On Ultimate Integrated Information Space Based on Digital Platform for Subsoil Use Management System

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ABSTRACT
The purpose of this article is to justify the need to integrate databases and information flows in the field of subsurface use. In the course of the study, the need to integrate cadastres, information databases, and technologies used and created in the field of subsurface use is considered and justified. Effective and high-quality application of information flows in the field of mineral resources is possible only on the basis of end-to-end integration. Integration of large information flows, cadastres, databases, technologies used and created in the field of subsoil use can be implemented on the basis of a digital platform. One of the main tasks in subsurface use is to create a geo-information resource base. The implementation of this task is related to the development and creation of a digital platform, which, taking into account regional characteristics, can be in the form of a territorial and regional information system.

Keywords: mining, system management branch, information system, information flows, technology platform, digital platform

1. INTRODUCTION
Apart from the fact that the demand for mining industry products stays stable, at present, the mineral resources sector is affected by numerous constraining factors. This is due to the depletion of productive fields, introduction of innovative and more sophisticated technologies and equipment into the production and processing, development of fields in remote areas with poorly developed or absent infrastructure. The mining industry is also affected by the factors, not directly related to the subsurface resources management, for example, as introduction of anti-Russian sanctions.

In this case, the use of modern information software systems becomes necessary for all production and management mining activities. Therefore, the industry development under these circumstances is largely determined by the need to use innovative digital tools in the industry management system. For the subsurface resources management, formation of large information flows is typical, they are associated with information arrays on natural resources, activities of natural resource users and environmental conditions. Taking of a managerial decision fully depends on the state of these information arrays.

The information flow shall be formed according to the requirements and requests of the organizational and economic management mechanism (OEMM) of the industry, information arrays shall be complex [1]. Meanwhile, information arrays are processed, managerial decisions are taken based on the results, various reference systems and registers in the field of environmental management, are considered as the area of interests of executive bodies for different purposes. The powers, associated with the control action of the system on management objects are distributed by different management entities [2].

There is no unified information system on the mineral resources sector in the country. There is also no unified natural resources cadastre. Meanwhile, this MRB information monitoring system is an integral part of the industry management system. Development of environmental measures for anthropogenic impacts, assessment of the current state, forecast and tendencies for future changes are impossible without information. But assessment results of the current and projected state of natural resources are also sketchy or absent.

During the study, general scientific (system analysis, comparison, description) research methods were used. Using functional and operational method based on the system, platform and semantic approaches, it is demonstrated that the IT-based management of economic space puts forward new scientific, theoretical and practical tasks to improve organizational and economic mechanism for managing industries in the digital economy, the mineral resources sector (MRS competitiveness depend on their solution.

2. METHODOLOGY OF THE STUDY
In our study, we proceed from the hypothesis that a platform is a digital form of organizing interactions between two or
more groups of participants in business processes and third-party users. It should be noted that in current publications on digitalization and the digital economy, especially when it comes to public administration, the term "platform" is associated as a synonym for the information system. However, we assume (as we noted it earlier) that it is digital platforms that are the only possible sources to create a unified environment for the integration of all information flows in subsurface resources management [12]. Figure 1: shows how information flows are involved in the development of information systems being an integral part of the OEMM economy. Figure 1 shows this relationship as a diagram.

Figure 1: Control system diagram

Information resources of the Ministry of Natural Resources of Russia (MNR), in charge of subsurface resources management, are quite extensional, a large number of information systems are used in the state subsurface management system. It owes to the fact that MNR is entrusted with the functions of development, maintenance, and support of national and regional databases, including natural resource cadastres. Table 1 presents national cadastres, databases and applied technologies [12].

Table 1: State of technology, information resources in the MNR of Russia

| Seq No. | Cadastre, data bank name            | MPR functions, applied technologies                                                                 | Notes                                                                 |
|--------|------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| 1      | Keeping the State Cadastre of Deposits | Electronic catalog of the State Cadastre of Deposits and occurrences of minerals.                      | Compiled and maintained by the Russian Federal Geological Fund (Rosgeolfond) structural divisions |
| 2      | Maintaining the State Register of Reserves | Automated system for keeping the State Register of Reserves                                             | Compiled and maintained by the Russian Federal Geological Fund (Rosgeolfond) structural divisions |
| 3      | Keeping the state of exploration    | “Diafond” automated system for the state of exploration, Electronic catalog of state of geological exploration cards | The cards are kept and filled in Rosgeolfond                        |
| 4      | Keeping funds of geological information | Electronic catalog of geological documents; Automated accounting system for unpublished geological information “Catalog of documents” | Performed by Rosgeolfond                                          |
| 5      | Licensing                           | Automated accounting system of licenses for the right to use subsurface mineral resources               | Performed by Federal Agency for Mineral Resources (Rosnedra) and territorial divisions |
| 6      | Archiving of fund geological information | Electronic archive of geological reports                                                                | Performed by Rosgeolfond                                          |
| 7      | Monitoring of subsurface use        | Information system for regulation of the use of mineral resources of the Russian Federation (ISR IMSR- IS "Nedra") | Used for complex automation of accounting and control functions in the Rosnedra activities |
| 8      | Production. Development of digital maps | Compilation of analytical geological maps. Remote sensing of the earth. Development of digital models (DM) of thematic maps and geo-informational packages | Performed by Rosgeolfond                                          |
Continuation of table 1

| No. | Description                                                   | Details                                                                 |
|-----|---------------------------------------------------------------|-------------------------------------------------------------------------|
| 9   | Integrated information and analytical system of fund geological information (IAS) | Cartographic resource “Interactive electronic map of subsurface use of the Russian Federation” (EC). The EC of subsurface use of Russia is focused on the simplest and fastest obtaining of brief background information in information blocks related to the national subsurface use, mainly on the geological structure of territories, MRB, exploration of territories, maps of subsurface fund distribution. Established jointly by the Mineral Centre, Federal State Unitary Research and Production Enterprise (FGUNPP) Aerogolgiya, Federal State Budgetary Institution Russian Geological Research Institute (FGBU VSEGEI), Federal State Budgetary Institution (FGBU) "Rosgeolfond", Russian National Research Institute Okeanologiya”, etc. |
| 10  | Keeping the State Bank of Digital Geological Information      | IS “Cartographic Information Retrieval System (CIRS) of the State Bank of Digital Geological Information” (SBDGI). Provides cataloging of primary and derived digital materials of geological reports and display on an electronic map of work contours, profiles, wells, observation points. CIRS SBDGI is in trial operation. Performed by Rosgeolfond |

Compiled by the authors based on the materials of the RF MNR [13]

We see that one ministry performs both management powers for MRB activities and for the supervision of mining activities. Abroad (both in the USA and in the European Union), within the antimonopoly legislation framework, it is virtually impossible to concentrate all powers in management structures for natural resources. In comparison, the same distribution was in the Soviet Union. The Ministry of Geology of the USSR was engaged only in geological and geological exploration activities.

3. RESULTS OF THE STUDY

The information arrays and databases, presented in Table 1, were developed, first of all, based on the needs of the MNR of Russia. Among the MNR powers is the duty to monitor the subsurface condition. Therefore, at first glance, it cannot be said that the monitoring of subsurface condition in Russia is absent. Information systems (since there are several of them) are present in the form of state observation networks and are intended specifically for taking management decisions. Until recently, there have been problems with such databases. They related to the independence of keeping information arrays in different constituent entities of the Russian Federation, they had different structures and architecture. With the introduction of subsurface use licensing, it became necessary to develop an information system for processing license materials. According to the, data presented in Table 1, information support of management systems in subsurface use is performed by the following criteria - for all subsurface users, licenses, subsurface plots, geological study of subsurface resource objects. This task is solved using IS “Nedra”. However, geological information tracking and its state is not performed by IS “Nedra”. Information flows are sketchy, it is impossible to use them for taking management decisions.

Access to geological information, obtained by subsurface users, is still not available in full, available information, generated by different subsurface users at different times, including one object (one field), is sketchy, not structured, not informative, stored in improper conditions and gets lost. Integration of information resources is not considered at all. The inventory of information resources is not performed. The available information resources do not comply with subsurface user's needs and the state, both in terms of volume and quality. However, we must thank subsurface users who are trying to develop software that allows using the entire completeness of geological information within the framework of one specific field.

Geological information, its development conditions, use and transfer need statutory regulation. To do this, it is necessary to develop a regulatory procedure or present a concept. But there is another problem concerning the assignment of the status of an intellectual property object. Geological information should be recognized as such an object with all ensuing legal consequences. The regulation on geological information shall be correlated both legally and economically, i.e. geological information shall not only be recognized as an intellectual property object, but it shall also (and can be) be evaluated.

It is necessary to develop and create a digital platform with regional characteristics, it can be implemented as a territorial-regional information system (TRIS) [12]. Development of a unified information base in the industry, including TRIS (with regional characteristics) is possible only by the integration of existing databases. It shall be formed by all interested parties. The digital platform will make it possible to implement tasks related to integration, including end-to-end integration, existing information arrays, and databases.
Using functions of digital platforms in the mining industry management system at the regional level will also solve such problems as the assessment of the mineral potential in regions and territories in terms of common minerals, geological and mining conditions, mineral diversity, economic application.

It is necessary to develop and implement the maintenance of an information resource on mineral resource objects. Regarding the authorities of subjects and characteristics of the territorial distribution of mineral resources, this register shall include both widespread minerals and monitoring of dynamic changes, reliability control of the licensed area boundaries, identifying discrepancies between license coordinates and the actual location of mining allotments [14]. These tasks can be solved within an integrated information system. At present, at the federal level, in a test mode in many regions of Russia, a new information system as a developed software, called the Unified Geological Information Fund, has been used. However, geological information in this system is not present in full, it is sketchy, its interpretation is not updated.

Meanwhile, the accumulated non-digitized geological, technical and economic information on the regional mineral resources is quite extensional, rather complex and has a low degree of orderliness and standardization, its use by traditional methods is very time-consuming and ineffective.

4. DISCUSSION OF RESULTS

For decades the researchers have been trying to develop a unified fund of geological and other information in the area of subsurface use [3]. Certain problems are present in the process of a single information resource development [3,4]. The mechanism for the distribution and use of information databases and cadastres shall be based on the adoption of a federal law or amendments to the current law "On Subsurface", and this mechanism is used to organize electronic document flow [5]. The researchers are focused on the study of "digital economy" institutions [6], or formation of the architecture of technological platforms, digital business analytics [7], and pricing principles in the digital economy [8].

At present, the mining industry is one of the largest industries that actively implements all digital innovations, that is, they take interest in both technological and digital platforms, blockchain, for example. In its simplest version, a "blockchain" is a decentralized database or distributed ledger, that is, essentially nothing more than an electronic journal that registers records of completed operations (transactions) in the prescribed manner. The journal records (or blocks of the chain) are protected cryptographically. As the records are in a certain sequence and represent a chain, the records are updated simultaneously for all participants. Blockchain solutions are implemented by the oil and gas production industry. For example, a number of oil companies and commodity traders, such as Statoil, BP, Shell, Gunvor, Mercuria, etc. and a group of banks - Societe Generale, ING, Ambro, have merged into a consortium and, using the blockchain, have developed a blockchain platform for trade transactions with oil. It is assumed that those oil and gas companies shall pay to join the blockchain consortium for further oil transactions. The interaction of parties to the transaction is ensured by the conclusion of a digital "smart" contract [9], the blockchain platform can be used both in production, subsequent processing, and supply to consumers.

Information technologies have been efficiently used for a long period in the mining industry at all production stages. The industry's current challenges, related to mining and production management, are addressed through IT solutions. However, in our opinion, the most interesting application of digital technologies in the mining industry is ensured by the digital platform (DP) functions. It is a system of algorithmic relationships between numerous participants in a business process, united by a single information environment, using a package of digital technologies [10]. We determined that integration of information resources and flows, required for the implementation of a territorial-regional information system, can be introduced on the basis of a digital platform. It is, on the one hand, a method of information interaction between technological platform (TP) is a communication platform for interaction between business, science, consumers and the state on the issues of modernization, scientific and technological development in certain technological areas) [10], on the other hand, it is a new innovative method of the management system.

5. CONCLUSIONS

1. Integration of information resources and flows for implementation of a territorial-regional information system (TRIS) can be performed on CPU basis, which, on the one hand, is a method of information interaction between technological platform participants, and on the other hand, a new innovative method of a control system. Basic technologies shall form TRIS basis.

2. TRIS conceptual structure shall be related to management levels. Current cadastres, information databases, technologies shall be integrated.

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