

**IMPLEMENTATION OF 3D CADASTRE IN KAZAKHSTAN:
INTERNATIONAL EXPERIENCE, CHALLENGES, PRIORITIES**

**ҚАЗАҚСТАНДА 3D-КАДАСТРДЫ ЕНГІЗУ:
ХАЛЫҚАРАЛЫҚ ТӘЖІРИБЕ, МӘСЕЛЕЛЕР, БАСЫМДЫҚТАР**

**ВНЕДРЕНИЕ 3D-КАДАСТРА В КАЗАХСТАНЕ:
МЕЖДУНАРОДНЫЙ ОПЫТ, ПРОБЛЕМЫ, ПРИОРИТЕТЫ**

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Abstract. Objective – to consider the possibilities of implementing a three-dimensional cadastre in the Republic of Kazakhstan, taking into account international experience, existing technological solutions, and regulatory aspects. To achieve this goal, the theoretical foundations of the 3D cadastre, methods of economically developed states, and the current state of the republic's cadastral mechanism were reviewed, and recommendations for implementing a three-dimensional cadastral model across all land categories were presented, with a priority role assigned to agricultural land. **Methods** – monographic method in studying world practice of applying the 3D cadastral approach; analytical – to compare various cadastral management mechanisms, identify shortcomings and advantages; cartographic – when identifying patterns and interrelationships of phenomena in the process of monitoring, processing, and modeling geospatial data from various maps; statistical – to collect and systematize land-cadastral information. **Results** – during the research, foreign examples of using a three-dimensional structure of cadastral regulation were summarized, key factors for transitioning to a geometric cadastre were determined, and prospects for using a 3D cadastral registration scheme in Kazakhstan were shown; a SWOT analysis was conducted. Special attention is paid to the phased integration of spatial data, digital technologies, and the regulatory framework to ensure the effective functioning of the 3D cadastral format. It was established that the existing information system, the Unified State Cadastre of Real Estate, with

its resources and developed infrastructure network, will serve as the foundation for the further transition to a 3D cadastre. *Conclusions* – the creation of a 3D cadastre must be carried out in stages, without destroying the existing cadastral administration framework, alongside improving current legislation and other areas related to the cadastre. *Conclusions* – as a result of the scientific inquiry, the author's interpretation of building a 3D spatial land accounting model in the Republic of Kazakhstan is presented, and conclusions are substantiated.

Аңдатпа. Мақсаты – халықаралық тәжірибені, қолданыстағы технологиялық шешімдерді және нормативтік-құқықтық аспектілерді ескере отырып, Қазақстан Республикасында үш өлшемді кадастрды енгізу мүмкіндіктерін қарастыру. Қойылған мақсатқа жету үшін 3D-кадастрдың теориялық негіздері, экономикалық дамыған мемлекеттердің әдістері, республикадағы кадастрлық механизмнің қазіргі жай-күйі қарастырылды, барлық санаттағы жерлерді ескере отырып, үш өлшемді кадастрлық модельді жүзеге асыру бойынша ұсыныстар берілді, бұл ретте басым рөл ауыл шаруашылығы мақсатындағы жер алқаптарына беріледі. Әдістері – 3D-кадастрлық тәсілді қолданудың әлемдік тәжірибесін зерттеуде монографиялық әдіс, кадастр жүргізудің әртүрлі механизмдерін салыстыру, кемшіліктер мен артықшылықтарды іздеу үшін талдамалық әдіс; әртүрлі карталардың геокеңістіктік деректерін мониторингтеу, өңдеу және модельдеу процесінде құбылыстардың заңдылықтары мен өзара байланысын айқындау кезінде картографиялық әдіс; жер-кадастрлық ақпаратты жинау және жүйелеу мақсатында статистикалық әдіс қолданылды. *Нәтижелері* – зерттеу барысында кадастрлық реттеудің үш өлшемді құрылымын пайдалану бойынша шетелдердің мысалдары жинақталды, геометриялық кадастрға өтудің негізгі факторлары анықталды және Қазақстанда кадастрлық есепке алудың үш өлшемді схемасын пайдалану келешегі көрсетілді, SWOT-талдау жасалды. Үш өлшемді кадастрлық форматтың тиімді жұмыс істеуін қамтамасыз ету үшін кеңістіктік мәліметтерді, цифрлық технологияларды және нормативтік-құқықтық базаны кезең-кезеңімен интеграциялауға ерекше назар аударылады. Өзінің ресурстарымен, дамыған инфрақұрылымдық желісімен қолданыстағы Жылжымайтын мүліктің бірыңғай мемлекеттік кадастры ақпараттық жүйесі кейіннен 3D-кадастрға өтудің іргетасы болатыны белгіленді. Қорытынды үш өлшемді кадастрды құруды кадастрлық әкімшілендірудің қолданыстағы концепциясын бұзбай кезең-кезеңімен жүргізу, сондай-ақ қолданыстағы заңнаманы және кадастрға байланысты басқа да салаларды жетілдіру қажет. *Қорытынды* – ғылыми ізденіс нәтижесінде Қазақстан Республикасында жер аумағын кеңістіктік есепке алудың үш өлшемді моделін құрудың авторлық интерпретациясы баяндалып, тұжырымдар дәлелденді.

Аннотация. *Цель* – рассмотреть возможности внедрения трехмерного кадастра в Республике Казахстан с учетом международного опыта, существующих технологических решений и нормативно-правовых аспектов. Для достижения поставленной цели рассмотрены теоретические основы 3D-кадастра, методы экономически развитых государств, текущее состояние кадастрового механизма республики, представлены рекомендации по реализации трехмерной кадастровой модели с учетом земель всех категорий, при этом приоритетная роль отводится земельным угодьям сельскохозяйственного назначения. *Методы* – монографический при изучении мировой практики применения 3D-кадастрового подхода, аналитический – для сравнения различных механизмов ведения кадастра, поиска недостатков и преимуществ; картографический – при выявлении закономерностей и взаимосвязи явлений в процессе мониторинга, обработки и моделирования геопространственных данных различных карт, статистический – с целью сбора и систематизации земельно-кадастровой информации. *Результаты* – в ходе исследований обобщены примеры зарубежных стран по использованию трехмерной структуры кадастрового регулирования, определены ключевые факторы для перехода на геометрический кадастр и показаны перспективы задействования трехмерной схемы кадастрового учета в Казахстане, составлен SWOT-анализ. Особое внимание уделяется поэтапной интеграции пространственных сведений, цифровых технологий и нормативно-правовой базы для обеспечения эффективного функционирования трёхмерного кадастрового формата. Установлено, что существующая информационная система Единый государственный кадастр недвижимости с его ресурсами, развитой инфраструктурной сетью станет фундаментом для дальнейшего перехода к 3D-кадастру. *Выводы* – создание трехмерного кадастра необходимо проводить поэтапно, не разрушая существующую трехмерную концепцию кадастрового администрирования, а также совершенствовать действующее законодательство и другие сферы, связанные с кадастром. *Выводы* – в результате научного поиска изложена авторская интерпретация построения трехмерной модели пространственного учета земельной площади в Республике Казахстан, аргументированы выводы.

Keywords: 2D cadastre, 3D cadastre, BIM technologies, geographic information system, spatial data, Unified State Cadastre of Real Estate, cadastre digitalization.

Түйінді сөздер: 2D-кадастр, 3D-кадастр, BIM-технологиялар, географиялық ақпараттық жүйе, кеңістіктік деректер, Жылжымайтын мүліктің бірыңғай мемлекеттік кадастры, кадастрды цифрландыру.

Ключевые слова: 2D-кадастр, 3D-кадастр, BIM-технологии, географическая информационная система, пространственные данные, Единый государственный кадастр недвижимости, цифровизация кадастра.

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Introduction

The transition of the Republic of Kazakhstan (Republic of Kazakhstan) to market relations, the use of GIS technologies and artificial intelligence have a significant impact on the management of the cadastre. The rapid growth of urbanization contributes to the development of the urban environment, the modernization of infrastructure, and the improvement of living standards, but it also places a high burden on the density of urban development. The changing structure of the urban environment and the real estate objects located within it create new requirements for the quantification and management of land resources. Modern requirements for cities in the rational management of land resources create the need to include real estate objects on the surface of the earth, underground structures, areas of multi-level objects and engineering communications. The use of a three-dimensional cadastre in agriculture plays an important role in assessing soil quality and fertility, as well as terrain characteristics.

The cadastral system of the Republic of Kazakhstan based on the two-dimensional cadastre of land plots, now requires more modern approaches due to the intensification of urbanization processes and the increasing number of types of rights and rights holders in the system of land relations. In modern international practice, we can often observe a change in the concept from a two-dimensional to a three-dimensional cadastre, which allows for registration not only on a horizontal plane but also in a three-dimensional space of all necessary characteristics of a real estate object. This approach enables precise determination of ownership rights, addressing issues of liability and restrictions on real estate rights in the context of rapid urbanization processes.

In Kazakhstan, the process of digital transformation of state land and real estate management systems is currently ongoing. Despite the development of electronic government services and

cadastral information systems, the existing registration model is primarily focused on two-dimensional representation of real estate objects. This can create limitations in the registration of complex multi-level objects and spatial rights.

The integration of 3D cadastre data with Geographic Information System (GIS), Building Information Modeling (BIM), and other digital technologies can contribute to the creation of a unified spatial information environment. Integration is relevant for the rapidly developing cities of Kazakhstan, where the vertical expansion of urban space is becoming increasingly important. The transition to a three-dimensional cadastral system can be considered as one of the promising ways to increase the efficiency, transparency and reliability of real estate registration and land management in the country.

The article analyzes the possibilities of implementing a three-dimensional cadastre in the Republic of Kazakhstan, taking into account international experience, existing technological solutions, and legal aspects. To this end, the theoretical foundations of 3D cadastre, international implementation practices, the current state of the cadastre system in Kazakhstan, and approaches to implementing a three-dimensional cadastral model are considered.

Literature review

The development of a three-dimensional cadastre has been actively researched in the international scientific community over the past few decades.

In the Netherlands, the main priority has been standardization, which involves the registration of rights to multi-level real estate objects (above-ground and underground). These objects are registered as three-dimensional spatial objects that are then linked to the land plot. This registration system is based on the international standard LADM (Land Administration Domain Model) (ISO 19152) [1].

In Sweden, the implementation of a 3D cadastre is based on its legal status in order to delineate rights under the 3D Property Act. Rights to real estate located on different floors or in basements, etc. are registered separately from the owner of the land plot [2].

In Australia, a 3D cadastre has been implemented as part of the digitalization of cadastral information. In this regard, paper-based documentation and 2D cadastral data have been converted into a unified digital format within the ePlan system, which supports 3D formats for precise delineation of rights in high-rise buildings [3].

In China, 3D cadastral data has been implemented in megacities for the registration of objects in skyscrapers, multi-level shopping streets, and transportation interchanges. 3D cadastre data has been integrated with urban cadastral GIS systems [4].

The application of 3D cadastre data for agricultural land is significantly different from that for urban land. While 3D cadastral data is important for distinguishing between above-ground and underground objects in urban areas, it plays a crucial role in the agricultural sector as a multidimensional tool for precision farming and land monitoring for land protection. The 3D cadastre data for agricultural land includes three main factors: soil, topography, and engineering networks, as well as subsurface resources.

BIM technologies with LADM make it possible to create 3D cadastre objects with spatial legal registration [5].

The development of a 3D cadastre system is a complex process that requires parallel development of GIS technology and the LADM standard, digital information databases, and other elements [6].

It is necessary to take into account compatibility, BIM integration processes, standardization and not forget the aspects of the 3D cadastre as organizational and technical in management processes [7].

Thus, it can be concluded that there are a number of problems associated with maintaining a modern cadastre, the main ones being the lack of a unified 3D cadastre database architecture, insufficient integration with existing systems, and imperfect information management mechanisms.

One of the solutions is to use BIM technology with LADM data, which allows you to create 3D cadastre objects and greatly facilitates the registration of spatial legal relations [8].

Adapting the above-described approaches to the existing conditions is one of the alternative options for improving the cadastral system in Kazakhstan, which makes this research relevant.

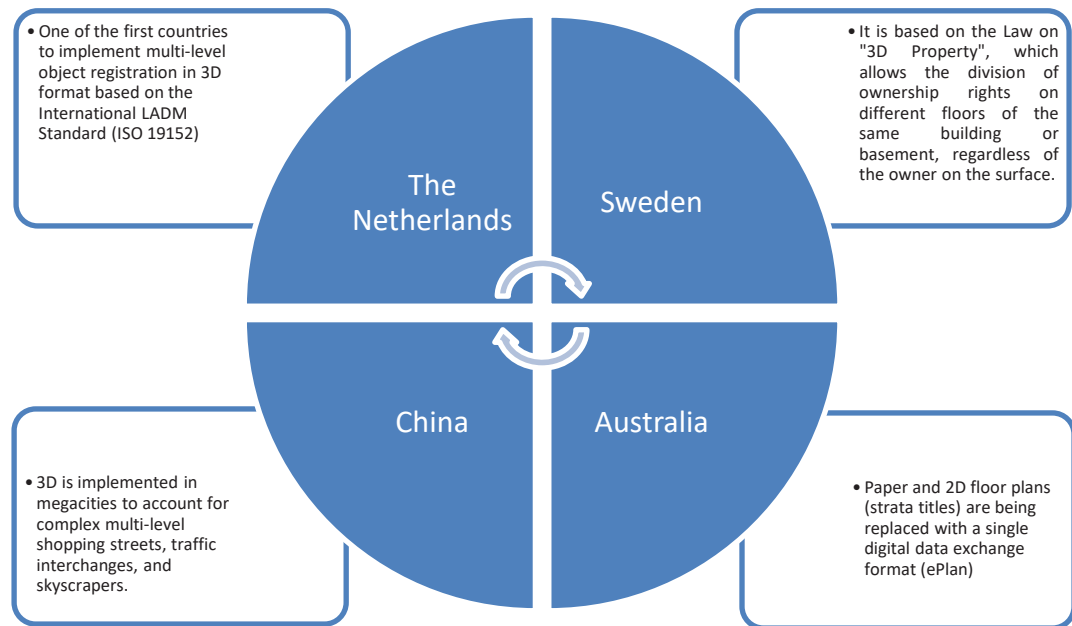
Materials and methods

The study was based on scientific publications by foreign and domestic researchers, an analysis of regulatory documentation and materials devoted to the formation, implementation and development of 3D cadastre, as well as related digital technologies. The methodological process of the study includes four stages: the first — the definition of the theoretical and technological base; the second — a comparative method of foreign experience in working with a three-dimensional cadastre; the third — the study of the current cadastre system and its assessment; the final — the identification of existing obstacles and problems in the cadastral system of Kazakhstan and the development of proposals on the subject under study. At the first stage, an analysis of scientific papers related to the three-dimensional cadastre, its implementation and development was carried out. The resources were selected in accordance with the subject of the study. To study the foreign experience of using this cadastre, a comparative method was applied.

Examples of successful implementation of a 3D cadastre include the Netherlands, Australia, China, etc. The results of the experience study served to recommend the introduction of a three-dimensional cadastre for the Republic of Kazakhstan. At the fourth stage, an assessment of the existing cadastre capacity and regulatory authorities was carried out. At this stage, the study relied on the method of structural analysis and the method of data systematization. The existing problems hindering the implementation and development of a three-dimensional cadastre were identified.

Results

The Netherlands, Sweden, China, and Australia were among the first countries to implement 3D cadastral systems (figure 1).

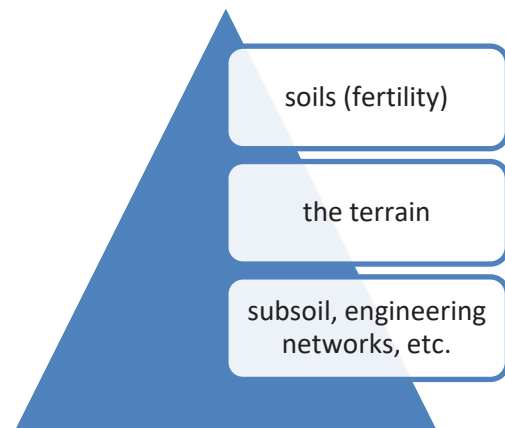


Note: compiled by the authors based on sources [1,2], [3,4]
Figure 1 — Foreign models of 3D cadastre implementation

As can be seen from figure 1, the principles of conducting a 3D cadastre in the countries under consideration are generally the same. However, the approaches used in these countries are applicable to the cadastre of urban land.

As for the three-dimensional cadastral map of agricultural land, it should be noted that it differs from the cadastral map of urban land. In urban areas, underground facilities include parking lots, bridges, and others, while in the agricultural sector, it takes into account three main factors [9]: soil quality, topography, subsoil, and engineering networks located beneath the fertile layer (figure 2).

It should be taken into account that agricultural lands require special ways and approaches in designing a three-dimensional cadastre, since their features depend on the properties of soils, relief and boundaries of land plots. The information component can be used in the rational use of land, the identification of lands with high agricultural potential, as well as state control and protection of soil cover. These technologies, combined with GIS, create conditions for more efficient use of land resources and provide complete information about agricultural land.



Note: compiled by the authors based on source [9]
Figure 2 – Factors taken into account in the 3D cadastre of agricultural land

A two-dimensional cadastral map does not fully illustrate the structure of complex multi-layered real estate objects, which include underground structures such as underground parking lots, engineering networks, and above-ground structures such as different levels of real estate [10].

The main differences between 2D and 3D cadastre systems in accounting for agricultural lands and settlements are presented in table 1.

Table 1 — Comparative Analysis of 2D and 3D Cadastral Systems

Criteria	2D cadastre	3D cadastre
The data model	Two-dimensional (X,Y)	Three-dimensional (X,Y,Z)
An object	Land plot	Land plot, buildings, structures (above-ground, underground)
The borders	Displayed on the plane (on the surface of the earth)	Displayed by volume (length, width, height\depth)
Image	Cadastral map	3D spatial model
Underground structures	Are not displayed	Presented as an independent object
Multilevel objects	Unable to display	Presented as a model (parking facilities, bridges, etc.)
Ownership rights	Linked to a land plot	Tied to each volume object
Engineering networks	Displayed only to a limited extent	Spatial mapping with coordinates
Accuracy	Limited by a plane	Provides high spatial accuracy
Scope of application	Cadastral registration, land rights registration, and land accounting	Real estate management, BIM
Note: compiled by the authors based on source [10]		

As can be seen from table 1, 3D cadastre has a number of advantages, the main ones being the high degree of detail of the object display in reality, which enables more informed and reliable decision-making based on the visual data obtained. The disadvantages include the imperfection of legal acts developed under the two-dimensional cadastre, the technical side, as well as the cost of surveying and processing the resulting images [11,12].

The process of creating a 3D cadastre requires geodetic surveying, photogrammetry, and the use of BIM technologies and GIS. Today, there are successful examples in international practice. These include the city of Shenzhen in China, where the use of 3D cadastre is actively implemented in a densely populated city. Another exemplary use of 3D cadastre in Europe is in the Netherlands, where the city of Delft has implemented detailed visualization of its railway station and the legal aspects of multi-level structures. Malaysia has launched a pilot project to combine the LADM standard with 3D cadastral data for residential planning and other purposes.

The cadastre in Kazakhstan is maintained by the NJSC “State Corporation “Government for Citizens” and its branches. The creation of this organization became an important stage in the implementation of reforms related to digitalization and the creation of the digital infrastructure of the cadastre system — the Unified State Real Estate Cadastre (USREC) [13]. The USREC was put into operation on July 1, 2023, combining data from the land and legal cadastre, making the process of obtaining public services in the field

of real estate and land relations simpler and more convenient. In the near future, all cadastral services will be carried out online through the Unified State Cadastre of Real Estate [14]. However, it should be noted that the country is currently using 2D cadastre data, but is gradually transitioning to 3D cadastre data, particularly in the field of urban planning.

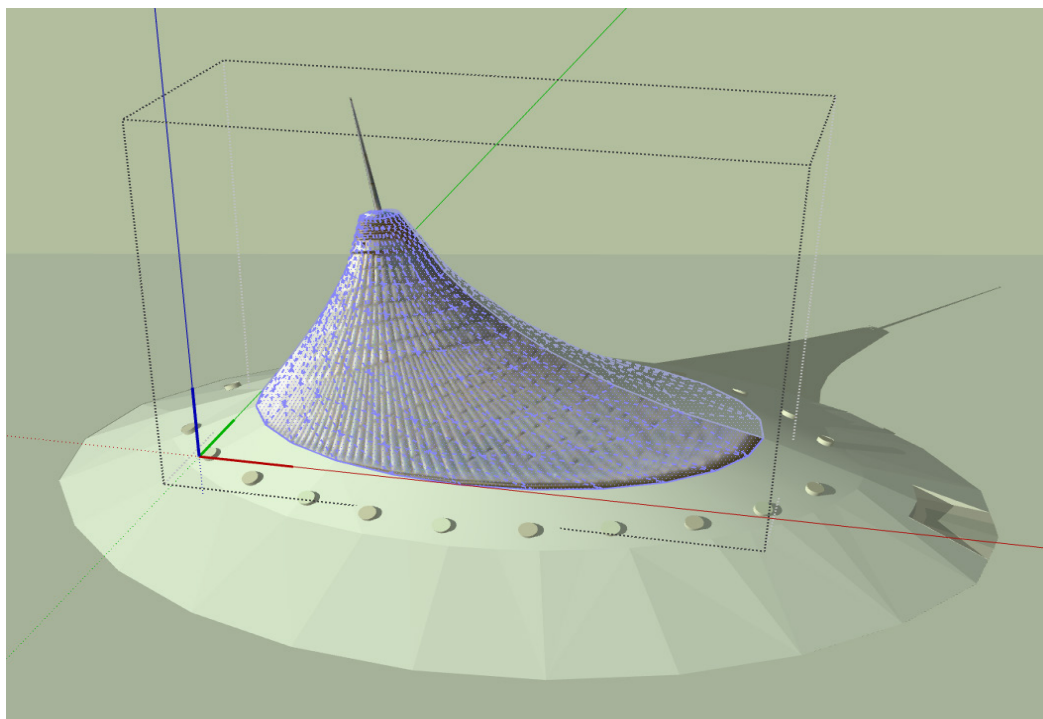
3D cadastre is a cadastre in which real estate objects are modeled as volumes in three-dimensional space. BIM models provide detailed information about the geometry of buildings and structures, GIS is used to store and analyze spatial data, and LADM serves as a basis for describing ownership rights, restrictions, and obligations. The combined use of these technologies allows for the creation of three-dimensional models of real estate objects, the precise definition of spatial boundaries, and the registration of volumetric rights within the framework of a modern cadastral system.

A two-dimensional cadastre system does not fully illustrate the structure of complex multi-layered real estate objects, which include underground structures such as underground parking lots, engineering networks, and above-ground structures such as different levels of real estate.

The three-dimensional model of the Khan Shatyr building demonstrates a 3D cadastre integrated with digital technologies, including BIM and GIS. Information about the geometric characteristics of a real estate object or other structure, its features and properties can be obtained through the information modeling of the building, i.e. BIM technologies. GIS provides data on spatial

characteristics, analysis, storage, processing, etc. Here, not only X and Y coordinates are taken into account, but also the Z coordinate, i.e. the

description of volumetric spatial characteristics (figure 3).



Note: compiled by the authors based on Internet source [15]

Figure 3 — Visualization of the three-dimensional model of the Khan-Shatyr shopping center

Figure 3 illustrates the advantage of three-dimensional image, which makes it possible to recreate the spatial geometry of any object. Digital modeling technologies can divide an object into levels and components, which allows you to clearly define the boundaries and features of a real estate object. For agricultural land, a three-dimensional representation will make it possible to determine the steepness of slopes, soil erosion, moisture availability, and other indicators.

The implementation and further development of 3D cadastral systems also require the adoption

of international LADM standards, which are widely used in countries with a well-developed 3D cadastre infrastructure. Each of these technologies has a specific function: BIM technologies provide geometric data, GIS technologies provide spatial information, and LADM serves as a basis for legal and property relations.

In this regard, a SWOT analysis of the implementation of 3D cadastre was conducted to identify the strengths, weaknesses, opportunities, and threats associated with this process (table 2).

Table 2 - SWOT analysis of the implementation of 3D cadastre in the Republic of Kazakhstan

Strengths	Weaknesses
High accuracy of object display in three-dimensional space. Possibility of displaying underground structures and multi-level objects as an independent object. The possibility to determine the steepness of slopes, soil erosion, and moisture availability. Integration with GIS and BIM technologies. Efficient management of land resources and engineering infrastructure.	Lack of comprehensive legal documents for the registration of three-dimensional objects. High cost of maintaining a 3D cadastre. Lack of personnel in the field of 3D cadastre, BIM, and GIS technologies. Limited availability of high-precision spatial data. High costs of upgrading information systems. Long transition from 2D to 3D cadastre.

Opportunities	Threats
Formation of a unified spatial digital platform of the republic. Increase in investment attractiveness of real estate objects. Possibility of using artificial intelligence and BIM technologies for automation of land cadastre works. Improvement of conducting urban planning cadastre and management of engineering networks. Aligning the EGN with international standards (ISO 19152 LADM, OGC, CityGML).	Risk of spatial and cadastre data leakage. Insufficient funding for cadastre digitalization. Data discrepancies between various government information systems. Rapid obsolescence of software and hardware. Potential errors when transferring existing 2D data to a 3D model.
Note: compiled by the authors based on source [16]	

As can be seen from table 2, there are certain difficulties in implementing a three-dimensional cadastre in Kazakhstan. The main factor is the institutional and legal nature. The cadastre system of the Republic of Kazakhstan was initially focused on a 2D cadastre, which today does not allow us to give the real estate object a complete spatial picture. It follows from this that it is necessary to specify and develop appropriate regulatory legal acts for the implementation and improvement of the three-dimensional cadastre.

The next obstacle is the technological side. The creation of a 3D cadastre for the entire territory of the republic requires the creation of a unified integrated system with modern GIS and BIM technologies.

The three-dimensional cadastre in the European Union has its own characteristics: BIM technology is used, which is the technology of building information modeling, together with a 3D cadastre, providing complete information about a real estate object.

The Netherlands was one of the first countries to actively use these technologies. Dutch scientists have made significant contributions to the development and implementation of the main concepts of 3D cadastre, as well as to the processes of registering spatial rights. The reason for the transition to a three-dimensional cadastre is the complexity of urban infrastructure and the growth of real estate objects located at different spatial levels.

The use of a three-dimensional city model provides support for urban planning processes, investment project evaluation, urban infrastructure management, and territorial development monitoring. The integration of geodata and digital models allows for spatial analysis, modeling of urban development scenarios, and improving the validity of management decisions.

The Polish cadastral system has developed in its own way due to the circumstances it faced after the transition to a market-based system. A dis-

tinctive feature of Poland's cadastral system compared to Kazakhstan's is the absence of collective farming. The database of landowners established after World War II facilitated a smooth transition during the period of economic transformation. The cadastre system in Poland is predominantly two-dimensional, and the transition to 3D cadastre requires some time and resources [17], [18].

There is no universal model for implementing and improving 3D cadastre, and its development in our country requires not only copying foreign experience, but also adapting it to the existing realities of Kazakhstan: amending, supplementing, and introducing new terminology in the Land Code of the Republic of Kazakhstan. In particular, we believe that it is necessary to supplement Article 152 with a definition of the state land cadastre, as well as to separate the three-dimensional cadastre into a separate definition [19].

Discussion

The implementation of a 3D cadastre is a complex process that requires not only technological or regulatory changes, but also a complete rethinking, change in the structure of the formation of cadastre data of the Republic of Kazakhstan. Analysis of foreign experience has shown that the existing two-dimensional cadastre system creates serious limitations for the transition to a three-dimensional cadastre. It should be noted that there is no need for a complete transition to 3D cadastre with the replacement of the existing cadastre. The process should be carried out in an evolutionary way, that is, a gradual transition to a three-dimensional system. A revolutionary transition can exacerbate the process and may create a number of difficulties in the future. A gradual transition requires the technical capacity that the USREC possesses, which has its own developed infrastructure and a network of branches. A 3D digital model of a building is not sufficient for the transition to a three-dimensional cadastre; complete information and data systemization are also required.

We believe that at the transition stage, it is necessary to launch a pilot project of 3D cadastre in areas with a predominance of multi-level objects (in cities) and in large agricultural enterprises (on agricultural lands). The pilot project will help identify shortcomings and deficiencies, simplify the adaptation process at the initial stage, and allow for the collection of sufficient information before the full implementation of the system throughout the country. Thus, the implementation and development of a three-dimensional cadastre requires the gradual improvement of the existing system, legislative regulation mechanisms, the unification of land cadastre information storage units, the development of digital data infrastructure, and the adaptation of foreign experience to the current cadastre system.

Conclusions

1. The modern cadastral system of the Republic of Kazakhstan is based on a two-dimensional cadastre. However, the digitalization of the cadastre, the introduction of artificial intelligence, and the use of GIS technologies require more modern approaches, i.e., the transition to a 3D cadastre, which has the advantage of providing a high level of detail in the representation of an object in reality and enabling the adoption of more accurate and reliable decisions based on the visual data obtained. This is of particular importance when accounting for agricultural land, as the agricultural sector has an agri-economic impact on the food security of the republic.

2. An analysis of foreign experience in conducting a real estate cadastre has shown that there is a tendency to transition from a two-dimensional to a three-dimensional cadastre, which will allow for the registration of real estate objects not only in a horizontal plane, but also in a three-dimensional space.

3. 3D cadastre data in populated areas differ significantly from that in agricultural areas, as underground facilities such as parking lots, bridges, etc. are common in cities, while in the agricultural sector, it includes factors such as soil fertility, terrain slope, and underground facilities (such as subsoil and engineering networks).

4. The 3D cadastral system is based on the integration of GIS, BIM, and LADM, which allow for the creation of 3D models of real estate objects and provide for the precise definition of spatial boundaries and the registration of 3D objects within the modern cadastre system. BIM models provide detailed information about the geometry of buildings and structures, GIS is used for the storage and analysis of spatial data, and LADM

serves as the basis for creating a database of property rights, boundaries, and owners.

5. The transition to a three-dimensional cadastre will require the improvement of legislative and regulatory documents in order to provide legal support for cadastre activities.

6. In order to identify the advantages, disadvantages, and possible risks of the transition to a three-dimensional cadastre, a SWOT analysis was conducted, which showed that there are more opportunities and strengths than weaknesses and risks. Thus, it can be concluded that the transition from a two-dimensional cadastre to a three-dimensional one is necessary, since Kazakhstan is striving for complete digitalization of the cadastre, which will have a positive impact on the land management system, including agricultural land.

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