planners, architects, builders, investors and administrative bodies.

## 1. Introduction

The formulation of the scientific hypothesis consists in a methodological approach to the representation of the habitat as an informational product of the territorial social organization produced by the society. Such an approach will ensure the integration of various methods, including mathematical-statistical, functional, frame-fabric, eco-oriented, economic-statistical, sociocultural, and



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will give new impetus to research. The relevance of the methodological approach is to implement the synergy of research methods on the basis of architectural cartography as the most important component of the Digital Economy of Russia [1, 2, 3, 4]. The importance of the approach is extremely important both for the territorial-economic and architectural-environmental approach, and for the society - TCO, which produces this integrated product. In practice, some individual fragments of the environment are currently used in the form of target cadastres and registers, so the proposed approach will give a new quality to the system of managing the environmental conditions of the society [6, 7]. The new approach will allow for the analysis and management of the development of the territories, both for a particular land plot with property located within its borders, and for the aggregate of land plots that form territorial (district, microdistrict) and administrative-territorial units (populated area, municipal region, subject state, state). For further proof of the hypothesis, it is advisable to give several concepts and their definitions. In the light of the universal laws of the world [8] and the laws of informatics [22] the material and information-energy field of the environment, interacting with the material and information-energy field of the society and social environment through the material and information-energy field of their interaction environment form the material and information-energy field Habitat or habitat [1, 2]. The society and the social environment are considered by the authors as an aggregate of various territorial and social organizations, as well as the community of group-type people, the totality of the social conditions of human activity that affect its consciousness and behavior. Territorial and social organizations (TSO) - in "... a vertically integrated system of planning and monitoring ..." are certain territorial associations of different levels organized on an administrative and territorial basis, with their governing bodies that unite a certain group of people who operate on a certain territories, the interactions between which take the form of a purposeful process of creating a joint product - Habitat. Architectural mapping is the material and information-energy copying of the habitat or part of it with the aim of creating a modern information model of the surrounding world with the help of information-energy fields and modeling it in a spatio-temporal continuum to meet the needs of territorial social organizations. The study defines the general properties of the habitat: comfort, quality, economic, social, cultural, environmental, information and energy stability and information balance, biological information and energy balance, defense against unfriendly external influences and revolutionary internal transformations, spiritual evolution and creative creation for reproduction environment. It should be noted that all methods are based on documented information in different types of presentation: on paper, computer or electronic media. In this connection, it is expedient, in the framework of this study, to rely on the method of forming and adopting the document [19]. Therefore, in the study on the example of TSO 1 MOC using architectural mapping will demonstrate: Habitat, including: the surrounding, social environment TSO 1 MOC and the environment of their information interaction.

## 2. Review of the literature

Unfortunately, the authors of this work have so far not been able to find similar approaches in the writings of foreign and domestic authors. Fundamental research and methods of foreign and domestic authors used the city, regional, regional structures as macro-level structures that unite various land-property complexes and have certain research directions. The methods for studying individual land and property complexes were carried out within the boundaries of land use from the standpoint of the economic efficiency of the land-economic and property structure, as elements of the territorial structure of the micro-level. The total vector of territorial development, integrating the interests of macro and micro levels, was determined with the help of mathematical-statistical, economic-statistical and grapho-analytical methods of territory planning. Currently more and more attention in society and the world society is given to how information-energy system [7, 8, 9, 12, 13, 19, 20, 21, 22]. Architecture in its historical and cultural context in the modern context is in its new capacity as a system of energy-informational interaction of society and environment [8, 10, 14, 15, 16, 17, 18, 21, 22]. While the environment in material terms is quite touchable objects is described in legislative

documents [20, 22]. The social environment and interaction of its structural components set forth in the Civil code [21], other legislative and normative documents and literary sources [17, 22]. As a result of the analysis of the legal and regulatory framework was built of material community-based model organization of any territories, as structural units of the Russian Federation [18]. The development of any territory implies its transformation into a new state using the process approach [2, 11, 22] on the basis of the planning organization [4, 22], the land-economic using and property structure [3, 4]. The structural and planning development and property development of the territories should be carried out in the context of the architectural and aesthetic [5, 6, 14, 15, 16] perception of the environment and the spiritual development of the society [7, 20, 21, 22]. As a result, the principles of planning organization of the territory and the architectural environment will reflect the spirit of the era and the level of spiritual development of the society. Depending on the structural unit of the territory with the use of architectural cartography and the life cycle of the project, the planning organization, organizational support, motivation and deadlines for commissioning, as well as the conditions for the functioning of the land and property complex, as TSO - the habitat will be determined. Therefore, in this article, we will analyze the formation of a new information and energy quality of the TSO 1 MOC habitat using modern innovative technologies in the field of topography, land management, spatial planning, construction and architecture, using the example of the 1 MOC.

### 3. Methodology

The leading methodological approach to the study of this problem is the use of modern innovative systems of ground-based laser imagery, which allows to reveal huge volumes of information about the environment by innovative software and hardware technologies, to process this information and to obtain on the basis of architectural mapping various types of documents in the field of topography, land management, territorial planning, construction and architecture for a territorial-social organizations (TSO) of different levels. The process of organizing the experiment is based on the general methodology of architectural and urban planning and is presented on the basis of the architectural and design project of the complex architectural and landscape arrangement and design modeling of the educational cluster of the State Budget Educational Institution of Moscow "The First Moscow Educational Complex", which includes the process of formation of the habitat 1 MOC according to the following research scheme:

- collection of initial data on the object of research and the formation of a view of the current state of the habitat of the object;
- wishes of the survey respondents to the future habitat, including approaches to the upbringing and planning of the facilities;
- development of the idea of a future habitat;
- formation of the image of the object;
- creation of architectural and design project of complex architectural and landscape arrangement and design modeling of educational cluster of the 1 MOC;
- the impact of interventions and manipulations on the results of the study on the creation of the 1 MOC habitat as public protection before the council and asset 1 MOC.

#### *The subjects of the study were observed in natural conditions*

During the research, the following methods were used: laser scanning of the territory, automated processing of laser scanning data, written questionnaires, interviews, field observations and site surveys. To ensure the reproducibility of the research results in the part of the formation of the current state of the TCO 1 IOC habitat as components of architectural mapping, innovative methods of ground-based laser scanning of the territory were used to update the original topographic plans, and the construction of space-spatial architectural objects and landscapes. The accuracy of measurements obtained as a result of laser scanning was within the limits of up to 1 centimeter, which corresponded to the requirements for production and updating of topographic plans and geodetic measurements of

buildings and structures.

The choice of the method of ground-based laser scanning was justified by its advantages for this study:

- universality for obtaining various actual end products required for this project (topographic plans M 1: 500, facades and models of buildings and structures, terrain);
- accuracy from 4 mm and reliability of data on the parameters of space-spatial objects of the territory;
- speed and processing of the same data fields for obtaining topoplanov territories of educational institutions and buildings and structures located on sites;
- high detail;
- automation of the data processing process and fully digital data format.

To ensure the first phase of architectural mapping, the ground-based laser scanning system RIEGL VZ-400, available to OOO GeoProjectsystaniya, was used. This system is used for scanning buildings, interiors of premises, surveying engineering structures and territories. Below are some of the characteristics of the system:

- The shooting speed is up to 1 million points per second.
- Distance to the object being scanned: 600 m;
- Measurement accuracy: from 4 mm. (Depending on the distance from the scanning system);
- field of view: - horizontally, vertically.

The object of the study is 1 MOC, which represents, on the one hand, the social environment and on the other hand the environment or land and property complex. At the same time, the society is represented by organizational structures, and the land and property complex includes the territories of four kindergartens, two secondary schools and a college. The main objective of the interaction of the social environment is the production of the environment of the society through the medium of their information interaction (documented information presented in various forms).

Restrictions in the development of the habitat of the 1 MOC are documented restrictions included in the composition of Urban Passports of land plots that are part of the 1 MOC.

Questioning, interviewing, field observation, survey, modeling and generalization was used for empirical determination of the state of the environment of the 1MOC society.

#### 4. Results

There is no need to prove that each person as a subject of research seems to be a rather powerful and spiritualized information-energy field connected with the information-energy fields of the universe [7, 21, 22]. Each person with certain skills can feel these energy fields. In addition, within the organizational structure of TSO 1, the 1 MOC begins to operate the field of egregor [7] - "... the energy information structure created by the co-directed emotions and thoughts of a group of people united by one idea" (arcanes.ru> egregory) - the idea of creating a product - the habitat of the 1 MOC

. Environment [22] The 1 MOC as a land and property complex is also represented by information and energy fields. This is proved by the Russian scientists academicians of RAEN G.I. Shipov and

A.E. Akimov, who discovered the torsion fields. With respect to architecture, planning organization and communication infrastructure, this means that "... any object having a form, in general, any object creates a Torsion Field" [12] and "... any geometry of space causes a torsion effect ..." [10.12]. Academician G.I. Shipov "... the relationship between energy and matter, matter, between the ideal and the material was proved." [22]. In addition, "... physics mathematically proved the presence of the Creator-Supermind-Absolute-God." [12]. In the field of the theory of torsion fields, "Consciousness is understood as a special form of the field (torsion) matter, as the highest form of information development - Information creating" [12, 21, 22], so it is quite justified that "In the beginning was the Word, and The Word was with God, and the Word was God." [1]. And since the Information Creator [21, 22], the medium of information interaction is the product of the consciousness of the Socium, "... as a special form of field matter" [21, 22]. Therefore, the design

project of an educational cluster as a creative product of consciousness is a product of the medium of information interaction aimed at shaping the environment of the 1 MOC socium. The habitat of the socium 1 of the 1 MOC is formed from subclusters of the habitat environment of societies of children's educational institutions, secondary schools and colleges. Despite the different tasks, each subcluster has a single vector of development - the upbringing of the younger generation in the process of its growing up. Each age subclass includes its own set of environment, social environment and environment of their information interaction. Therefore, the design project as an environment of information interaction of each age subcluster in the formation of the social environment of each specific age subcluster took into account upbringing as a key factor in the development of the environment of the 1 MOC socium. The study was conducted in three main areas: the study of the environment, the social environment and the environment of their information interaction for each sub-cluster, and in general for the 1 MOC. Analytical material of the environment is presented using the method of ground-based laser scanning of the territory and the modeling method for the formation of the current state of the environment of the 1 MOC and each age subcluster. The key meaning of such a methodological approach is to form a field of points of the space-time continuum for simultaneous use in the part:

- Updating the initial topographic plans of the land plots;
- formation of a three-dimensional model of the entire 1 MOC complex;
- construction of the space-time model of development of the 1 MOC.

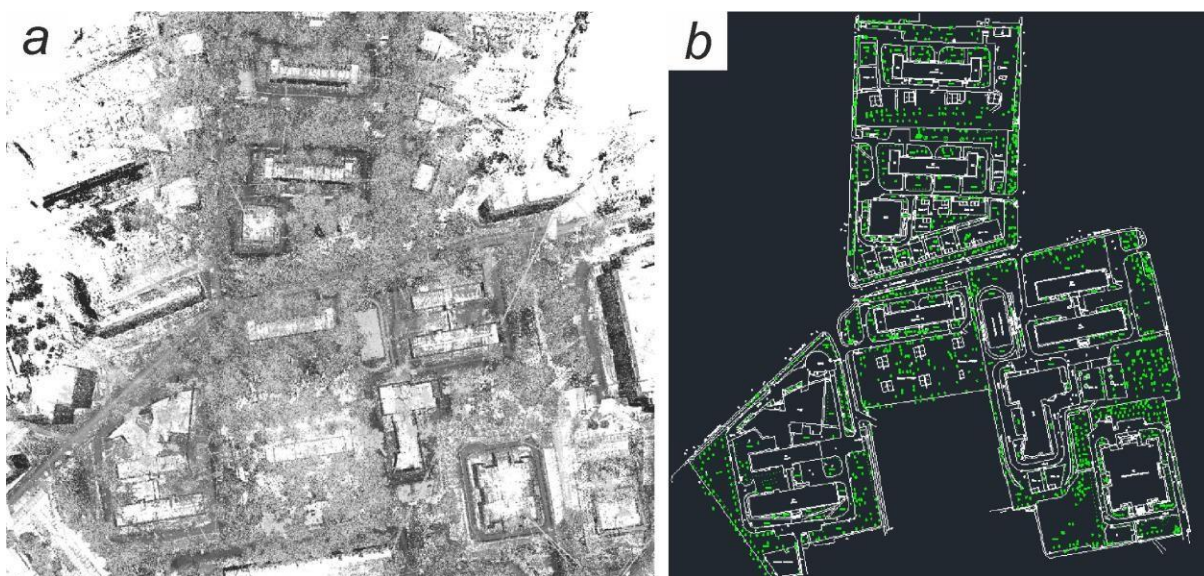
In the process of preparing for laser scanning and preliminary survey of the territory of the 1 MOC, the routes of the ground-based laser scanning system and blocks of point arrays were formed (see Figure 1).



**Figure 1.** Routes of movement of the system of ground-based laser scanning RIEGL VZ-400 through the territory of 1 MOC and blocks of point arrays

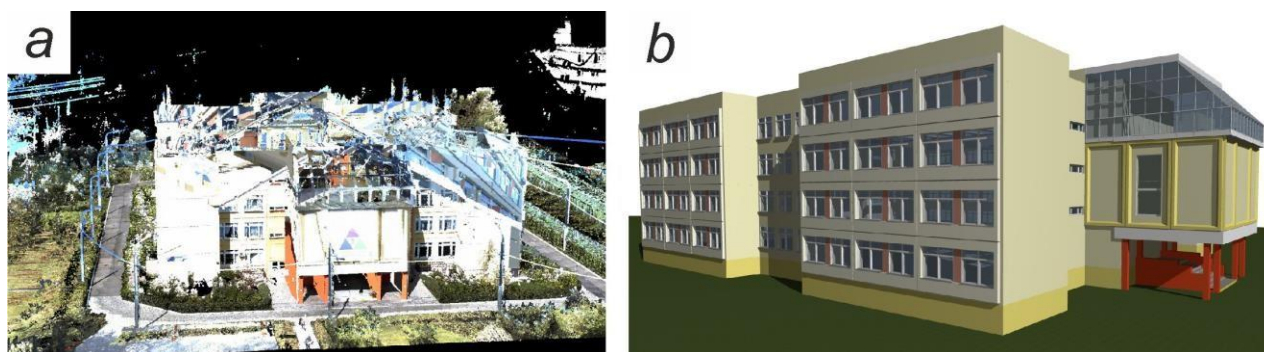
As a result of laser scanning of the territories of educational institutions and objects, an information field of points with a volume of more than 4.5 billion points has been obtained. The bound orthogonal projection of the array of points is shown in Figure 2 a.





**Figure 2.** The schemes of the bound orthogonal projection of the array of laser scanning points and topography plan of the 1 MOC territory: a – orthogonal projection; b - updated topographic plan of the 1MOC territory

As a result of the processing of the orthogonal projection of the array of laser scanning points of the 1 MOC territory, the original topographic plan M 1: 500 was updated. The updated topographic plan of the 1 MOC territory (see Figure 2 b) was created in accordance with the Topographic Survey in 1: 5,000, 1: 2000, 1: 1000 and 1: 500 (GKINP-02-033-82). This updated topographical plan was the basis for the formation of the planning organization of the territory, the spatial and design decision of the 1 MOC as a whole and the land and property complexes that make up its structure, as well as the formation of a three-dimensional model of the 1 MOC territory and the current state of the environment within the architectural system mapping. This same field of points was the basis for the formation of models of buildings and structures on the land plots of educational institutions. For example, the information field of the college building points (see Figure 3 a) was transformed into a three-dimensional vector model of the College building (see Figure 3 b).



**Figure 3.** Basis for the formation of the models of the buildings and structures on the land plots: a - information field of the College building points; b - three-dimensional vector model of the College building

With sufficiently high accuracy of measurements and the speed of presentation of ground-based laser scanning data, as well as individual linear control measurements using other spatial methods, it is

established that the results obtained can be represented by repeating the experience of organizing these initial spatio-temporally documented data electronically. Therefore, the method of ground-based laser scanning for building a modern state of the environment in our case is more effective than the method of tachymetric survey and the method of deciphering the terrain model and objects using the orthophoto transformation method. Analysis of the social environment was carried out using the methods of questioning, interviewing, field observation and survey of the council and asset of the 1 MOC. The social environment of each subcluster ("Kindergartens", "Secondary Education Schools", "Secondary Vocational Educational Institutions - Colleges") was questioned for the formation of the social environment of each subcluster and 1 MOC as a whole. In addition, interviews and interviews with the assets of each subcluster identified priorities for the development of the habitat for each subcluster. On the basis of these documented data, the concept of development of the 1 MOC and its subclusters was prepared, as well as technical specifications for the formation of the habitat for each subcluster and, in general, for the habitat of the 1MOC. Since the social environment of each subcluster in the administrative system for a certain period of time is sufficiently stable structure, based on the system of permanent education, the system of planning organization and design modeling of the environment was based on the principles of upbringing of the younger generation in the process of its growing up. On the territory of 1 IOC simultaneously there are children of three age periods - childhood (1-7 years), adolescence (7-14 years) and youth (14-21 years).

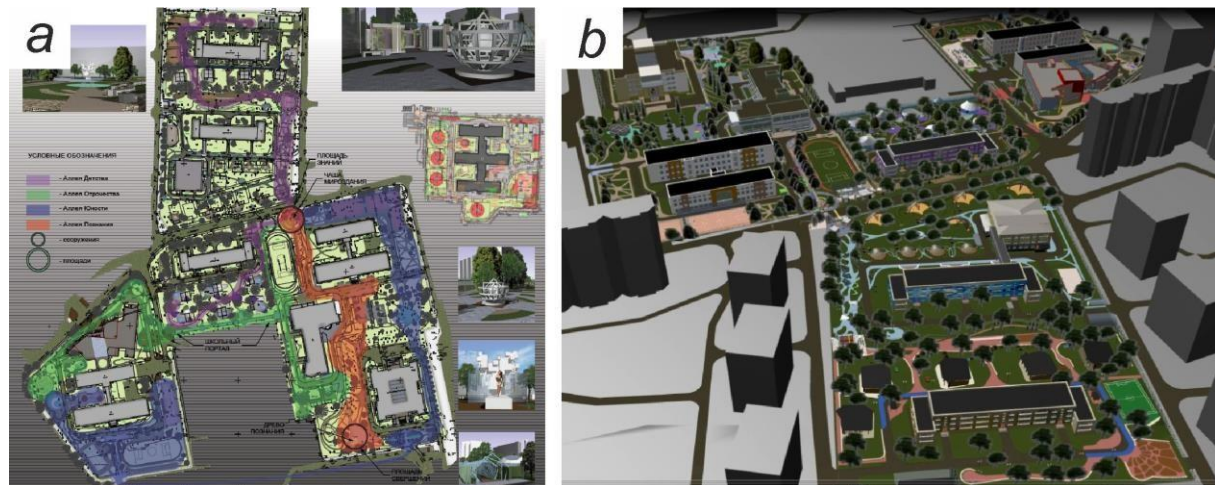
The specifics of children's social development, the assimilation of social norms and the acquisition of appropriate skills and knowledge in these age periods can and should be reflected in the design project by the special allocation and design of the corresponding territorial zones:

- territorial zone "Territory of Childhood", which unites a single concept for the territory occupied by the 1 MOC of the subcluster "Kindergartens";
- territorial zone "Territory of the Adolescence", which unites a single plan part of the territory occupied by the 1MOC of the subcluster "Secondary educational schools" (the territorial subzone "Primary classes" and the territorial subzone "Middle classes");
- territorial zone "Territory of Youth", which unites a single plan part of the territory occupied by the 1 MOC of the subcluster "Secondary education schools" (the territorial subzone "Senior classes") and the territory occupied by the 1 MOC of the subcluster "Secondary vocational educational institutions - colleges".

At the same time, territorial zones in no way violate the "territorial integrity" of the educational institutions that make up the IOC. Analysis and creation of the model of the information interaction environment was based on the methodology of architectural design and architectural mapping, as well as education of the younger generation. Therefore, the design of the complex architectural and landscape arrangement and design modeling of the educational cluster 1 of the IOC (see Figure 4 a, b) as a creative product of consciousness was based on the concept of development of the IOC and its subclusters, approved by the IOC asset and council. The project envisaged a territorial zone: "Territory of Childhood", "Territory of the Adolescence" with sub-zones "Elementary classes" and "Middle classes", as well as "Territory of Youth". "Territory of childhood" according to the authors' intention was represented by the elements of earth, water, air and fire and was expressed in the planning and design of the surrounding children of the environment with the corresponding attributes of Plato's bodies. The conceptual idea of growing up from adolescence to adolescence was based on the educational and planning concept of cognition of the universe on the Square of Cognition and the City of Masters and on the basis of the 1 MOC of sciences and arts presented to pupils. The quintessence of the conscious life path of the younger generation is the tree of knowledge, which is expressed in architectural forms on the Square of Accomplishment. Therefore, when completing training in the 1 MOC system and going into a new life, pupils should perceive the tree of knowledge as a definition of their future life path. Information and energy fields of previous epochs were transformed into and transmitted to the project with the help of planning and small architectural forms, in which epistomically, obliquely, allegorically or in other forms, the path of cognition was designated. As a result of the implementation of the architectural and planning concept and based on the design developments



presented in (figure 4 a), as well as using ground-based laser scanning elements, a three-dimensional model of the space-spatial solution of the 1 MOC territory was formed as the leading component of architectural mapping (see figure 4 b).



**Figure 4.** The project of complex architectural and landscape arrangement and design modeling (three-dimensional model of space-spatial decision) of the territory of the educational cluster of the 1 MOC: a – master plan; b - three-dimensional model

Consolidated analysis of the environment of the 1 MOC socium as a whole and taking into account structural subclusters using the methods of questioning, interviewing, field observation, survey, modeling and architectural mapping revealed the state of the environment interacting with the social environment through the medium of information interaction (documented information). At the same time, the current state of the environment of the 1 MOC socium and the state of the habitat of the 1 MOC socium and its subclusters within the framework of interaction between the environment and the social environment on the basis of the information and energy influence of the information interaction environment were to be compared. With the help of an empirical method of processing an array of samples of about 60 respondents, including representatives of the asset and Council I of the 1 MOC, the following conditions of the environment of the 1 MOC socium are revealed. The state of the modern habitat of the IOC socium 1 and its subclusters (Table 1) and the state of the environment of the IOC socium 1 and its subclusters within the interaction of the surrounding and social environment on the basis of the information and energy influence of the information interaction environment.

**Table 1.** The state of the modern habitat of the socium society 1MOC and its subclusters (in points on a ten-point scale)

No	Parameter name	College	School No. 274	School No. 1380	DS No 758	DS No 1849	DS No 1989	DS No 594	MOC
1	Comfort	7	7	6	5	5	5	6	5.9
2	Quality	7	7	7	6	6	6	6	6.4
3	Economic sustainability	6	6	6	6	6	6	6	6
4	Environmental sustainability	6	5	6	4	4	4	4	4.7
5	Social sustainability	7	6	6	6	6	6	6	6.1
6	Culturological sustainability	7	7	7	5	5	6	5	6
7	Space-spatial aesthetics	4	5	5	4	4	4	4	4.3

8	Information and energy sustainability	7	5	5	5	5	6	5	5.4
9	Information balance	5	5	5	5	5	6	5	5.1
10	Biological information and energy balance	6	6	6	6	6	6	6	6
11	Defensive capacity	7	8	6	5	4	5	5	5.7
12	Creative creation	7	6	5	5	4	5	4	5.1
13	Spiritual evolution	5	5	4	4	4	4	4	4.3

It should also be noted that, within the framework of normative documents, design and estimate documentation was also created for the territory of one of the kindergartens and transferred to the administration of the 1 MOC for coordination with the prefecture and full-scale implementation. Given the small architectural forms (SAF) of children's playgrounds, the estimated cost of the project to convert the habitat to a new state was about 36.5 million rubles, while the cost of the SAF for the price lists of SAF "Trading House Game World" was about 15 million rubles. The prefecture and the building complex can use this document to transform the environment on the basis of the received design and estimate documentation as one of the components of the information interaction environment.

## 5. Conclusions

Thus, TSO 1 MOC, forming its own habitat as a product of TSO, changes the surrounding and social environment. These changes transform the existing state of the habitat into a new information-energy state of the habitat of TSO of the 1 MOC. The main results of the article show that the use of laser scanning of the territory as the basis of architectural mapping forms the database of the current state of the environment for the TSO management system, substantiates the pre-design solutions and allows performing complex architectural and landscape arrangement and modeling of the educational cluster on the basis of its three-dimensional representation. On the example of educational cluster of the 1 MOC in practice, the technology of the formation of these documents has been tested. The model of spatial-temporal development on the basis of the three-dimensional topographical plan of the cluster territory has allowed to successfully create a living environment and to determine the territorial and economic development of TSO, differentiated approach to the accounting of social, financial, legal, and other aspects of urban planning. At the same time, the documented environment of information interaction in the space-time continuum demonstrates a new state of the surrounding and social environment. This happens first as a documented information and energy component of the transformations, and subsequently as a guiding document of these transformations. As an information and energy product, it begins to function from the moment it emerges. This is in accordance with the laws of informationology [22] and the Universal Laws of the World [9] using documented information of the information interaction environment, which was demonstrated in this study. On the basis of empirically obtained data using the method of architectural mapping, the authors state the hypothesis that the Habitat is an informational product of the territorial social organization. The authors consider it to be proven that the material and information-energy field of the environment interacting with the material and information-energy field of the socium and the social environment through the material and information-energy field of their interaction environment form the material and information-energy field of the Habitat or Habitat. On the example of project design and empirical research, the authors demonstrated the correctness of the hypothesis, based on documented information of the information interaction environment. Despite the local nature of the study using the example of a functional area, the authors are convinced that the theoretical and practical results presented in the study will work equally for any TSO and their land-property complexes. Architectural cartography will be an effective and modern tool for these purposes. The properties of the environment, defined in the study, sufficiently substantively characterize the state of the environment of the society at the stage of the existing state, and the transformation of the environment into a new state on the basis of the laws of information science. Theoretical significance of the conclusions can form the basis of the system for managing the conditions of the environment of the society using architectural mapping. The practical significance of the study is due to the fact that architectural

cartography is a strategic space-time component of the Digital Economy of Russia. The authors suggest that there is practically no difference between the target population group as an example of TSO of the 1 MOC as a used sample and as a functional component of TSO of a higher order (Moscow), from the standpoint of the product of the habitat and its properties. A significant difference will be in the characteristics of the habitat, due to various documented information of the medium of information interaction. It can be argued that the results obtained by the authors can be reproduced both for the environment and for the social environment using the mechanism of architectural cartography. The authors consider promising research in the field of the environment of the society for such territorial entities as neighborhoods, micro-districts and administrative-territorial entities such as prefectures, urban areas, populated areas, municipalities, subjects of the Russian Federation, using the relevant documented information defined by legislative and regulatory documents. In the context of the digital economy, it is important to determine the methods for the cost of the environment of the society as a product of TSO of different levels, and also through the laws of information science, the territorial cadastre and using architectural cartography to reveal the fractions of factors in the properties of the environment, including their cost expressions. The foregoing determines the relevance of the selected topic and requires the development of conceptual models of clusters for educational institutions. Promising, according to the authors, will be the formulation of principles and the development of methods for managing the environment of the society as a leading component of the digital economy of Russia.

### Recommendations

The materials of the article can be useful for city planners, architects, builders, investors and administrative bodies.

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