ANNOTATION

of the dissertation work by Aigerim B. Yesmaganbetova on the topic “Improving normative documents in the field of technical regulation of the service sector”, submitted for the degree of Doctor of Philosophy (PhD) in the specialty «6D073200 – Standardization and certification (by industry)»

Relevance of the research topic. In the context of digital transformation of Kazakhstan's economy, the quality of public services for registration of rights to real estate is of particular importance. The efficiency of this area directly depends on the functioning of the state real estate cadastre, which serves as the basis for registration of rights, taxation and territorial administration.

In accordance with Decree of the Government of the Republic of Kazakhstan No. 269 dated March 28, 2023, the integration of disparate cadastres into a unified information space is defined as one of the strategic tasks of digital transformation. Its solution requires improvement of regulatory documents of technical regulation, as well as harmonization of the national base with the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)”, which establishes uniform requirements for cadastral registration, including three-dimensional representation of real estate objects.

An analysis of the current regulatory framework in the field of the state real estate cadastre of the Republic of Kazakhstan shows that existing documents do not fully comply with modern international requirements. The lack of a systematic approach to harmonizing national standards with ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)” leads to fragmentation of information resources, complicates interagency interaction and reduces the quality of public services. These problems are aggravated by the lack of uniform requirements for the formation of 3D models of real estate objects, which is especially important in the context of the transition to digital territorial management.

Consequently, the relevance of the dissertation work is determined by the need to bring the system of technical regulation in the field of the state real estate cadastre in line with international standards and strategic priorities of Kazakhstan's development. It is to solve this problem that the purpose of the study **is aimed** – improving regulatory documents in the field of technical regulation of services for maintaining the state real estate cadastre.

Objectives of the study:

- to study the current state of formation and registration of real estate objects in the cadastres of the Republic of Kazakhstan and foreign countries;
- to determine criteria for improving the quality of public service provision;
- to develop a mathematical model for data exchange between information resources of the cadastral system;
- to build a technological scheme of 3D modeling in accordance with the mathematical model;
- to develop a scientifically based adapted draft of the national standard ST RK ISO «Geographic information. Land administration domain model», harmonized with

the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)”, taking into account the features of the cadastral system of the Republic of Kazakhstan;

- to develop methodological recommendations for the application of the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)” on the territory of the Republic of Kazakhstan.

Object of research is the regulatory legal support and the system of maintaining the state real estate cadastre of the Republic of Kazakhstan.

Research methods. To achieve the goal and solve the tasks set, the following complex of methods was applied:

General scientific methods: induction, deduction, analysis, synthesis, deconstruction, abstraction, systemic-structural approach. These methods were used at all stages of the study – from the analysis of regulatory legal acts regulating cadastral activity to the synthesis of the mathematical model and technological scheme.

Special methods:

- bibliographic method (retrospective and comparative-chronological) – systemic analysis of regulatory legal acts of the Republic of Kazakhstan in the field of real estate registration;

- statistical methods (quality management tools: Ishikawa diagram, histograms, marker charts) – identification of factors affecting the quality of cadastral activity and establishment of criteria for their improvement;

- expert method and inverse ranks matrix – quantitative assessment of the degree of influence of various factors on the quality of public service provision;

- formalization and mathematical modeling (using predicates and quantifiers of mathematical logic) – construction and verification of the cadastral mathematical model;

- comparative legal analysis and formal legal method – comparison of the requirements of the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)” with the Land Code of the Republic of Kazakhstan, the Law “On State Registration of Rights to Real Estate” and other regulatory acts, identification of gaps and collisions in the current legislation.

Special scientific methods of standardization:

- unification method – harmonization of the terminology of the draft national standard with the international standard, establishment of uniform requirements for the technological scheme of forming 3D models, as well as proposal of a unified structure of cadastral numbers for 2D and 3D objects;

- typification method – development of standard solutions when adapting LADM classes to the conditions of Kazakhstan;

- simplification method – exclusion or limitation of the use of optional classes (e.g., “LA_Responsibility”) in the draft national standard for its optimization.

Additional scientific approaches:

- benchmarking method – analysis of national LADM profiles of other countries (Netherlands, Germany, Malaysia, Australia, etc.) and adaptation of their best practices;

- decomposition method – dividing LADM into four main packages (Party, Administrative, Spatial Units, Surveying and Spatial Representation) and independent study of the features of each package;

- analogy method – transferring cadastral solutions from international practice to the Kazakhstani cadastral system.

The information base of the study consisted of regulatory legal acts of the Republic of Kazakhstan, materials of foreign and domestic organizations, state statistics data, results of monitoring of public service provision processes, as well as scientific publications and Internet resources.

Main provisions submitted for defense (proven scientific hypotheses and other conclusions that constitute new knowledge):

1. Criteria for improving the quality of public service provision for maintaining the state real estate cadastre, allowing to evaluate the effectiveness of cadastral activity and identify directions for its improvement.

2. Cadastral mathematical model of information interaction of various information resources, in which cadastral information plays a leading role; the model is developed using predicates of mathematical logic, which ensures its verification and adequacy.

3. An expanded technological scheme for the formation of 3D models of real estate objects, adapted to the conditions of the Republic of Kazakhstan, including the stages of collecting, processing, storing and visualizing spatial data, as well as requirements for accuracy and quality.

4. A scientifically based adapted Draft of the national standard ST RK ISO "Geographic information. Land administration domain model", harmonized with the international standard ISO 19152:2012 "Geographic Information – Land Administration Domain Model (LADM)" and adapted to the features of the cadastral system and regulatory framework of the Republic of Kazakhstan.

5. Methodological recommendations for the application of the international standard ISO 19152:2012 "Geographic Information – Land Administration Domain Model (LADM)" on the territory of the Republic of Kazakhstan, allowing cadastral engineers and specialists to carry out cadastral activities for the formation of 3D models of real estate objects in accordance with the requirements of the international standard.

Description of the main results of the study. The dissertation provides an analytical review of the cadastral systems of Kazakhstan and foreign countries, revealing the fragmentation of information resources and the difference between the national regulatory framework and the requirements of ISO 19152:2012 "Geographic Information – Land Administration Domain Model (LADM)". Considering Kazakhstan's position in the Doing Business ranking, the need to improve regulatory and technical documentation is substantiated. Using the Ishikawa diagram and expert assessment, criteria for improving the quality of public services for cadastre maintenance have been established; it has been proven that the most significant factors are regulatory legal acts, the database and the cadastre maintenance technology.

A mathematical model of information interaction of cadastral system resources has been developed, and based on it – a technological scheme for the formation of 3D models of real estate objects, adapted to the conditions of Kazakhstan. A comparative

analysis of ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)” with the current regulatory legal acts of the Republic of Kazakhstan has been carried out, and discrepancies have been identified. In the course of the study, based on the analysis of the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)”, taking into account the requirements of the national legislation of the Republic of Kazakhstan, a scientifically based adapted draft of the national standard ST RK ISO “Geographic information. Land administration domain model” was developed, aimed at implementing LADM into the Kazakhstani real estate cadastre system. Methodological recommendations for its application have also been prepared.

Practical significance of the research lies in the developed scientifically based adapted draft of the national standard ST RK ISO “Geographic information. Land administration domain model” and methodological recommendations for the application of the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)” on the territory of the Republic of Kazakhstan, which allow cadastral engineers to carry out cadastral activities for the formation of 3D models of real estate objects in accordance with the requirements of the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)”, and can also be used in the creation of a 3D cadastre on the territory of the Republic of Kazakhstan.

The results of the study have been approbated in the form of methodological recommendations for the application of the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)” on the territory of the Republic of Kazakhstan, which have been adopted for use by the Land Cadastre Department of Almaty city of the Directorate of Land Cadastre and Technical Survey of Real Estate of the NAO «State Corporation «Government for Citizens» in the conduct of real estate cadastre.

Justification of novelty and importance of the obtained data. The scientific novelty of the dissertation research lies in the fact that for the first time in the work:

- criteria for improving the quality of public service provision for maintaining the state real estate cadastre have been identified, allowing to evaluate the effectiveness of cadastral activity and identify directions for its improvement;
- a cadastral mathematical model of information interaction of various information resources has been developed using predicates of mathematical logic, which ensures its verification and adequacy;
- an expanded technological scheme for the formation of 3D models of real estate objects has been proposed, adapted to the conditions of the Republic of Kazakhstan and including the stages of collecting, processing, storing and visualizing spatial data;
- a scientifically based adapted draft of the national standard ST RK ISO «Geographic information. Land administration domain model» has been created, harmonized with the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)” and adapted to the features of the cadastral system and regulatory framework of the Republic of Kazakhstan;
- methodological recommendations have been prepared for the application of the international standard ISO 19152:2012 “Geographic Information – Land

Administration Domain Model (LADM)”on the territory of the Republic of Kazakhstan, allowing cadastral engineers to carry out professional activities for the formation of 3D models of real estate objects in accordance with international requirements.

Compliance with directions of science development or state programs. The dissertation research was carried out in accordance with the following strategic documents:

- Message of the President of the Republic of Kazakhstan K. Tokayev to the people of Kazakhstan dated September 8, 2025, which sets the task of «creating a unified digital map of land resources with integration of cadastral data»;
- The Concept of Digital Transformation, Development of the Information and Communication Technology Industry and Cybersecurity, approved by Decree of the Government of the Republic of Kazakhstan No. 269 dated March 28, 2023 (section «Digital Transformation», task «Open Government»), aimed at integrating disparate cadastres into a unified information space;
- State program «Digital Kazakhstan», approved by Decree of the President of the Republic of Kazakhstan No. 827 dated December 12, 2017, which provides for the creation of an automated information system of the state real estate cadastre.

Description of the doctoral student's contribution to the preparation of each publication. On the topic of the dissertation, 11 scientific and methodological works have been published, including: 2 articles in journals indexed in the international databases Web of Science and Scopus; 3 articles in publications recommended by the KKSON of the Republic of Kazakhstan; 5 publications in the proceedings of international scientific and practical conferences and methodological recommendations for the application of the international standard ISO 19152:2012 “Geographic Information – Land Administration Domain Model (LADM)”.

Publications in journals indexed in the international databases Web of Science and Scopus:

1. “Quality of State Real Estate Cadastre-Maintenance Process Based on Ishikawa Cause-and-Effect Diagram” / Geomatics and Environmental Engineering. The journal is indexed in Web of Science and Scopus, percentile in the field “Earth and Planetary Sciences” – percentile 61.
2. “Analysis of the kazakh legislation concerning the state registration of rights to immovable property and the state real estate cadastre in relation to the international standard ISO 19152:2012 Geographic information – land administration domain model” / International Journal of Civil Engineering and Technology (IJCIET). The journal is indexed in Scopus, percentile in the field “Engineering, Civil and Structural Engineering” – percentile 50.

The main results of the dissertation work were reported at international conferences: II International Scientific-Practical Conference “Integration of the scientific community to the global challenges of our time” (Osaka, Japan, 2017); VI International Scientific-Practical Conference “Innovation Management and Technology in the Era of Globalization» (Pattaya, Thailand, 2019); International scientific conference “Actual problems of modern science in the XXI century” (Dushanbe, Tajikistan, 2019), as well as at conferences in Kazakhstan and Russia.

Scope and structure of the dissertation. The dissertation is presented on 128 pages of computer text (Word editor, font 14 Times New Roman, one and a half line spacing) and consists of an introduction, a review of literature and regulatory legal acts, materials and methods of research, research results, conclusion, list of references and appendices. The work contains 8 tables, 10 formulas and 16 figures. The list of references includes 118 works of domestic and foreign scientists.