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# Information Management Systems in Science

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**Abstract**—This paper reviews a variety of information systems that support the organization of scientific research in Russia. The quantitative analysis of such systems is performed and duplicate functionality is revealed. Possible integration of the data that are collected by various portals within the "Map of Russian Science" project in order to compile information about all of the research activities in Russia according to the categories applied by the Russian Ministry of Education and Science for decision making is explored. Such an approach will help to overcome the fragmentation of information that is collected onsite and to reduce the bureaucratic burden on scientists that is related to the application for funding and reporting.

*Keywords*: information systems, map of Russian science, centers of collective use, unique scientific installations, register of scientific and technological results

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## INTRODUCTION

Significant funding has been allocated in Russia to improve research performance. Specifically, gross domestic expenditure on research and development (R&D) grew by 14.6% from RUB 610.4 billion to 699.9 billion in the period of 2010–2012, respectively [1, p. 17]. However, the share of R&D expenditures in the GDP declined from 1.27% in 2002 to 1.12% in 2012.[1]

The Strategy for Research and Innovation Development in the Russian Federation until 2015 has foreseen an increase in the GDP share of domestic expenditure on R&D to 2.5% by 2015. However, this target has not been achieved. The Decree of the President of the Russian Federation No. 599 of May 7, 2012, On measures to implement the state policy in the field of education and science, set another target: 1.77% of GDP by 2015. To date, this target has not been reached either. Despite the increasing funding, the country's research performance is still weak. According to the National Research University Higher School of Economics [1, pp. 263–264], the share of Russian publications in journals indexed by Web of Science and Scopus amounted to 1.9% (WoS) and 1.74% (Scopus) in 2012, compared with 2.24% and 1.97% in 2006, respectively.

Some authors believe that the improvement of research performance requires the reform of Russian science in line with foreign practice [2], an increase in funding allocated for science in general and for the Russian Academy of Sciences (RAS) in particular [3], and an analysis of the contradictions of science and technology policy [3]. Furthermore, the declining research performance is associated with the overall degradation of society's intellectual capacity [4].

In practice, the development of Russian science has been based on the support of federal and national research universities, as well as the establishment of national research centers. It is expected that the consolidation of organizations will enhance the efficiency and effectiveness of Russian science as a whole and will also help to solve the funding issues and define the priority areas of development.

Other studies have explored the problem of red tape in the research field [5], or focused on the shift in the organization of the research funding system from state orders to a competitive funding model [6]. Thus, numerous studies critically review the overall scientific and technological policy in Russia.

In this paper, we analyze various information systems that support the organization of scientific activities. Such systems integrate information about the activities that are pursued by research institutions and collect applications for project funding and reporting documentation. Our study is focused on the organizational component of such information systems, which is reflected in gathering information about resource capacity and research performance in the scientific sector as a whole and in specific areas (to provide information for decision makers), in reducing the time that is spent by scientists on paperwork and facilitating this process, as well as ensuring a certain level of data accessibility.

[1] Data provided by the Analytical Center of the Government of the Russian Federation. URL: http://ac.gov.ru/files/attachment/4879.pdf

Information systems that collect data about research activities

| No. | Name of the information system | Website |
|---|---|---|
| 1 | Unified register of the results of publicly funded civilian research, development, and engineering works | http://www.rntd.citis.ru/php/rntd4.php |
| 2 | Unified state information system that accounts for the results of civilian research, development, and technological works (IS RSTA) | http://www.rosrid.ru |
| 3 | State records of the results of civilian research, development, and technological works | http://intelpro.extech.ru/ |
| 4 | Information and analytical materials on the analysis of performance of higher education institutions* | http://miccedu.ru/monitoring/ |
| 5 | Electronic catalog of high-tech equipment and research facilities of the Russian Federation | http://www.xn----7sbam6aiqfmx.xn--p1ai/ |
| 6 | Modern research infrastructure of the Russian Federation: openness, accessibility, and innovation | http://www.ckp-rf.ru/ |
| 7 | Map of Russian science | https://mapofscience.ru/ |
| 8 | Development of innovation infrastructure in Russian higher-education institutions | http://rii-vuz.extech.ru/ |
| 9 | Accounting and monitoring of small innovative enterprises in the research and educational field | https://mip.extech.ru/ |
| 10 | Federal roster of scientific and technical spheres of the Russian Ministry | https://reestr.extech.ru/experty/index.php |
| 11 | The project aimed at improving the competitiveness of the top Russian universities among global leaders of research and education | http://5top100.ru/ |
| 12 | The federal system for monitoring of performance of scientific organizations, performing research, development, and engineering works | http://www.sciencemon.ru/ |

* The information system contains both data about research and education and other activities that are pursued by higher-education institutions.

Source: compiled by the author.

The analysis of the degree of red tape in research (for example, within Federal Targeted Programs (FTP), as well as within grants and state research orders) has revealed the insufficient development of information systems that support the operation of the scientific sector. Specifically, it has been established that such systems pursue an outdated approach, where materials are required to be prepared in MS Word and uploaded into the system; therefore, such systems neither fully utilize the possibilities of automatic validation of input data, nor use the predefined lists that facilitate the submission of application and reporting forms. The number of information systems that require data entry is quite significant.

### *Information Systems in the Research Field*

Two groups of information systems that support research can be identified:

1. Application submission and reporting systems;

2. Research performance and capacity data-collection systems.

The first group includes:

- The portal of the Federal Targeted Program "Research and development in priority areas of science, technology, and development" for 2014–2020 (FTP R&D) (http://fcpir.ru/);
- Information systems for the submission of reporting documentation under the FTP R&D (https://sstp.ru/);
- Websites of research foundations: the Russian Foundation for the Humanities (RFH), the Russian Foundation for Basic Research (RFBR), the Russian Science Foundation (RSF), and grants of the President of the Russian Federation;
- The information system for state orders placed with higher education institutions and research organizations in the field of research (http://xn–80aahfgik3be4a.xn–p1ai/).

Information systems of the second group are presented in the table. The list is not exhaustive, as the Federal Agency for Research Organizations creates new information systems, while collecting data on the activity of RAS institutions.

The publication of this list on the website of the Russian Ministry of Education and Science or that of the RAS will help to raise the awareness of the scientific community about multiple opportunities that are offered by the systems.

### *Accounting of R&D Results*

The following systems are analyzed to identify duplications and inconsistencies.

1. The unified register of the results of publicly funded civilian research, development, and engineering works (http://www.rntd.citis.ru/php/rntd4.php).

2. The unified state information system for the results of civilian research, development, and technological works (http://www.rosrid.ru).

3. The state register of the results of civilian research, development, and technological works (http://intelpro.extech.ru/).

The first and the third information systems on this list have similar names. However, it should be noted that the third information system ceased its operation after the introduction of the second system. The appropriateness of replacing one system by another, which involves spending additional funds for the development of a new analogous system, has not been justified by public authorities.

The second information system cannot be openly accessed, despite the fact that the works are paid for by the public budget, which means that the public has the right to obtain information about the scope of budget spending and the obtained results. In truth, these results may be novel, commercially sensitive, or otherwise secret. However, the question is of how appropriate it is to publicly fund R&D works whose information is totally closed to the public, experts, business, and scientific communities. The access to the reporting documentation is only granted to the representatives of public authorities, auditing and supervisory organizations, and researchers based in the Moscow region, as the latter can visit the Center for Information Technologies and Systems of the Executive Power (CITSEP). CITSEP, which is based in Moscow, supports the operation of the second information system and collects all R&D reports that are submitted for the Federal Targeted Programs.

It is unclear how the first information system relates to the second one. Apparently, the second information system contains more detailed information on R&D results. Part of this information is channeled to the first information system. Unfortunately, business users who are potentially interested in R&D results can only use the information about patents that result from R&D works if they consult the first information system; however, they already have access to such information without this system.

Thus, neither the scientific nor the business community can benefit from publicly funded R&D results, which makes it impossible to integrate such results in production. It would be appropriate to openly publish at least the abstracts of R&D reports, if not full-text reports. Alternatively, the state could place orders for publicly funded R&D works on a particular topic that can be of interest to business with a subsequent cost-free transfer of results for their commercialization.

### *Information Systems that Offer Details about Research Equipment*

At present, two systems that provide information about scientific equipment exist.

1. The electronic catalog of high-tech equipment and research facilities of the Russian Federation (http://www.xn—7sbam6aiqfmx.xn–p1ai/) (IS equipment).

2. Modern research infrastructure of the Russian Federation: openness, accessibility, and innovation (http://www.ckp-rf.ru) (IS CCU).

Despite its name, which defines the system as a source that offers information about all of the high-tech equipment in the Russian Federation, the equipment information system is a system that collects data about the equipment that is available in higher education institutions and companies, while research organizations are not represented in the resource.

The CCU information system only contains information about centers of collective use of scientific and other unique equipment (CCU). Originally, it only contained the information about the equipment that belongs to the centers for the collective use and unique research facilities supported by the Russian Ministry of Education and Science under activity lines 1.8 and 5.2 of the FTP "Research and development in priority areas of science, technology, and engineering" for 2007–2013. The list of related organizations was later expanded. Given that individual higher-education institutions also have centers for collective use of scientific equipment, the information about their equipment is reflected twice in both information systems, which leads to the duplication of the functions that are performed by the two portals.

At the same time, none of these systems offers an inventory of all equipment (scientific, technological, and other types) that is available in higher education institutions, research institutes, and R&D companies, which hampers assessment of the degree of deterioration of not only machines and equipment in the scientific sector (a common statistical indicator), but also scientific (analytical and measuring) and technological equipment.

Therefore, it is appropriate to create a single portal to collect such information and enable analytical studies by different categories: field of science, type of equipment, and type of organization.

### *Information Systems of Foundations and Federal Target Programs*

In addition to the information systems that collect information about the scientific capacity and performance of the research sector, various systems that are aimed at supporting the application for and reporting on grants and other competitions exist.

It should be noted that information systems of public research foundations have similar goals and objectives that are related to the submission of applications and reports. However, these systems lack a common user interface. They have their own forms, completion rules, and lists of required evidence documents. This makes it difficult for the users to determine the system requirements.

The system for the collection of application and reporting documentation for the FTP R&D is the most difficult one, as it requires significant volumes of data about all employees of the organization that is applying to participate in a project. For example, the required data cover publication and patent activities and citation indexes for each article that is presented in the application.

Thus, all these application and reporting systems somehow collect the same information about the publication activities of researchers and research performance in the form of publications and patents, etc. It is appropriate either to unify application forms and procedures, or to create a single portal for such information with the possibility of its further use in the information systems of the research foundations and the FTP R&D. This would greatly simplify the preparation of applications and reports by scientists. Rather than filling out forms for each information system, researchers would only need to specify their identification number, which will be followed by downloading of data from a single portal where such data on scientific activities are stored. The "Map of Russian Science" could be such a portal (Map).

### *The Map of Russian Science*

The Map of Russian Science was originally conceived as a portal that contains the most comprehensive information about research activities and financial and technical support of research that is performed by organizations and individuals. Such a system also allows the collection of data on the publication activities of researchers and organizations.

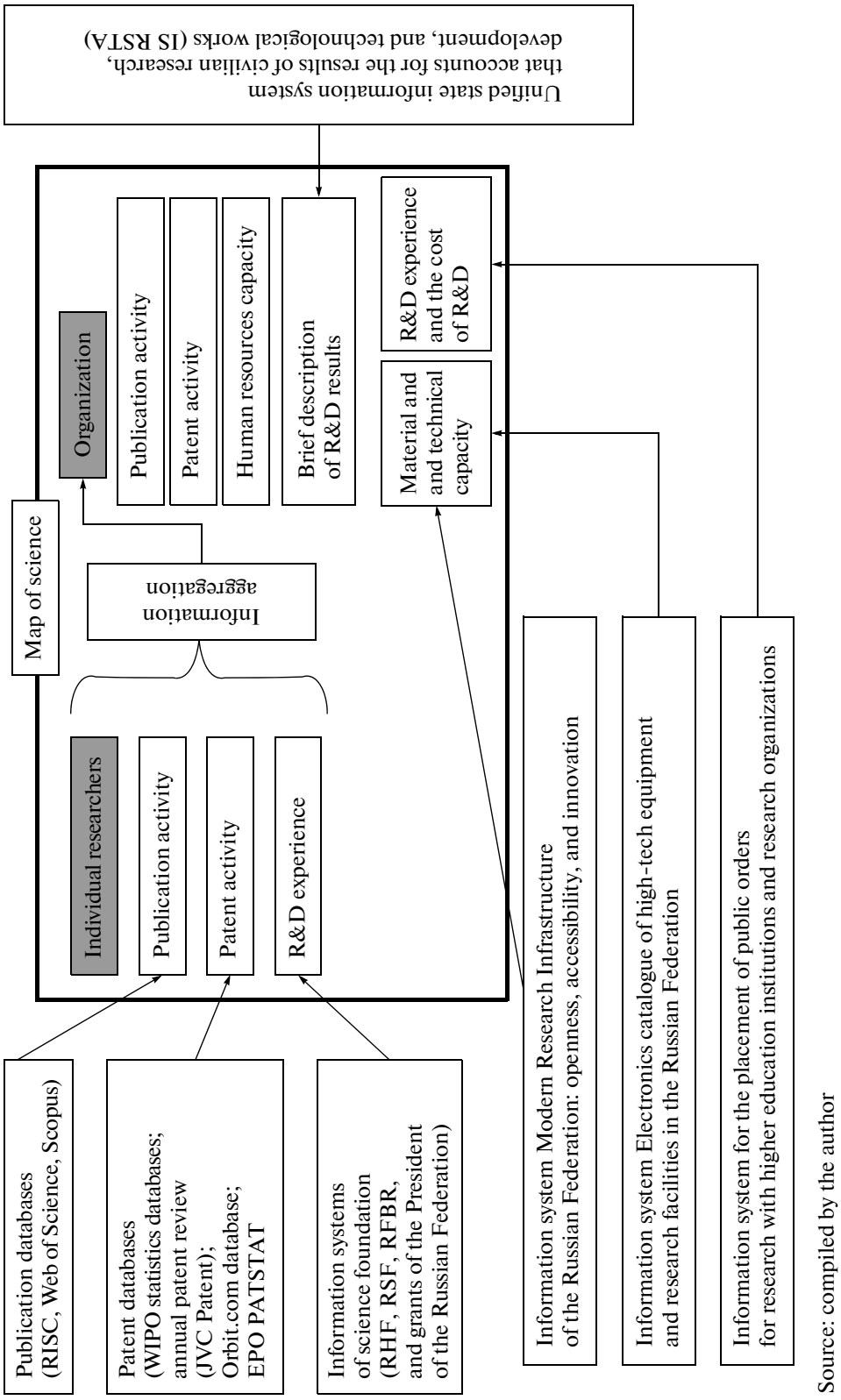
However, as of February 26, 2015, the system was still at the trial stage. The information that is contained in the portal database relates to 2013. The information about publications is taken from the Web of Science and Russian Index of Science Citation (RISC) databases. The Scopus database is not represented on the portal, although the publications that are indexed in Scopus are considered as a part of the evaluation of grants and competitions. Information from the RISC database is not updated.

In fact, the Map of Russian Science would help to reduce the amount of application and reporting paperwork (for research foundations and within the FTP R&D), requiring only specification of the identification number of the applicant organization and project participants, with other data being automatically uploaded from the application portal of the Map. This would help to reduce the volume of documentation, facilitate verification of application and reports, and reduce the cost of research support. Such a mechanism could not be realized practically because of multiple data inconsistencies in the Map[2], which makes it impossible to use such data.

In addition, the Map could provide information to support decision making. As an example, this can be the information about the threshold level of publication activity indicators that is established for scientists who are younger than 35 years to admit their applications to competitions of research foundations. In addition, the map is in fact a census of Russian scientists, as well as an inventory of the country's scientific capacity. Therefore, if the possibilities of the map with regard to the collection of appropriate comprehensive information about scientific activities are fully realized, decision makers could tap into a valuable source of operational information about scientific potential and research performance presented by various categories with a level of detail that cannot be provided by the official statistics. By accumulating data from many sources, it would be possible to obtain data on the equipment base of the entire country, as well as of individual higher education institutions, research institutes, the Russian Academy of Sciences, and centers of collective use. The Map would also provide information about the available sources of funding that are allocated within the federal targeted programs and state orders, as well as by research foundations. Such data categories are typically used for decision making at the Ministry of Education and Science; however, the required data have to be collected separately for each specific task, as the official statistics do not provide them. The map would be a cheaper alternative to the official statistics and would allow one to obtain more accurate data compared with the official statistics on a subject in a field that is appropriate for decision making. However, despite the great potential of this project, it has never been completed.

The figure presents a possible scheme for the operation of the Map of Russian Science project. By accumulating data from different information systems, the Map could become a portal that contains information about the entire research sector in Russia, namely:

[2] General Assembly of the Society of Researchers: Map of Russian Science from the perspective of Russian researchers. Electronic access: http://www.saveras.ru/archives/tag/%D0%BA%D0%B0%D1%80%D1%82%D0%B0-%D1%80%D0%BE%D1%81%D1%81%D0%B8%D0%B9%D1%81%D0%BA%D0%BE%D0%B9-%D0%BD%D0%B0%D1%83%D0%BA%D0%B8




Source: compiled by the author

The aggregation scheme for the Map of Russian Science project.

• Information about the performance and efficiency of research activities (thus making the federal system for monitoring of activities that are performed by research organizations engaged in R&D, design and engineering, and technological works redundant);

• A list of the most frequently published and cited authors in Russia (to select experts who can participate in the activities of research foundations and the assessment of publicly funded R&D results);

• Justification of the threshold values for the criteria that are applied for the assessment of applications that are submitted to competitions that are announced by research foundations and under federal targeted programs;

• Automatic preparation of applications for the participation in competitions that are announced by research foundations and under federal targeted programs, thus reducing paperwork;

• The possibility of obtaining operational statistical data about the research sector by categories that are more detailed than those that are offered by the official statistics of Restate (Russian Federal State Statistics Service);

• A short description of the R&D results that are obtained by organizations;

• The ability to make projections about the key indicators of scientific and technological development, specifically based on the analysis of research despots.

## CONCLUSIONS

This analysis of Russian management information systems in the field of science has shown that the systems that are designed to support the organization of research, facilitate the work of scientists, including paperwork, and collect the necessary consistent information about Russian science sometimes fail to perform these tasks. Specifically, we have identified the information systems that functionally duplicate each other. The results of publicly funded research are not transparent to the public, which results in the inaccessibility of information or authorized access to certain information about the results of the work.

The collection of data on the capacity, performance, and efficiency of Russian science by categories that appear in various public documents[3], which are used for decision making, is also challenging. At present, a new information system is created for each task that is important for the ministries. Such an approach makes it impossible to collect data on the entire object, for example, not only on the scientific equipment that is operated by centers of excellence, but also on all of the country's scientific and analytical equipment. As a result, the information that is delivered to decision makers is a mosaic. The Map of Science could integrate such data and accumulate information about the equipment, personnel, and research performance by various categories. The Map of Russian Science project could bridge disparate portals and unify the data that are provided in applications for funding and reporting documentation, which would spare scholars the need to provide the same information to different systems, for example, when applying for grants of the research foundations and participating in the federal targeted R&D program.

Thus, the management system of Russian science as analyzed from the perspective of information systems that are applied to manage the activities in the scientific sector is ineffective and fragmented. This leads to a decrease in the effectiveness of scientific activities per se.

[3] For example, on critical technologies, as well as the existing research equipment and its age.

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