Innovative approaches to the formation of an intellectual system of support of decision making during the solution of tasks of management of land resources

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Abstract. The article discusses innovative approaches to the formation of an intelligent decision support system for solving problems of land management, land use, cadastral and market valuation of lands, management of specially protected natural territories and objects. The research results can be used in the formation of intelligent management systems for the subsequent creation of an information resource digital platform for land use, the development of an information resource digital platform for intelligent management of agriculture and land use systems at the level of an economic entity and a region for the transition to a highly productive agricultural sector of a new technological structure, as well as for the adoption of effective managerial decisions, which will also increase the rationality and the possibility of involving land uses, subject to special protection, including those included in the territory of historical settlements and related to the territories of small towns. From the point of view of assessing agricultural land plots, or territories of cultural and historical interest, a complex of language and software tools designed to create, maintain and share a database by one or many users is one of the most promising methods of storage, processing and using data.

1. Introduction
Land management processes require automation and acceleration of all processes in order to obtain competitive advantages and ensure greater efficiency in the use of land resources. First of all, it is used to ensure greater efficiency of land agricultural relations and of territories with special regimes of use (for example, historical settlements). Certain functions of the land management system such as real estate cadastre, land monitoring, land management, territory planning, cadastral valuation, etc. are hard to imagine today without using modern means and methods of information processing.

Many authors have previously addressed the issue of “digitalization” and “automation” of the land management system, including at various administrative and territorial levels or in its individual tasks. The works of A.A. Varlamova, S.N. Volkova, S.A. Galchenko, T.V. Papaskiri, D.A. Shapovalova, I.A. Gracheva, N.I. Kresnikova, M.A.Sulina, V.V. Bugaevskaya, N.I. Bukhtoyarova, M.I. Korablechkina, V.A. Kuleshov, D.V. Antropova, A.V. Fedorinov and many others [1–4, 6, 7, 9, 10 et al.]. Some works of the current Prime Minister of the Russian Federation M.V. Mishustina are devoted to the information and technological foundations of property tax administration, the basis (tax base) of which is the cadastral value [6].

In addition, since the land reform period, the country has been creating and is creating regional and municipal information systems (RIS, RGIS, MZIS, etc.), which have become the basis for many management decisions in our country. And in October 2012, the Ministry of Economic Development...
prepared a Roadmap for optimizing property registration procedures, which stated that "...by 2018, for the first time in the new history of Russia, a unified state information resource will be created in real estate." The implementation of this information resource is impossible without improving the automation of the state cadastral registration system and state registration of rights, without switching to the use of electronic government infrastructure, creating electronic archives systems, converting a large amount of available paper information into digital form, creating interregional centers, creating a database control system, etc. [2]

However, it should be noted that the rapidly evolving digital space requires revision and updating of previously used and already traditional methods and technologies for automating the processes of the land management system. As T.V. Papaskiris notes, methodological and technological solutions are crucial in the modernization of the industry, which bind the entire chain of information and analytical support for management, including the collection, storage, retrieval, processing, transformation, distribution and use of information. Moreover, its systematization, adequacy and efficiency of decisions made on its basis that are the key to the successful activities of business entities and means of forming economic guidelines [6, 10].

In Russia, the national program “Digital Economy” is currently being implemented, which is aimed at creating a new permanent environment for relations between the population of the state and business arising from the development of the digital economy, and creating a modern high-speed infrastructure for storing, processing and transmitting data.

When developing a new method and a new technology for assessing the resource and natural potential of lands (as one of the functions or tasks of the land management system) for the intelligent management of land use systems, one of the tasks is to apply new (advanced, innovative) method for collecting and processing data on the territories under consideration in the purposes of the subsequent creation of an information resource digital land use platform that meets the trends in the development of digital agriculture, namely developing information and resource platform digital of intelligent management of farming systems and land management. This can be done at the level of the state entity and the region to move to the highly productive agricultural enterprises of the new technological order, which can then be used as an intelligent decision support system (IDSS or DSS).

At the same time, database management systems are widely used due to their simplicity in terms of integration and adaptation to various requirements. For example, from the point of view of assessing agricultural land plots or territories of cultural and historical interest, a complex of language and software tools designed to create, maintain, and share a database by one or many users is one of the most promising methods of storage, processing and data usage.

A separate task is the question of choice and application the modeling technologies – the intellectual management of systems of agriculture and land use at the level of an economic entity and a region, i.e. adoption of the most effective managerial decision ensuring a highly productive agricultural holding in the conditions of a new technological structure. Such technologies may be, for example, neural network analysis technologies.

In particular, the task of creating a system for assessing resource potential in order to make effective managerial decisions will increase the rationality and the possibility of involving land uses subject to special protection, including those included in the territory of historical settlements and related to the territories of small towns. Municipal government bodies will be able to receive and use information not only on the value of agriculture and land use, but also to assess their cultural potential, which are of unique value to the entire multinational people of the Russian Federation.

2. Research methods
In this case, it is necessary to separate the information on the results of various types of assessments to those obtained and updated directly by the system itself using unmanned aerial vehicles, or UAVs (resource assessment, economic assessment, investment assessment, etc.) and information obtained from official sources, after it approval and implementation of relevant processes (cadastral valuation). For example, the results of cadastral valuation (cadastral value and other characteristics) can be
obtained from the databases of the Federal Service for the Registration of Cadastre and Cartography (Rosreestr) and / or budgetary institutions (state-financed institutions) created in the constituent entities of the Russian Federation.

It is possible to transfer and update data based on the technologies of a distributed registry (distributed database), which will allow you to go beyond the simple storage of data and thereby provide a high degree of trust in the data (both statistical (registry) and dynamic (transactions), which especially has value at the frequency of research or evaluation.

The technology for using big data may include a number of other information processing units, such as a unit for collecting, updating and storing land state data; unit for monitoring the state and use of land; a multi-purpose unit for assessing land suitability and modeling potential yields; block forecasting crop yields of agricultural crops; a block for planning the placement of agricultural lands and crops of individual crops, and not just a block for assessing (cadastral, investment, etc.) land plots and their resource and investment potential. Speaking about creating such a block to create the specified system (evaluation block) based on Big Data, the following tasks need to be solved: determining the composition of the required data (characteristics and indicators of objects to be evaluated); determination of information sources (obtaining new and updating existing information, including using UAVs, the use of materials from various departmental and state information systems, data from state and municipal authorities, etc. containing estimated information or information necessary to carry out an assessment); formation of a database (selection of methods and technologies for creating a digital platform and related tools); presentation of the database (provision of information).

Statistical (mathematical) modeling is actively used in accordance with applicable law when conducting an assessment. In this case, the appraisers, if the appraised real estate market allows, build assessment models for each appraisal group based on the pricing information of this market. The cadastral value of real estate is determined using the valuation model – an equation drawn up by the appraiser based on all the information available for use. Moreover, the model should include several variables that play the role of pricing factors, which, according to the evaluator, affect the value of the cadastral value. For example, as a pricing factor, the location of the property can be used – the area of the land, its type, the presence of anthropogenic impacts or erosion processes.

When applying the methods of mass valuation, the cadastral value of the valuation object is determined by substituting the values of pricing factors corresponding to the valuation object into the valuation model selected by the valuer. As a rule, when substituting the values corresponding to the real estate object in the valuation model, the unit value of the real estate property is obtained (the cost per 1 sq. Meter is the specific indicator of the cadastral value), the multiplication of which by the area of the real estate object gives the resulting cadastral value.

It is not necessary to exclude the correction factors determined by the appraiser and applied in order to level out specific fluctuations of the model with respect to individual pricing factors, are an integral part of the state cadastral valuation.

Thus, all of the above components must be connected not only at the level of compiling and filling a certain base, which would contain the information required for evaluation, but also would have a subordinate hierarchy for further use and adjustment of the information entered.

In the tasks of constructing complex information systems, one of the main problems is the exchange of data between various subsystems. Often the simplest task of importing / exporting data from one system to other leads to the need for serious development of modules at the junction of subsystems. The task is greatly facilitated if the data of a certain class will be moved between subsystems, provided that these subsystems will have a technologically feasible ability to perceive from the outside and give out the data in the standard import / export format. This approach is the basis for the development of metadata and interfaces for exchanging regular data for various legacy multi-format systems. At the stage of constructing infological models of document management support and creating specifications for the protocol of interaction of different-format systems, XML technologies are used.
3. Results
Thus, DSS can be divided into the following groups of components, for each of which, various technical and software solutions can be applied:

1. Interface for interactivity and visualization;
2. Modeling, where numerical models, big data, distributed register, neural networks, models based on game theory, etc can be involved;
3. Intelligent (in-depth) data analysis that meets the tasks of organizing the data stream, their physical and logical presentation in the system, working with the database (it is possible to use a DBMS);
4. Environment for creating applications based on ready-made code (api).

In addition, when developing the platform, one should pay attention to the combination of geoinformation technologies (administration of graphic information) and modern technologies for processing, storing and providing semantic (attribute) information, not only such as DBMS (database management systems), but also such as large data (bigdata), distributed registry (block chain) (Fig. 1).

Figure 1. The use of modern means of obtaining and processing information (assessment data) in the context of the use of innovative technologies

Using simple methods for a lower system load is not always effective, since the names of details can be different, and recording with errors (for example, with empty details) is quite suitable for unloading and loading certain elements between non-standard configurations. For more complex tasks involving uploading and downloading documents and directories with a subordinate structure, it is recommended to use data conversion and universal data exchange in XML format between non-standard configurations.

To solve this problem it is necessary:
1) to develop an exchange document format based on the XML language and specifications for creating software tools for the exchange between various information systems and / or subsystems, both already created and, if possible, those that will be created in the future;

2) develop specifications for various layers of metadata that will describe the data in each of the subsystems involved in the processes of information exchange. The XML standard itself is a generalized data format, it was created by a consortium of many companies, and it is necessary to supplement the XML language with semantics that exist in the development of information systems based on the concept of “document”, such as: electronic archives, workflow systems and paperwork, report generators from various ERP systems;

3) to develop scenarios of information exchange, which will include and use a subset of XML schemas, which provides, on the one hand, the ability to work with files in a single universal format with standard XML tools, and on the other hand, simplifies the developed programs for importing / exporting structured data in XML format.

4) to prepare a number of correction factors for land use included in areas with special conditions for the use of the territory, to exclude violations of the constitutional rights of landowners and land users, as well as to identify the most valuable land and land use from the point of view of historical and cultural heritage.

4. Conclusion
Thus, in order to implement a database management system, in the context of the issue under consideration, it is necessary to solve a number of very acute problems, namely, choosing a platform for creating a database, determining algorithms for filling, importing and exporting data, editing, and revealing possible technical and methodological errors when entering or post-processing data. The most successful platform for implementing all of the above is Oracle. Also, it is worth noting that as a further development, we offer the linking of all semantic data to a cartographic basis, which will consist of images from UAVs and remote sensing probes. It is advisable to use remote sensing data already at the stage of filling the database. Particular attention should be paid to XML processing technologies that could allow you to import any XML data and transform their structure efficiently and simply, while the same processing process could transform the source data of any structure without any change to the program code.

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