SECTION: SCIENCE ORGANISATIONS

APPROACHES TO EVALUATING PUBLIC SCIENTIFIC ORGANIZATIONS: EXPERIENCE OF LEADING COUNTRIES AND POSSIBILITY OF USING THEM IN RUSSIA

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ABSTRACT: The article aims at revealing the features and approaches in the auditing of public research institutions in the leading EU member states - Germany and France. To achieve that goal the authors provide a comparative analysis of the assessment systems of scientific organizations in the countries mentioned. The choice of focusing on Germany and France was made because French and German research institutions had held leading positions in the international ratings of scientific organizations. The study reveals the common features of the evaluation system of scientific organizations in France and Germany, including the predominance of qualitative expertise carried out by international experts over the quantitative ones, based on the measurable indicators, as well as their distinctive features. In conclusion the authors give recommendations on the possibilities of using the strengths of the European research evaluation systems in Russia.

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1. Introduction

Nowadays the science sector plays an increasingly important role in social and economic development and achievement of a country's global superiority. It necessitates a substantial revision of the bases of the state policy on science, including the continuous development of the legal framework and creation of the mission-oriented institutions that directly or indirectly influence the increase in performance of the science sector.

The system of the scientific organizations is different and depends on the specifics of the polity, the financing system, the development of the real sector of the economy and its historical evolution. It can be represented in some way by a system, which

includes mission-oriented scientific organizations, higher education institutions, research units of corporations and holdings, etc.

At the same time it is mission-oriented scientific organizations that serve as a generators of new knowledge and technologies. Through their extensive use the economy has been able to shift to a new techno-economic paradigm.

In this regard the study of foreign best practices on how to organize the management of research institutions, including the external audit of scientific organizations becomes especially urgent.

Audit and evaluation of the performance of the scientific organizations can be carried out at different levels depending on the consumer who shall receive information gained from the analysis of the assessment. In the context of globalization and integration of the scientific and educational space mega-projects are becoming increasingly important. If implemented they would be able to develop breakthrough technologies and cutting-edge knowledge that can significantly change the technological level of the real sector of the economy and the social sphere. Their implementation due to the high cost and the need for creation of interdisciplinary research teams is not possible without the participation of a state. In this regard it is the scientific organizations performance assessment initiated by the state that is becoming a relevant tool for increasing the effectiveness of scientific activity.

In Russia the issues concerning the management of scientific organizations as a coordinated activity aimed at ensuring their control and governance are paid much attention due to the adoption by the Government of the Russian Federation the Decision No. 312 of April 8, 2009 "On the Assessing the Effectiveness of Scientific Organizations, Performing R&D Activities and Technological Works for Civil Purposes". Moreover the improving the performance in research could be seen as an important prerequisite for enhancing the competitiveness of Russian science and ensuring its technology leadership.

2. Theoretical background

The question on "audit culture" has been widely discussed in the literature. Audit culture has both broad and narrow senses. In a broad sense, it refers to the summation of the material and ideological wealth created in the process of audit activities. The elements of audit culture are material culture, institutional culture, and ideological culture. In a narrow sense, it refers only to audit ideological culture, for instance, core values of auditors, audit concepts, audit psychology, audit ethics, etc. (Liu, 2015). The development of audit technology has led to dissemination of the evaluation procedures and rules from the financial sector to the public sector, including public research institutions and higher education institutions. This article analyzes an institutional culture understood as a set of norms and rules governing the activities of scientific organizations and one of elements of the audit culture of public research institutions.

Currently there is a lack of studies dealing with economics and management of science due to the specific nature of this type of activity and significant differences in the functioning of the research entities specialized in various subject-matter areas. The knowledge management can be considered as the closest scientific direction of the topic in question. It is actively used in the management of scientific organizations. The literature addressed the theoretical background of the knowledge management includes books by Toffler (1980), Senge (2006), Nonaka and Takeuchi (1995), Davenport and Prusak (1998), Milner (2003).

At the same time there are a few scientific and methodological scholarly writings, which create the theoretical foundations for the assessment and audit of scientific

organizations. However a recent literature review shows that there are many survey works or academic writings on methodological approaches for carrying out the assessment. Most of them are devoted to best practices and lessons learned in different countries.

The collection of essays under the title “The changing governance of the sciences” (Whitley & Glaser, 2007) provides approaches to the evaluation of scientific organizations in different countries - Germany, Spain, the Netherlands, Sweden and Japan. It should be noted that content of this collection and its recapitulative nature allow to create an information base for comparative analysis of different evaluations systems.

British scientist Richard Whitley when analyzing the research evaluation system in different countries identifies weak and strong systems (see Appendix Table 1).

The proposed classification can be taken as a basis for the analysis of the evaluation systems in different countries and organizations. However it has a number of shortcomings, including recapitulative nature and a narrow field of application.

It is obvious that the analysis of evaluation systems of public research institutions should contribute to the improvement of their performance and better organization. It is also intended to provide the federal agencies with the credible, timely information used to make managerial decisions aimed at improving state policy in science and education and providing targeted direct or indirect support for individual scientific organizations. There is a lack of similar studies in the literature requiring further development of the theoretical and applied aspects of the question raised.

3. Methodology

To obtain research results various quantitative and qualitative methods are used in the article. The first one consists of statistical methods for analyzing the data of the Organization for Economic Cooperation and Development (OECD), which make it possible to assess the research potential of the countries studied by such criteria as the share of government spending on R&D, the total number of researchers, the number of government researchers and the share of government researchers in the total number of researchers.

The second one includes case study methods, which is broadly understood as an in-depth analysis of the cases under consideration (Hamel, Dufour & Fortin, 1993). The advantages of these methods are the possibility of studying cases in their historical context and ensuring a high internal validity (Gagnon, 2010). Thus case study method within the framework of this study makes it possible to use different types of information for investigating the research evaluation systems. It also allows to carry out the analysis of the legal and regulatory frameworks that govern the rules, procedures, evaluation criteria for auditing scientific organizations and compare the obtained data with the findings by other researchers.

4. Case studies

4.1. Benchmarking of the scientific potential of Russia and the leading European countries

To date European and American scientific organizations hold a leading position in various international rankings. For instance, research institutions and universities of France, the USA, Germany and China are among the top 10 scientific entities in the SCImago Institutions Rankings for 2016, prepared by the University of Granada (Spain)

and based on a multifactorial model for evaluating scientific organizations (SCImago Institutions Rankings).

Similarly in 2016 public research institutions of the United States, France, Germany, Japan, South Korea, China and Singapore joined Thomson Reuters' annual ranking of the Top 25 Global Innovators – Government, which is compiled by analyzing bibliometric and patent data for 600 academic and state scientific organizations from all over the world (Ewalt, 2017, March 1).

At the same time Russian research organizations in the abovementioned rankings are represented only by the Russian Academy of Sciences, which ranks 28th in the SCImago Institutions Rankings.

When comparing the scientific potential of Russia and the leading European countries using international statistics, one can conclude that Russia is 2-3 times ahead of France and Germany in terms of absolute and relative indicators on the number of researchers, especially on the share of full-time in the total number of researchers (see Appendix Figure 1).

In 2014, according to OECD, Russia held one of the leading positions if compared data on the share of public spending on R&D. At the same time the gross expenditures on R&D (GERD) financed by the government in France and Germany were close to the average value in the EU (see Appendix Figure 2).

If one compares the share of non-university sector in total public research spending it may be concluded that Russia is inferior to France and Germany (see Appendix Figure 3).

Thus when comparing the international rankings and statistical data on the number of researchers and state expenditures for R&D (in relative terms) a certain pattern is revealed: countries, which have fewer researchers, including government researchers, with relatively low level of state support for R&D if compared to the contribution of business sector in R&D expenditures, hold most of the top places in SCImago Institutions Rankings and Thomson Reuters rankings.

It is necessary to accept the hypothesis that the nature of this pattern is determined by several factors such as the quality of human capital of scientific organizations, the state policy aimed at supporting the priority areas in science as well as research institutions, etc. Given this hypothesis the article focuses on those aspects of the management of scientific organizations that are related to their external audit, that is an assessment of their performance carried out either directly or indirectly by the state, or via the authorized organizations. The authors subscribe to the idea that the quality and effectiveness criteria, which are established by the bodies responsible for monitoring scientific organizations, play an important role in management of the research institutions and organizing work with their personnel. For that reason the article deals with the approaches to the evaluation of scientific entities in Russia and EU countries.

Although the US research institutions are also the leaders of the above-mentioned rankings, the American research evaluation system fundamentally differs from similar systems in European countries due to the fact that the evaluatees are not scientific organizations but federal programs, through which the Government provides financial support for state research entities.

It is also noted that business actively stimulates the development of US science sector, and the Government-funded research addresses primarily strategic tasks aimed at strengthening national security. There has not been developed a single

unified methodology for evaluation of the research entities in the US, thus it is being formed at the local level mainly for management purposes. In this regard the article doesn't consider the US experience¹.

4.2. The French experience in evaluating scientific organisations

In France the High Council for the Evaluation of Research and Higher Education (Haut conseil de l'évaluation de la recherche et de l'enseignement supérieur, HCERES) is responsible for the auditing of higher education institutions, consortia of universities, research entities, the French National Research Agency, and in some cases other evaluators and their evaluation procedures. According to Article L.114-3-1 of Law no. 2013-660 of 22 July 2013 on Higher Education and Research HCERES has the right either to carry out an assessment independently or evaluate the assessment procedures developed by other entities.

HCERES evaluates both scientific organizations and their units, for example, laboratories. It has developed evaluation procedures and criteria for each evaluatee.

The main principles for the assessment of universities and research institutes are the following:

- complexity: the assessment shall take into account all processes for developing the institution's strategy, its operational implementation, the resources and systems used, the results obtained and continuous improvement mechanisms;
- inclusiveness: it shall cover all bodies and governance and management systems and take into account the territorial, national and international positioning of the institution;
- attendance-based manner: it shall include an on-site visit (High Council for the Evaluation of Research and Higher Education (2016, June 6). Principles for HCERES validation of the procedures for evaluations carried out by other bodies).

In order to prevent conflicts of interest, experts should not be associated with the institution inspected, they are obliged to avoid any contacts with the representatives of the institution during the evaluation. In addition, the qualification of the expert is taken into account on the basis of the analysis of the quality of his work (Legifrance, 2017, June 9).

The frequency of monitoring is determined by an agreement between a customer, i.e. government agencies, and the contractor (Legifrance, 2006, April 18; High Council for the Evaluation of Research and Higher Education (2016, June 6). Evaluation Charter).

The on-site visit of the Expert Committee precedes the self-monitoring of the research institution: the evaluatee has to upload data for the last 5 years into specialized Pelican system.

The main criteria for assessing scientific organizations are the following:

- strategy and management;
- research and training;

¹ It should be noted that, France, for instance, is also actively dealing with the issues of budgetary effectiveness with regard to scientific organizations. High Council for the Evaluation of Research and Higher Education includes a Science and Technology Observatory responsible for that matters (Science and Technology Observatory, 2016, November).

- student success;
- promotion and scientific culture;
- European and international relationships and steering (High Council for the Evaluation of Research and Higher Education, 2016, November).

In general French research evaluation system has the features of a strong-one. This is evidenced by the existence of formalized procedures, principles and evaluation criteria developed for various evalutees, for instance scientific organizations and their research units. At the same time, the High Council for the Evaluation of Research and Higher Education, established in 2013, is not only an oversight body, but also a methodological center for developing approaches and criteria for the evaluation of scientific organizations that are updated on a regular basis. Moreover HCERES is paid much attention to the need to ensure the independence of evaluation and involve the international experts.

It is important to note that, conceptually, French research evaluation system is created in such a way that scientometric, including bibliometric indicators don't play a decisive role in determining the effectiveness of a research institution. HCERES put criteria that define good-quality research (for instance, indicators used to evaluate research integrity¹) and the organization of the work of a research institution first. It is worth noting that monitoring is performed also on research units of the scientific organizations with the involvement of international experts. This increases the importance of the research, which is conducting, for example, by laboratories, and enhances the responsibility and authority of lab directors. At the same time the results of the evaluation aren't used in order to rank evalutees in such a way that allow to define leaders and outsiders, but designed to develop recommendations for improving the performance of a research institution or its unit.

4.3. The evaluation of scientific organisations in Germany

Unlike in France, the German Council of Science and Humanities (Wissenschaftsrat) is one of the leading advisory bodies for science and education that evaluates research institutions in selected areas of scientific knowledge and disciplines, according to the terms of an agreement between the federal and Länder governments. The Council has developed "Recommendations for rankings in the system of higher education and research" based on various measurable indicators, including scientometric ones, used as evaluation criteria (German Council of Science and Humanities, 2004, November 12).

However one of the main tasks of the Council is to conduct an audit of public research institutions. According to the German Federal Ministry of Education and Research non-university research institutions include the Max Planck Society, Fraunhofer, Helmholtz Association and Leibniz Association, which are financed from the federal and regional budgets, as well as 40 state research institutes, which are subordinated to various German federal executive authorities (Federal Ministry of Education and Research, 2016, December).

German Council of Science and Humanities carries out the external audit of abovementioned institutions at the request of the Länder governments or the German federal executive authorities every three to five years (the exact frequency of this procedure has not been established). In general, the procedure for assessing the

¹ Research integrity is commonly understood as the performance of research to the highest standards of professionalism and rigour in an ethically robust manner (Hiney, 2015, December).

performance of research institutions can be presented in the following scheme (see Appendix Figure 4).

The main goal of the evaluation of the research institution is to identify strengths and weaknesses of the organization's activities that affect its performance. At the same time, the evaluation focuses on quantitative rather than quantitative indicators (for instance, the assessment of the research performance is reinforced by reading selected publications).

It should be noted that the German research evaluation system is decentralized. Besides the German Council of Science and Humanities various German science foundations that finance research, for instance, the Alexander von Humboldt Foundation and the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG), rank their grantees. In this connection German research evaluation system can be identified as a strong evaluation system. However the evaluation of research institutions that are members of the Helmholtz Association, Max Planck Society, etc., is carried out on an irregular basis and conducted on a request from the Government (Koroleva, Vasiliev & Torjkov, 2014).

4.4. The development of the research evaluation system in Russia

In Russia in accordance with the Decision of the Government of the Russian Federation No. 312 of April 8, 2009 the federal executive bodies have the right to evaluate scientific organizations, which are subordinate to them and determined in accordance with Article 5 of the Federal Law of August 23, 1996 No. 127-FZ "On Science and State Scientific and Technical Policy". The Evaluation Committee, which is formed from the representatives of the scientific community, i.e. the leading specialists in the relevant fields of science, business community, public associations, non-profit organizations and other stakeholders, evaluates the research organization according to the following criteria:

- scientometric evaluation of the organization's performance;
- analysis of the dynamics of the results of the activities of the scientific organization in relation to the dynamics of the performance of organizations in the reference group;
- expert evaluation of the main results of scientific organization.

The evaluation of the effectiveness of the activities of scientific organizations is carried out on the basis of analysis and comparison of indicators of the evaluation of the organizations' performance in the following areas:

- scientific potential and effectiveness of research;
- the involvement of a scientific organization in the national and world scientific and educational community;
- commercialization and future implementation of research results;
- the staffing of a scientific organization;
- furnishing suitable resources;
- financial activities.

A system of indicators is defined for each of the abovementioned area. It is flexible enough to conduct evaluation tailored to the needs of the federal authorities across all stages of the policy development.

The distribution of the evalutees by reference groups can be considered as a feature of the Russian research evaluation system. The groups are formed on the basis of the similarity of one or several characteristics:

- goals and stages of scientific and/or scientific and technical activities (fundamental research, applied research, experimental development);
- field of science;
- sources and mechanisms of financing;
- organizational and legal form.

The allocation of reference groups ensures the flexibility of evaluation since the activities of scientific organizations operating in various subject areas and fields of research have their own specifics. Each reference group has its own criteria of target indicators, which are determined by the analysis of extensive statistics on the activities of scientific organizations of the corresponding group.

Since the evaluation of the performance of a scientific organization had been completed it can be assigned to one of the following categories:

- 1st category - leaders;
- 2nd category - sustainable organizations with a satisfactory performance level;
- 3rd category - organizations that are no longer relevant to their scientific mission and deviated from their development path.

The results of the evaluation are used for management purposes through elaborating programmes for the development of scientific organizations that have been classified as leaders, determining the amount of financial support and optimization and development of a network of scientific organizations.

4.5. The international comparisons of research evaluation systems

Thus the fundamental difference between the Russian and European research evaluation systems lies in the use of the peer review method. In France and Germany the audit of scientific organizations is essentially based on the method of qualitative evaluation by scientific peers while the results of the scientometric analysis are used as auxiliary data (see Appendix Table 2).

In Russia an expert analysis of the qualitative characteristics of the scientific organization is used in order to adjust data based on the scientometric study on those research institutions that have met the threshold levels of the main and additional indicators in their corresponding reference groups (Federal system for monitoring scientific organizations performing R&D activities and technological works. Application 2 to the proceedings of the meeting of the Interdepartmental Commission for the performance evaluation of the scientific organizations).

The above-mentioned difference in methodological approaches stems from the concepts and nature of the audit of public research institutions in European countries and Russia. In Germany and France the audit aims, first of all, to develop recommendations for improving the performance of the scientific organizations. In this regard a comprehensive assessment of their activities is carried out in order to evaluate management system, internal quality management system, including methods for ensuring research integrity, etc. In this connection the evaluation reports, which are made freely available, contain recommendations of an expert panel how to improve the work of an organization. The second goal of the evaluation

of the European research institutions is to assist federal authorities in making funding decisions.

In Russia research evaluation system is aimed primarily at identifying outsiders, reorganizing the system of research organizations. Before the implementation of the federal system for monitoring scientific organizations (FSMSO) there was a way of reorganizing the system of scientific organizations by merging them with higher educational institutions. Today the federal authorities through FSMSO have a tool used to control scientific organizations that underlies their reforming as a perpetual task. As a result of the implementation of policy measures the number of research organizations in Russia decreased by 63% during the period from 2000 to 2014 (Russia in figures 2016). In this regard, the method of ranking scientific organizations in Russia is built primarily on scientometric indicators, while the ability of an outside observer to access expert report on assessment of scientific organizations is limited.

Conclusions

Thus, the audit of scientific organizations in France and Germany serves, primarily, as a tool to support the adoption of managerial decisions and improve the performance of research entities. The strengths of the European research evaluation system include the following:

- the avoidance of partiality and enhancing the status of expertise through the involvement of international experts;
- a wide range of quality indicators used when evaluating the research institution;
- a flexible combination of qualitative and quantitative expertise;
- the functioning of a special center, which main task is to carry out scientific and methodological support for evaluation, perform supervisory functions, etc.

The Russian research evaluation system can also be considered as effective and adapted to the realities of the development of the economy and society in Russia. As in the case of the implementation of the Unified State Exam, the research evaluation system in Russia is designed to reduce the impact of the human factor and risk of fraud by keeping the names of experts in secret and restricting access to their report. If the European system of the research evaluation was being implemented in Russia, a question on the partiality of the experts would inevitably rise. In general Russian research evaluation system is aimed at identifying problems and weak links that undermine the efficiency of a system of scientific institutions rather than finding solutions and supporting organizations that are under threat of dismantling. So in order to improve the research evaluation system in Russia it can be suggested to impose on evaluator an obligation to provide recommendations as to how weaknesses can be eliminated. So they can be used in developing strategic plans, road maps and other strategic planning documents aimed at enhancing the effectiveness of scientific institutions.

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Appendix

TABLE 1. THE MAIN DIFFERENCE BETWEEN WEAK AND STRONG RESEARCH EVALUATION SYSTEMS (RES)

The type of RES	Evaluators	Evaluatees	Procedures and/or evaluation criteria	The frequency of evaluation	The rankings of evaluatees	The use of evaluation results
Weak	Funding agencies and/or a consortia of universities	Universities, research groups and departments	Little standardisation of procedures or criteria	Conducted on an irregular basis	Evaluatees aren't ranked	The results don't have direct financial consequences
Strong	Scientific elites	Universities and similar organizations and their departments	Highly formalised rules and procedures	Conducted on a regular basis	Evaluatees are usually ranked on a standard scale	The results directly affect funding decisions and management of evaluatees

Source: Whitley (2007).

TABLE 2. THE FEATURES OF RESEARCH EVALUATION SYSTEMS IN FRANCE, GERMANY AND RUSSIA

Country	Evaluatees	Guidelines for designation of members of the Evaluation Committee	Main approaches to evaluation	Frequency of evaluation	Rankings of evaluatees	Public disclosure of the evaluation results
France	Scientific organizations and their research units	In order to prevent a conflict of interests an expert shouldn't be affiliated with an evaluatee. A corresponding professional level of an expert is also taken into consideration. There can be involved foreign experts.	Peer review expert evaluation of a scientific organization, scientometric indicators don't play a determining role	The frequency is determined by an agreement between a customer, i.e. government agencies, and the contractor	Ranking is not provided	The results are made freely available.
Germany	Scientific organizations	To preserve the principle of impartial	Peer review expert evaluation of	Every 3-5 years	Ranking is not provided	The results are made freely

TABLE 2. THE FEATURES OF RESEARCH EVALUATION SYSTEMS
IN FRANCE, GERMANY AND RUSSIA

Country	Evaluatees	Guidelines for designation of members of the Evaluation Committee	Main approaches to evaluation	Frequency of evaluation	Rankings of evaluatees	Public disclosure of the evaluation results
		evaluation none of the experts shouldn't have a relationship to evaluatee. A quality of experts involved is also taken into consideration. Foreign experts are actively involved.	a scientific organization, scientometric indicators don't play a determining role			available.
Russia	Scientific organizations and their research units	Panel of experts is strictly based on equal representation of federal executive authorities, business community, non-profit organizations, on the one hand, and qualified specialists, from another hand.	A two-tier research evaluation system: peer review expert evaluation and evaluation based on measurable and quantitative indicators	Every 5 years	Scientific organizations are ranked into three groups.	On application, legal entities may be given an information in the form of extract from the database.

Source: Legifrance (2006, April 18); Federal system for monitoring scientific organizations performing R&D activities and technological works. The Decision of the Government of the Russian Federation No. 312 of April 8, 2009 "On the Assessing the Effectiveness of Scientific Organizations, Performing R&D Activities and Technological Works for Civil Purposes".

FIGURE 1. RATIOS OF THE GOVERNMENT RESEARCHERS TO THE TOTAL NUMBER OF RESEARCHERS (FULL TIME EQUIVALENT) IN FRANCE, GERMANY AND RUSSIA (2014)

Source: OECD, own calculations.

Note: bubble size shows the number of the government researchers as a percentage of the total number of researchers (full time equivalent).

FIGURE 2. PROPORTION OF CONTRIBUTIONS OF VARIOUS SECTORS OF THE ECONOMY IN R&D FINANCING (2014)

Source: Own Source. Calculations based on OECD data.

FIGURE 3. THE SHARE OF NON-UNIVERSITY SECTOR IN TOTAL PUBLIC RESEARCH SPENDING (2010)

Source: Allmendinger & Gamisch (2017); Russia in figures (2016).

FIGURE 4. AN EVALUATION PROCEDURE OF THE SCIENTIFIC ORGANIZATIONS SUBORDINATED TO FEDERAL AND REGIONAL AUTHORITIES IN GERMANY

Source: German Council of Science and Humanities (2014, October 24).