Key provisions of digital land management theory and methods

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Abstract. The article discusses some of the new positions of theory and methods of digital land management (DLM). The goals and objectives of digitization of the land building industry in the country’s land management system (LMS) are highlighted. Significant reduction in financial costs and relatively rapid restoration of all the functions of land management are possible only through its automation, information and complete digitization. The work carried out in the field of DLM is aimed at improving and implementing an intelligent system of planning, land-building and optimization of both land of all categories and agricultural resources, use and protection of land in agricultural production at different levels of generalization. These are field, economy, municipality, subject of the Russian Federation, country, foreign territories, operating on the basis of digital, remote, geo-information technologies and computer-generated methods. Smart land management assumes the basic spatial basis of the implementation of digital transformation of the following priorities: smart land use, smart field, smart farm, smart storage, smart greenhouse, smart garden, etc. Implementation of this concept is carried out in the form of the realization and introduction of the technological geo-information platform of DLM as the main mechanism for the implementation of agricultural policy of the state, rational use and protection of land resources and is key in relation to the sectors of the economy, which have a spatial link. The issues discussed in the article are directly related to the creation of essentially a new content of land management which corresponds to the zeitgeist. And the non-formation basis is the data derived from traditional ways of obtaining information, new technologies among them: unmanned aerial vehicles, laser scanning high-resolution satellite imagery, development of computer systems, network solutions based on cloud storage information, big data “Big Data” and block-chain “Blockchain”, etc. This modernization and rearmament of the industry should be accompanied by adjustments about the new provisions of the theory and methods of land management, its goals and objectives, the emergence of new concepts and terms and their interpretations.

1. Introduction
The need and expediency of the total involvement of information technologies in land management are conditioned by scientific and technological advances in geodesy, mapping and inventories based on
geo-information technologies, as well as the need for regular mass land building activities caused by the complete reorganization of land ownership and land use of agricultural organizations. This includes the diversity of forms of ownership, land redistribution, land allocations and the revitalization of the land market, a significant increase in land ownership and land use, as well as the rapid development of computer and related technical support. The regulatory framework of recent years also contributes to this [1].

Many users use AutoCAD and MapInfo or other software products and complexes for land management, adapting them to address elements of the technological chain of a particular land-building problem [2–8, 12]. Therefore, the improvement of the scientific and theoretical provisions of domestic land management, taking into account the application of information and communication technologies (ICT) and its information provision is one of the current and important scientific tasks in improving the theory of land management. It, through its intellectualization and new technological equipment and modernization, should be transformed into a DLM [6–8, 12].

The goals of Digital Land Management (DLM) are:

- Shortening the development of land management schemes and projects by significantly reducing the time spent in obtaining and sharing information, speeding up the processing of graphic and textual information, automating the creation of graphic materials (planning and cartographic materials, drawings, diagrams, graphs), typing and unifying design solutions and tools, and promptly monitoring all processes.
- Reducing the cost of development by reducing costs: reworking (fixes) of the project due to the reduction of conceptual errors typical of the initial stages of design; workforce, in connection with the elimination of manual processing of graphic information and intermediate calculations the use of mathematical models in exchange for in-kind research;
- Improving the quality of work through a systematic approach and multivariate development of design solutions, more detailed and in depth analysis of the information used, the ability to solve optimization design problems, accompanied by integrated computer modeling, and 3-D visualization of the elements of the object (or object itself) in kind, the use of new methods and technical tools that expand the creative potential of the designer in making new design decisions.

The main goal of automation and digitization of the land-building industry and the creation of automated land-building systems (further CALBS) and related technologies is to modernize the entire system of land management and land building design, based on economically viable and institutionally adjusted technology of consistent automation and digitization of all processes [8].

The object of automation should be the processes of land management and land-building design related to the collection, accumulation, processing and synthesis of data, analysis, generation, selection and justification of design decisions, formation and issuance the project and analytical documentation [8].

Land-building design is conjugated with a large number of quantitative and qualitative relationships and interdependences and is often based on alternative design solutions that cannot be directly evaluated. So CALBS should initially be built on the type of human-machine systems. At the same time, the non-formalized part of the information preparation and decision-making process should be carried out directly by high-end land management specialists. And the formalized part of the information preparation process (collection, accumulation, storage, upgrade and transmission) and its processing should be carried out by ICM computers [8].

The general theory of the development of CALBS provides for the obligatory establishment of its role, place and objectives in land-building science in the theory and practice of digital land management.

The formation of the land-building tasks of digital land management should be carried out through the new functions of the country’s land building service in land management, including:

- maintaining a state inventory of real estate, monitoring and appraisal of land as an information basis for a decision on land management;
- receiving and updating planning and mapping material, conducting special surveys and surveys for land management and inventory at all levels (from local to global);
- survey and geodesic works for land management and inventories;
- planning and forecasting land use;
- development and implementation of public (regional) programs and sub-programs for land management and protection;
- management and land protection through land management on a regular and timely basis;
- implementation of a legal, institutional and economic mechanism for regulating land relations;
- implementation of state control over the use and protection of land.
- it is obvious that the efficiency of the land-building service and the various automated systems it is created will depend on the degree of integration with the above-mentioned tasks [8].

2. Results and Discussion

Information provision of modern land management is directly related to the development of land relations, the implementation of the state’s land policy and scientific and technological progress (informatization, computerization and improvement of remote sensing data (DDD) technologies. At the same time, the negative consequences of the loss of state and systemic nature of land development are characterized by increasing negative consequences and as a result the creation of preconditions for the formation of a new land management system, changes in the legislative framework in the field of land relations and land policy, qualitative transition from classical land management to innovative land management, based on the achievements of science, technology and technology, designed to solve the problems accumulated during the years of the last land reform.

As the need for land-building work has increased, so has the technology of their implementation, this is due to the penetration of ICT into all areas of human activity and the emergence of a new information society today.

Information support for land management is considered by us mainly from the point of view of the logical-epistemological aspect, which will provide answers to three crucial questions:

1. What is the information provision of modern land management as an independent scientific direction?
2. What role does information ensure the automation and digitization of land management play in the country’s land management system?
3. What are the areas of further development of information support for the automation and digitization of land management?

Answering the 1st question, it should be noted that the information technologies have led to a change in the role importance and nature of the land builder’s work itself as well as brought land management to a new higher quality level. Accumulated knowledge and experience in land management and related industries (ecology, soil science, agriculture, reclamation, geodesy, etc.) have created a powerful foundation for the formation of the “Knowledge Base”, which in turn, using modern ICTs already allow the creation of CALBS with elements of artificial intelligence. All this allows us to attribute the information provision of modern land management to an independent scientific direction.

Responding to the 2nd question, we note that at the end of the 20th century, ICT became the main mechanism for collecting, concentrating, processing and generating new information and they are perceived as an integral part of the organizational structure and object of improvement of management activities, including the management of the Russian land resources.

The concept of “information society” characterizes such a structure of the economy and the degree of organization of a society in which the information is dominant resource and plays a crucial role in the development of productive forces and industrial relations, especially if it is land-resource information.
Full information support for decision-making and the formation of public policy in the field of land use and land management is an urgent task, the solution of which will ensure the rational and effective management of the country’s land resources.

In answering the 3rd question, it is absolutely clear that further development of land management is only possible through the application of ICT and improved information support.

As the transition to the information society strengthens the role of information in solving the problems of public administration, including land resources, the receipt, storage, search for information, objective understanding and its actual use become a public task, requiring time, money and personnel to create special systems using innovative approaches, the latest technology and technologies. [8–11]

Summing up the above, the development support of land management contains the following components: information itself, information and personnel engaged in information processing, infrastructure, including software, computer equipment, networks, etc.

In our opinion, there has been and objectively there is a new scientific direction of information provision of land management. It is a system that includes the co-occupation of information resources and ways of organizing them, aimed at solving the problems of land management; covering the entire land-building process. In doing so, it provides the foundation for DLM. In the process of improving the theory of land management and forming a new paradigm of it in the form of DLM there are a number of additional terms and their interpretations, we will refer to some of them.

Digital land management (DLM) is a mechanism for implementing the state’s land policy, based on the technological digital geo-information platform of smart land use and land management, which provide spatial linkage of industries. The operation of DLM at this stage should be carried out in five directions:

1. Developing the structure of a smart land management digital platform.
2. Establishing a system for planning and forecasting land use at the federal, regional and municipal levels through Big Data information flows.
3. Formation of an automated land design system, digital agricultural regulations and the development of an electronic land-making document system.
4. Formation of an effective land management system, including the formation of land ownership in the country’s agricultural sector, a system of involvement in the circulation of un-used agricultural land on the basis of the infrastructure of spatial land management data.
5. Staffing on the basis of a single on-line platform “Open Agricultural Education” with the inclusion of educational programs for training in the field of digital land use and land management.

Smart land management is designed to provide a basic spatial basis for the implementation of the digital transformation of the following elements of the strategic direction that decides the food security of the country – digital agriculture: smart field, smart farm, smart storage, smart greenhouse, smart garden.

3. Conclusion

Thus, the information systems used in land management (IS, GIS, GISIS, etc.) should solve both design and management tasks. Therefore, the most important source of replenishment of land management databases and keeping it up to date is the land monitoring system. Therefore, CALBS should provide:

- monitoring of land-resource information (on their quality, quantity and distribution by land user and land owners), information on land use (target, net targeted) and in kind of all types of land-building activities (including author’s supervision);
- accumulation, structuring and generalization of it in the respective databases at all levels of the hierarchy of the system;
- concentration, renewal and maintenance at all levels of the system of economic and technological regulations and regulations for the management and management of land use;
- generation of reports and responses to all requests from CALBS users.
A set of applied software products – modules of the system, should solve the problems of digital land management, using all types of effects from the application of information by type:

- Automation of unified model solutions, where the technological operations of input and procedural operations in the form of composite code (team list), corresponding to a set of standard operations.
- Significant cost reductions in manual (routine) data processing without a highly qualified operator.
- Excluding design errors, ensuring the quality of design land-building solutions by automating computing operators, applying an integrated approach, EMM, repeatedly increasing the ability to process a large number of solutions options, innovative methods and technical innovations. They allow one to expand the professionalism of the designer in the decision-making, gradually reducing the qualification requirements in the field of land management to users of systems, as they implement well-established intelligent algorithms, a system of innovation technologies and methods of solving land-building problems.

Thus, in the process of creation CALBS should rely on the above-mentioned basic provisions of the concept of DLM automation and land design.

It is advisable to use the uniform requirements for the elements, which as a system of formal indicators will ensure their comparability and confidence in approaches and evaluation. Taking into account the variety of possible combinations of program implementations in land management, first of all, digitalization and automation are subject to only those that fit into the system of logical sequence “land management scheme - land management project – working project”.

Thus, the set of software modules of CALBS should form a comprehensive informed solution to the interconnected problems of DLM with maximum economic effect as a result of automation, and the receipt of additional products not only through a better land-building solution, but also in the form of a new information resource, allowing to create additional added value.

Acknowledgments
The article is prepared with assistance of the grant of the Ministry of Education and Science (the agreement of December "10", 2019 No. 075-15-2019-1939. Unique identifier of the project - RFMEFI60719X0302).

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