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GATEKEEPERS IN RUSSIAN HIGH-TECH: A STUDY OF HEADS OF LEADING RESEARCH CENTERS

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GATEKEEPERS IN RUSSIAN HIGH-TECH: A STUDY OF HEADS OF LEADING RESEARCH CENTERS

The paper proposes one of the first attempts to conceptualize the "human capital" in science and technology gatekeeping in Russia, based on obtaining sociological data on real active subjects. The study strives to provide analytical information on the specific characteristics and stances of individuals making a decisive contribution to the development of strategic areas in science and technology. In Russia, the most perceptible impact on changing the situation of new scientific knowledge production and, in particular, high-tech development comes from heads of "advanced" research laboratories. Capable of forming and carrying out their own research programmes, in the majority of instances they act as "gatekeepers" of the high-tech sector.

In the first stage a quantitative questionnaire survey was carried out by means of a formalized interview (312 respondents). In the second stage qualitative information was collected using in-depth semi-structured individual interviews with the managers of leading laboratories in their field (31 interviews). The information on the gatekeeping strategies in the six science and technology priority areas was obtained.

Research on the expert community associated with high-tech projects logically fits into the "cluster" of foresight studies, supplementing it with "human capital".

Keywords: expert, gatekeeper, human capital, high-tech industry, technology transfer, research and development

JEL: I28, J24, O32, O33

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Introduction

The development of high-tech industry in Russia is directly linked to the state and level of scientific research activity carried out by academics in laboratories. A lot has been done in recent times to raise this level. Science, technology and research policy measures are being adopted that are recognized to increase scientific potential (Gokhberg, Meissner, 2013; Meissner, 2014). However, scientific production does not lend itself to state political management through some “incentive – reaction” scheme. The relationships between cause and effect here are far from obvious, as the scientific field has been endowed with its own strong spectrum of approaches to transformation. State political and economic influences only paint a general picture and shape the scale of the process of change for scientific production structures, but do not categorically determine the outcome of these changes. From an empirical perspective, this means that the dynamics of the scientific field, based on various political and economic influences, “on average” sooner or later lead to a unique state that “attracts” trajectories reflecting the evolution of that state. To ascertain what these states are, we need to study “gatekeepers”, as it is gatekeepers that are the catalysts or inhibitors of social management of the sciences carried out from the outside.

The research is focused on those that “stand on guard” over high-tech, that, within their own field of influence, determine what is promising and what is not, what is considered scientific and what is not, and what is adequately supported and funded and what is not. The gatekeeper model is most evident in the natural and technical sciences, where the role of scientific capital and the authority of research is more defined and less disputed than, say, the social sciences.

Under the “classic” approach which is widespread in foreign literature on this topic, the role of gatekeepers is often restricted to the roles of providing and handing over a particular type of resource. In this respect, expert and intermediary activities occupy a fundamental position. Taking into account the specifics of the Russian environment, it should not be restricted to just one form of activity, in particular, expert activity. Russian gatekeepers combine professionals working in research organizations with expertise in high-tech, but also act as various types of experts at various levels of science and technology development programmes. Their expert activities involve various duties: peer reviewing publications, sitting in on thesis vivas, carrying out expert reviews on research projects, sitting on tender committees, etc. All of these roles directly shape normative perceptions about what is promising and worthy of support, in particular in the high-tech field.

This “researcher – expert” bond which is so characteristic of Russian gatekeepers presupposes the availability of sufficiently extensive resources for individuals. This may be major scientific resources or administrative resources.

At the same time, the scientific practices of agents make a far from uniform contribution to the functioning and development of research institutions: some have a clear impact on institutional dynamics while others have little effect. It could be said that there is a continuum of the influence that individual agents of scientific output have on institutes. At one pole of the continuum there are the "gatekeepers" which are able, to a certain degree, to control the development of a certain part of the institutional spectrum, and at the other pole there are academics whose work has no statistically significant impact on institutional dynamics. The distribution of the ability to actively influence research institutions among individual agents of scientific production is an important structural characteristic of the scientific field in and of itself.

The most perceptible impact on changing the situation of new scientific knowledge production and, in particular, high-tech development comes from heads of "advanced" research laboratories. Capable of forming and carrying out their own research programmes, in the majority of instances they act as "gatekeepers" of the high-tech sector.

In their respective spheres of control, gatekeepers are organized into informal networks: mutual recognition, citations, candidacy nominations, etc. In reality, they are very few in number. And as for their research, it is not a question of a mass survey with a random sample, but rather surveys with a small target sample. In our case, the main target sample was the heads and chief specialists of high-tech development research laboratories who, at the same time (from time to time, infrequently), act as experts across a broad range of activities that are thematically or topically related to high-tech (publications, theses, projects, etc.).

The studies on the subject of "gatekeepers" turn to surveys of the academic community, supplementing the data from the survey with information on patent and publication activity. The closed approach to ours from the topical and theoretical perspective is the Finnish study on gatekeepers in the field of nanotechnology (Nikulainen, 2007).

Research approaches to gatekeepers and gatekeeping

The terms "gatekeeper" and "gatekeeping" have been actively used in social science discourse over the last fifty years. For a long time this concept was mostly used in communication theories, but was later extended to many other theories and areas of activity, including innovative technologies, research groups, effective health care and education mechanisms, expert activity in various fields, etc. As such, the gatekeeper theory is now a tool to analyse the different fields in which agents collaborate and information and goods are disseminated.

Gatekeepers can be any intermediaries (both individuals and groups) situated at the intersection of resource flows, but do not necessarily have to have any resources themselves. In contrast, some studies assert that gatekeepers “control access to benefits that they do not own” (Corra, Willer, 2002). This important feature of gatekeeping means that a gatekeeper can be seen to hold a key position in the structure of network interactions (Marsden, 1983). A gatekeeper acts as a sort of guide for information from the sender to the recipient, the nature of the interactions with which is defined by the type of remuneration, with the uniqueness of the transmitted message reflecting the value. Historically, this role can be traced back to the position of managers, one of the duties of which was to control the contact between a high-ranking individual and the “external” environment.

As a general rule, gatekeepers are more active than other workers in their development of both employment skills and persistent socialization in the work environment and in the work place directly. As such, they not only look to “transmit” information received from the outside, but also pass on information in the other direction, from their colleagues to the outside world (Blau).

Another view suggests examining the position of gatekeepers in the structure of formal hierarchies (Bacharach and Lawler 1980, 2000). This perspective is mainly restricted to an analysis of the structure of formal organizations and the emergence of key administrative positions within them. Studies of the interaction between an organization and the outside world and the role in this process of certain actors (gatekeepers) use the notion of informal communication (Rahm, 1994; Harada, 2003).

Some empirical studies of gatekeepers are based on the notion of social capital (Coleman, 1988) and “structural gaps” in communication (Burt, 1992; Nikulainen, 2007). In both concepts, possession of information and certain connections is viewed as a key resource in the fight for power. In this context, integrating into the information-rich social networks and occupying a position capable of controlling the direction of communications could come to be the object of a competitive struggle. The position of a gatekeeper ceases to be neutral towards the positions of other interaction participants.

Many studies suggest defining gatekeeping and gatekeepers through access to the resources that they provide to individuals or groups. For example, C. Forrest describes gatekeepers as a figure in modern societies positioned “between organizations and individuals who wish to use resources within those organizations. Gatekeepers use discretion when determining who will be granted access to these resources” (Forrest 2003: 692). D. Karen defines gatekeeping as “the process of developing and implementing criteria and practices that yields access to scarce resources” (1990: 227). M. Corra and Willer define gatekeepers as individuals controlling “access to benefits valued by others who are their clients” (Corra and Willer 2002). In addition, access to financial and other types of resources are sometimes directly implied: “The choice of specific projects or endeavors to fund is delegated to decision-makers in subunits, individuals we refer to as gatekeepers” (Pollack, Zeckhauser, 1996: 642).

Gatekeeping in the fields of science, technology and innovation

With reference to *scientific research* the term “gatekeeper” was first used in 1967 by D. Crane in the work “The gatekeepers in science: Some factors affecting the selection of articles for scientific journals” (Crane, 1967). After this work, the notion “gatekeeper” entered the discourse of the social sciences, where it is used to describe the position of an individual who furthers information exchange through informal communication (Allen, 1969). In subsequent works on the role of gatekeepers in the scientific world, many studies have given their own definitions. M. Tushman and R. Katz proposed viewing gatekeepers as “key individuals who are both strongly connected to internal colleagues and strongly linked to external domains” and are intermediaries in the transfer of contacts and knowledge (Tushman, Katz, 1980: 1071). They stressed that gatekeepers are distinct from individuals that have a wide network of contacts within an organization, but are often isolated from their closest colleagues (cf. Allen, 1977, Roberts, O’Reilly, 1979). They also describe gatekeepers as “those stars (i.e. high internal communicators) who also maintain a high degree of extra-organizational communication”. (Tushman, Katz, 1980: 1076). Gatekeepers process and transmit information arriving from the outside, i.e. they have to have sufficient connections and be able (1) to collect such information, analyse it and (2) “translate” it into a language that is accessible and understandable to their colleagues that are only geared towards working within a team. As such, Tushman and Kats describe gatekeeping as a two-phase process. Other researchers view this process in a similar way, describing the interaction between scientific research institutions and the outside world (Whitley and Frost, 1971), between creators and consumers of knowledge (Sundquist, 1978, Crane 1972), and between early and later users of innovations (Rodgers and Shoemaker, 1971, Coleman, Katz and Menzel, 1966), among others.

In the context of knowledge transfer and technology transfer, gatekeepers are described as “leaders who decide which pieces of code get stored in the community and which don’t. Gatekeepers help knowledge transfer over time by contributing to the timely update of knowledge and making it immediately available to others” (Awazu, Desousa, 2004: 1018). Gatekeepers which transfer knowledge can be both individuals and companies or divisions within an organization. Individuals fulfilling the role of gatekeeper must adapt to the receiving culture and knowledge transfer practices; the role of gatekeepers in the field of technological innovations is multidimensional and varies between establishing trustworthy relations, representing the interests of the company to the outside world, transferring information from the outside within the company, etc. (Harorimana, 2001: 63).

In the *innovation sphere*, it is more often than not "technology gatekeepers" that are seen. One of the first studies devoted to the role of gatekeepers in the transfer and development of technology was the work by D. Brown, in which he defined technology gatekeepers as "individuals involved in the diffusion and transfer of scientific and technical information from scientific groups to design offices" (Brown, 1979: 23). Brown described the diffusion of information as a process under the control of several gatekeepers. He depicted these gatekeepers as influential individuals and remarked that in decision-making a gatekeeper does not have absolutely autonomous power, but simply power that is dependent both on objective circumstances and the decisions of gatekeepers on other participants (Ibid.). "The efficiency of this structure may be explained by the key role played by a technological gatekeeper or boundary-spanner on whom project groups rely heavily for information and who contributes to an organization's effectiveness by filtering and channelling external technology and information into the organization. The boundary-spanner serves as a mediator between organizational colleagues and the world outside and effectively couples the organization to scientific and technological activity in the world at large" (Allen, 1970: 192, Robbin & Frost-Kumpf, 1997: 104).

"Technological gatekeepers and representatives are firm-level constructs that measure the degree to which a given firm channels knowledge from one group to another. Global gatekeepers absorb knowledge from foreign firms and convey it to domestic firms. Global representatives absorb knowledge from domestic organizations and convey it to foreign firms" (Spencer, 2003: 432).

Lissoni and his co-authors (Lissoni et al., 2009) appraise the activity of technological gatekeepers based on the number of registered patents. To analyse the patent activity of professors in Denmark, they used the KEINS database which contains information on patent applications submitted in Italy, France, Sweden, the Netherlands and Denmark (data will soon be added on the United Kingdom too). The research methodology is described in more detail in Lissoni's 2006 work.

One of the most recent empirical studies of technological gatekeepers was the work on gatekeepers in the Finnish nano-community (Nikulainen, 2007). In this case, gatekeepers are viewed as participants in projects to transfer new technologies to industry. Among these gatekeepers were university representatives with the capabilities and opportunities to offer relevant research information (Nikulainen, 2007). Nikulainen observed that until recently the role of individual gatekeepers in the knowledge transfer process from scientific research groups to industry has not received much coverage, compared with other actors involved in this process, while it is actually gatekeeping on an individual level that often accelerates and facilitates interaction between these two spheres.

Using nanotechnology as an example, Nikulainen distinguished several aspects that demand special attention when analysing gatekeeping in an emerging technological field: the choice of technology to launch production, regional characteristics, the level of activity among scientific research groups and the accessibility of data. Nikulainen describes gatekeepers in nanotechnology as key individuals with unique characteristics (including thanks to their special position in social networks), namely their capabilities and privileged opportunities to transfer necessary information resulting from research work to companies (Nikulainen, 2007: 3).

The interaction between industrial companies and universities is one of the key aspects in an analysis of technology transfer, with the intensity of the information exchange depending not so much on the specific scientific field where the developments are taking place, but rather on a combination of other factors, primarily the human factor (and the gatekeeper figure). Nikulainen also cites a work in which the authors came to the conclusion that the central position of the gatekeeper within an organization or between several organizations has a positive impact on the results achieved by the gatekeeper in his or her work, on progress up the career ladder or on his or her ability to adapt to an ever changing environment (Cross, Cummings, 2004).

Tushman and Katz remark that the role of gatekeepers depends on the direction of an organization's work (Tushman, Katz, 1980: 1073). From the results of the analysis, the positive influence of gatekeepers on the results of work by academic laboratories was only observed for projects to improve concepts that have already been developed (for example, combining or applying known notions and theories to solve specific tasks, develop new systems and components, etc.). For research projects (both fundamental and applied), the impact was negative, as their interaction with the "outside world" directly was more effective than through gatekeeping. As such, Tushman and Katz affirmed that the impact of a gatekeeper on the results of a project depends on the content of the project. To raise the quality and performance of research projects, gatekeeping turned out to be less preferable than direct collaboration between specialists and external sources.

To analyse the role of gatekeepers in the activity of various organizations, researchers frequently use in-depth interviews, surveys, analyses of sociometric data such as the age of the researchers, their education and work experience, a factor, cluster and regressive analysis, or the Gould-Fernandez model to analyse brokerage in information transfer.

Gatekeeping Human capital in Russia

Research methodology for gatekeepers in science and technology development priorities in Russia

The study of an expert community involved in the development and implementation of science and technology policy in Russia points to the key role of managers in Russian scientific research laboratories, who are concerned not only with assessing the corresponding projects and developments, but are also involved in the development of high-tech themselves. It is with these managers that the main responsibility lies in the gatekeeping of science and technology development priorities.

Research on the expert community associated with high-tech projects logically fits into the "cluster" of foresight studies (Sokolov, 2010; Sokolov, Chulok, 2013; Meissner, Gokhberg, 2013), supplementing it with "human capital".

The most important tasks of a study on gatekeeping in the high-tech sector include:

- studying the organizational and managerial strategies of managers at laboratories associated with high-tech development,
- researching the social and personal characteristics of the experts that allow them to become "gatekeepers" in their area of research.

The innovation in the research carried out by academics at the Institute of Statistical Studies and Economics of Knowledge at NRU HSE[3] lies in the fact that it is one of the first attempts to conceptualize the "human capital" in science and technology gatekeeping in Russia, based on obtaining sociological data on real active subjects. Unlike many studies which look at "ideal schemes", this research will offer analytical information on the specific characteristics and stances of individuals making a decisive contribution to the development of strategic areas in science and technology.

By way of gatekeeping subjects in priority science and technology areas, this study looked to survey individuals meeting the following criteria:

1. Researchers working in one of the following six science and technology priority areas:

   1 – Nanosystems industry
   2 – Information and telecommunications systems
   3 – Life sciences
   4 – Environmental management

[3] The study was implemented in the framework of the Basic Research Program at the National Research University Higher School of Economics (HSE) in 2010.

5 – Transport and space systems
6 – Energy efficiency and energy saving

2. Managers of laboratories, centres or institutes
3. Individuals who make decisions on supporting and/or funding work on projects carried out in priority science areas (for example, including this theme in a programme or allocating funding from a budget on a particular level, etc.) and who are members of one or more committees:
   - Members of expert committees of scientific and technological structures at various levels (commissions, committees under the Government of the Russian Federation, ministries, agencies, etc.)
   - Members of Boards of expert committees of scientific research funds
   - Members of the Board of Directors of large companies
   - Members of the Academic / Thesis Committee of a research institute council or board

Based on these criteria, two target samples were formulated:

1. a list of respondents to carry out a formalized questionnaire survey (n=796)
2. a list of experts to carry out in-depth interviews: managers of leading scientific research organizations, centres, laboratories (n=60).

Both quantitative and qualitative methods were used to solve the research questions. The survey was carried out in two stages.

In the first stage a quantitative questionnaire survey was carried out by means of a formalized interview based on a questionnaire. 796 surveys were distributed in accordance with list 1. 312 completed surveys were received in response, which were used to form a corpus of quantitative data.

In the second stage qualitative information was collected using in-depth semi-structured individual interviews with the managers of leading laboratories in their field based on a guide. In total, 31 interviews were conducted, which yielded qualitative information on the gatekeeping strategies followed by Russian experts.

Main characteristics of gatekeepers in priority science and technology development areas

The sample of surveyed gatekeepers includes members of the main science and technology priority areas (cf. table 1).

Table 1 – Distribution of surveyed gatekeepers by science and technology area

S&T Area	Frequency	Percentage of sample
Nanosystems industry	82	26.30%
Information and telecommunications systems	40	12.80%
Life sciences	57	18.30%
Environmental management	19	6.00%
Transport and space systems	26	8.30%
Energy efficiency and energy saving	38	12.20%
Other areas (none of the above)	50	16.00%

All of those surveyed engage in research work, however only 89% of respondents work at a research institute and 72.6% occupy professorial or teaching roles at higher education institutions. Thus, a substantial number of respondents combine research and teaching work and hold several managerial positions in different sectors of the economy. Only 40% of those surveyed have one job at present and 60% combine their activities at their main place of work with other additional jobs. Thus, 44.6% hold two jobs, 12% have three and 3.4% have more than three places of work. It is important to note that roughly 10% of respondents are members of the boards of directors of commercial companies.

The funding structure for the research and development carried out in the divisions managed by the surveyed respondents is complex in nature (cf. table 2).

Table 2 – Involvement of those surveyed (as manager or executive manager) in projects funded from the sources listed below

Research funding sources	Percentage of sample
1. Funds from Russian state funds supporting scientific and (or) scientific and technological activities	69.3
2. Funds from Russian non-state funds supporting science and innovation	13.4
3. Grants from the President of the Russian Federation	19
4. Funds allocated on a competitive basis as part of programmes by government academies of science	38.5
5. Funds allocated on a competitive basis as part of special programmes (federal, departmental, regional)	55.3
6. Funds from Russian businesses and organizations	26.3
7. Funds from foreign state funds and governmental organizations	29.6
8. Funds from foreign non-state funds and international organizations	13.4
9. Funds from foreign customers (excluding those listed above in points 7-8)	12.8

More often than not there is more than one source of funding, with budget funding being supplemented by other sources. However, the federal budget is indicated as the main source of funding by the overwhelming majority of respondents. Other significant sources of funding, in terms of funding amounts, are Russian state funds supporting scientific and (or) scientific and technological activities (roughly 70% of the sample) and special federal programme funds (roughly 55%).

The analysis of access to research and development infrastructure showed that many forms of infrastructure opportunities are available to respondents within their own or another organization. The worst situation concerns information technology centres and technology transfer centres, to which 22.7% and 24.3% of the sample respectively have access. At the same time, a large proportion of those surveyed indicated that they had no need for these specific structures, which are arguably essential for managers of projects linked to high-tech. Thus, more than half of those surveyed reported that they did not need technology transfer centre services, 44.6% had no need for information technology centres, almost 67% of those surveyed did not require business incubators, and 49% did not need technology parks (table 3).

Table 3 – Access to research and development infrastructure (%)

	no requirement	no access	access through another organization	have in own organization's structure
Design, engineering, technological divisions and organizations	31.3	12.2	13.6	42.9
Test facility (experimental facility)	27.9	12.2	17.7	42.2
Support divisions (workshop, repair services) and organizations	19.9	7.5	8.9	63.7
Centres offering common use of scientific equipment and experimental installations	17.9	9.9	18.5	53.6
Technology transfer centre	55.9	24.3	6.3	13.5
Innovative technology centre	44.5	22.7	14.3	18.5
Educational resources (basic departments in core higher education institutions)	6.0	4.6	27.2	62.3
Science and technology information divisions (library, patent service, etc.)	2.4	0.6	13.5	83.5
Technology cluster	49.2	18.6	10.2	22.0
Business incubator	66.7	16.7	8.8	7.9

This all suggests not so much that the infrastructure already available to high-tech researchers and developers is satisfactory, but rather that there is a lack of development in the communications with centres offering additional services and opportunities which are as yet untapped by Russian researchers. In this situation, the role of gatekeepers as mediators in the communication and exchange of information between internal and external structures should be of particular concern, requiring a special approach.

In the questionnaire survey, respondents were asked about the main sources of information on new technologies and future developments and on the value that these sources hold for the individual surveyed personally (table 4).

Table 4 – The importance of sources of information on new technologies and future directions of research and development

(*assessments are based on a five-point scale: 1 lowest importance, 5 highest importance*)

	1	2	3	4	5
Results of internal research and development by scientific and technological divisions within your organization	12.3%	7.2%	17.4%	19.6%	43.5%
Results of work by other divisions within your organization	19.2%	15.4%	30.0%	16.9%	18.5%
Organizations within a group (associations, unions, holdings…) to which your organization belongs	38.6%	13.2%	18.4%	17.5%	12.3%
Russian scientific publications	15.5%	20.4%	25.4%	22.5%	16.2%
Foreign scientific publications	7.4%	4.0%	10.1%	22.8%	55.7%
Russian and international (held in Russia) conferences, seminars, symposia	10.6%	16.2%	19.7%	26.1%	27.5%
Foreign conferences, seminars, symposia	8.3%	6.2%	14.5%	27.6%	43.4%
Russian and international (held in Russia) exhibitions and fairs	57.9%	14.9%	15.7%	3.3%	8.3%
Foreign exhibitions and fairs	59.8%	13.1%	14.8%	4.9%	7.4%
Patent information	58.7%	11.6%	10.7%	11.6%	7.4%
Informal contact between academics	8.3%	9.1%	13.6%	25.0%	43.9%
Business, organizations implementing the scientific and technological results of your organization	53.5%	11.4%	14.9%	10.5%	9.6%
Consumers of end goods, works, services	56.1%	14.0%	9.6%	8.8%	11.4%
Competing research organizations (in a sector or research area)	25.6%	10.3%	23.1%	23.1%	17.9%
Higher education institutions	34.2%	20.8%	20.8%	15.8%	8.3%
State organizations/clients	57.4%	12.2%	10.4%	9.6%	10.4%
Consultancy, information firms	77.7%	8.0%	8.0%	1.8%	4.5%

The results of the survey showed that the most important sources were foreign scientific publications, which received 78.5% of the highest assessments (for comparison: Russian scientific publications were important to only 38.7%). The second most important was foreign conferences, seminars and symposia (71%), third was informal contact between academics (69%) and, finally, fourth was the results of internal research and development (63%). In the context of the respondents' field of activity (high-tech), the views on the importance of patent information, which holds the greatest importance for those surveyed, appear especially paradoxical. Exhibitions and fairs (both Russian and foreign), consultancy and information firms, and, even more paradoxically, state customers were not so important to the respondents.

It can be seen that, on the whole, foreign sources of information gains more trust and interest than Russian sources. Consumers, customers and organizations implementing scientific and technological results hold little value as sources of information for the surveyed high-tech developers and managers of projects in priority science and technology development areas.

In line with the project objectives, the types of activity carried out by the respondents that marked them as gatekeepers in their scientific and technological fields were identified. In particular, we recorded various forms of involvement by those surveyed in projects linked to high-tech development and progress which, to varying degrees, reflect their role as intermediaries between researchers and managers of resources for research activity: involvement in the development and/or implementation of projects, involvement in expert reviews/assessments of projects, defining the subject matter of projects and programmes funded by the budget, involvement in the development and/or discussion of special federal programme design, and preparing and/or revising the list of critical technologies in the Russian Federation. More than half (60%) of those surveyed were involved in determining the subject area of projects and programmes funded by the budget (figure 1). Taking into account the particular importance of this source of funding for Russian researchers, it can be said that those surveyed sought to occupy an active position in the distribution of resources and to ensure that a research and development subject close to the resources was carried out.

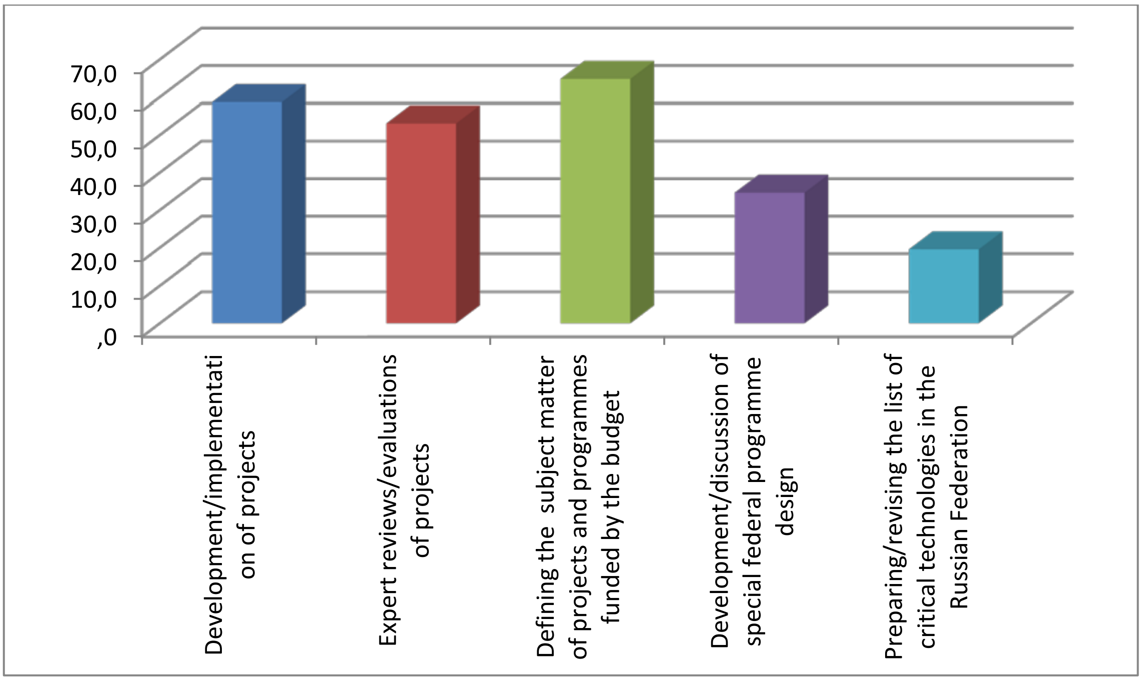

Figure 1 – Forms of individual involvement by surveyed gatekeepers in projects in priority science and technology development areas

In line with the respondent selection criteria for the sample, all respondents were involved in one form or another of expert review of projects linked to high-tech. These expert reviews are carried out in committees or councils on various levels: local, regional, national, international. The survey indicated that the highest gatekeeper activity was seen on a national level (figure 2). 60% of those surveyed were involved in this form of expert review, while only 30% of those surveyed (half as many) were involved in the most important form of expert review as part of international expert committees. However, their involvement in international committees does speak highly of the recognition of Russian researchers abroad and has not only economic but symbolic value.

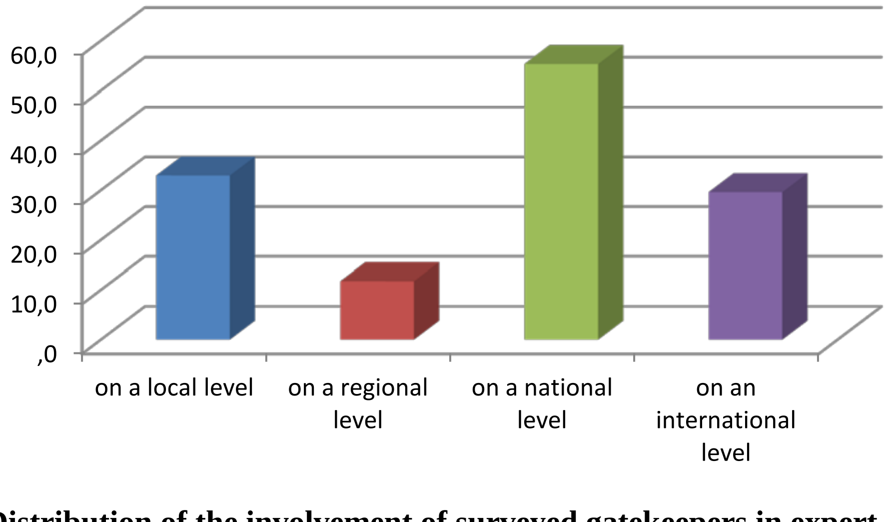

Figure 2 – Distribution of the involvement of surveyed gatekeepers in expert reviews on various levels of projects in priority science and technology development areas

The expert activity of those surveyed, taken in its broadest sense, includes involvement in expert reviews of Candidate and doctoral theses (in which 63.7% of respondents were involved, as members of the corresponding committees) and peer reviewing and editing articles in academic journals (46.4% are members of the editorial committees and boards of Russian journals and 21.8% are members of such committees and boards abroad). In addition, one tenth of respondents in our sample were involved in work by expert boards and committees at municipal legislative and executive authorities, and more than 4% are experts at federal government bodies (table 5).

Table 5 – Distribution of surveyed gatekeepers according to membership of professional and expert organizations

Organization type	Frequency	Percentage
Russian professional research communities/associations	156	50.3
Foreign and/or international professional research communities/associations	136	43.6
Editorial board/committee of a journal(s) in Russia and CIS	144	46.4
Editorial board/committee of a foreign journal(s), excluding CIS	68	21.8
Academic board of a Russian research organization (higher education institution)	205	65.9
Academic board of a foreign research organization (higher education institution)	14	4.5
Specialist board for vivas of Candidate or doctoral theses	198	63.7
Organizing committee of an international conference	171	54.7
Board of directors of a commercial company	31	10.1
Expert board/committee at federal legislative and executive authorities	33	10.6
Expert board/committee at regional and municipal legislative and executive authorities	14	4.5
Expert board/committee at regional and municipal legislative and executive authorities	31	10.1

According to the survey results, more than 43% of respondents are members of foreign and international professional research communities, almost 22% are part of editorial boards for foreign journals, and 4.5% are members of academic boards for foreign research organizations. At the same time, if you look at the expert activity of the surveyed gatekeepers in the narrow sense, i.e. as involvement in the distribution of resources, then it is important to note that there are far less among those surveyed on the expert committees of funds supporting the sciences. In this respect, 35% of those surveyed are members of expert boards for Russian funds, while only 6% are on the boards of foreign funds.

A more detailed examination of the resources and practices of surveyed gatekeepers requires an analysis of the existing research and expert capital available to them, as well as their connections.

Gatekeepers’ research and expert capital

Gatekeeping in the fields of science, technology and innovation is directly linked to “scientific production”. The approach to this notion is based on the merits of studying the reproduction of scientific knowledge “from the top down”, i.e. not from isolated individuals, but from the distributed whole that is being reproduced, which in the process of its own on-going reconstitution organizes both the distribution of resources for research practices and the distribution of relational properties inherent in agents of scientific production.

From this perspective, scientific production can be conceptualized as an ensemble of dynamic structures and agents integrated into them. All scientific production and, accordingly, “research gatekeeping” stems from a combination of feedback and regulation, which overcome the independence of the conduct of (individual and collective) agents and direct their egotistical isolation towards a particular goal. Competition for scientific recognition, administrative and financial resources and specialization, cooperation, imitation, etc. modify the practices and perception of gatekeepers and researchers, but the goal is an extreme principle, selecting actual behaviour from what is conceivable.

Scientific production can be described, first, by the distribution of all the types of resources needed for scientific practices, as well as those linked to the distribution of the active properties of scientific production agents and, second, by the stakes of a scientific game and specific interests that cannot be reduced to stakes and interests inherent in other types of output, and which are perceived only by those who are integrated into this output.

To explain the multitude of scientific production events, we need to learn how to design the most important, *“cardinal sociological value”* that, ignoring unimportant details, would express the essence of this diversity as simply as possible. In its own way, this value must synthesize the relationship between different events, offering a single overview of scientific production. Of course, in various studies, the set of sociological variables reflecting the properties of the scientific production events and used to construct this cardinal value may be different. However, the cardinal sociological value must be structurally stable, i.e. be such that any small changes in the model (for example, an increase or reduction in the number of variables used) cannot significantly affect its value. We will refer to these cardinal values as *scientific and expert capital*.

The notion of *scientific capital* reflects the emergent quality of all of an agent’s active properties. By this, we mean properties that are understood to be socially important resources for future scientific production which regularly yield an income for the agent, defined through the stakes of the game within the current production; as such, these resources exist for a long time. In other words, scientific capital determines an agent’s chances of achieving scientific recognition and/or occupying an administrative post. Therefore, in our framework, the notion of "scientific capital" is the relationship of scientific production, which can be studied empirically through its manifestation in production.

From the perspective of sociological theory, scientific capital is a characteristic function, i.e. a function of the state of the corresponding independent parameters (the active properties of the agent), which, through this function (and the parameters produced on this basis), can clearly describe all of the social characteristics of a scientific production agent that interest us. Scientific capital can be used to explain corresponding patterns, i.e. any subsequent events in scientific production, as the distribution of scientific capital evidently reflects the state and dynamic of production structures.

Since scientific capital is linked to the specific scientific income conditioned by scientific production, an agent's desire to maximize income can be described as a local optimal principle selecting real scientific practices from all possible options available to the agent. It should be noted, however, that every agent can have its own optimal principle, the functioning of which is restricted by its social trajectory and position in scientific production. Later, this principle is usually realized not in the form of rational planning, but post factum: it is realized as the coherence of an individual's practices shaped by the conditions of the individual's existence as an agent in the scientific field. Moreover, there is a hierarchy of optimal principles: aside from local principles, linked to specific positions, there is also a global optimal principle, which is the same for all scientific production and establishes a hierarchy of local principles.

In general terms, a local optimal principle which constitutes an agent's scientific capital is implemented in the process of deploying a certain self-training adaptive search strategy which is based on selecting profitable combinations of active properties values. The central problem of every local strategy is searching for a balance between efficiency and the sustainability of the social trajectory of a scientific production agent, i.e. achieving optimal results, in some sense, in different indefinite social situations. Therefore, we can conceptualize scientific capital as the "functioning" of a system of active "forces" which, generally, describe the multitude of possible positions for a particular agent in scientific production.

Research into scientific capital is associated with the analysis and conversion of an encoded multitude of events. In this case, events are taken to mean outcomes from sociological experience which fix the active properties of scientific production agents. The methodological basis of such an analysis is the principle of cumulative advantages: the higher the credit of an observed value of an active property, the higher the likelihood that the active property will in future be more pronounced in an agent. Accordingly, the lower the credit of an observed value of an active property, the lower the likelihood that the active property will intensify in future.

A mathematical object, called an "operation", allows us both to describe the properties of an agent in the scientific production system, and to form an equation for the probabilistic structure of an agent's social differences, which expresses the necessary and sufficient condition for the probabilistic structure of differences to correspond to the set system of active forces. This term operation serves as the main confirmation of scientific capital in the form of the optimal principle.

Operation is when a certain definition transfers from the state of producing to produced. Since the change is conceived as the result of an operation, the operation expresses the property of changeability. Accordingly, in our study, the functional of operation describes the changeability of scientific capital.

All of foregoing also pertains to *expert capital*, with one difference, however, that it can serve as a cardinal sociological value designed to explain conduct that is characteristic of gatekeepers in the field of scientific production. Expert activity is understood to be broader than mere involvement in expert committees. This covers various practices: involvement in determining the subject matter of projects and programmes funded by the budget, involvement in the development of special federal programme ideas, determining priority science and technology development areas, peer reviewing publications, sitting on thesis defence panels, carrying out expert reviews of research projects, working on tender committees, etc. Thus, expert capital is a central characteristic of gatekeepers.

In our study, the importance attributed to scientific capital by the respondents was determined from the empirical functions of social differences calculated on the basis of 50 variables describing the properties imparting scientific power and influence. In turn, the importance of expert capital was determined on the basis of social differences calculated from 31 variables which, as a whole, characterized the position of the respondent in the scientific expertise system. The results obtained are shown in the corresponding histograms in figures 3 and 4.

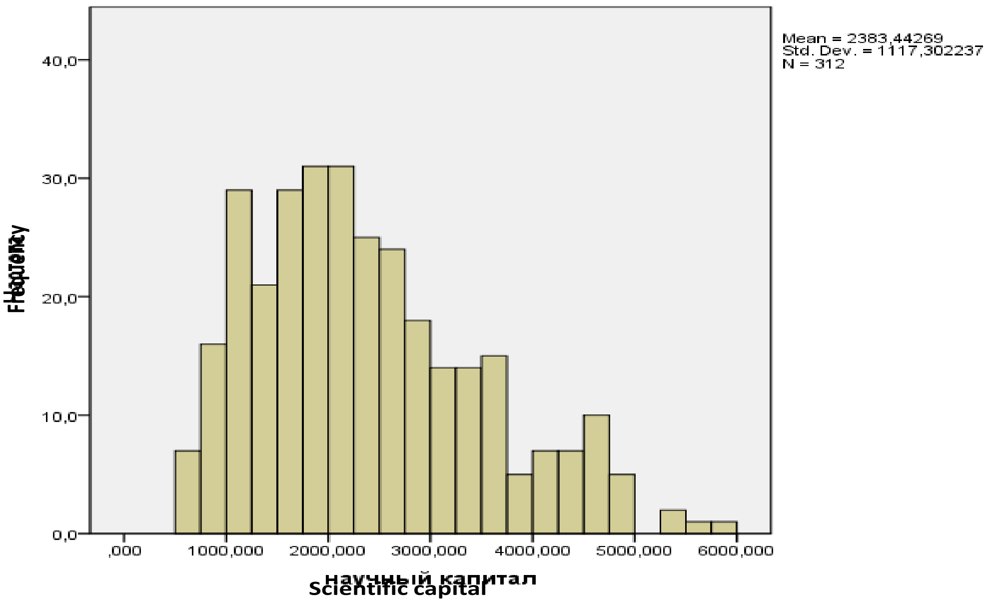

Figure 3 – Histogram of the distribution of research capital

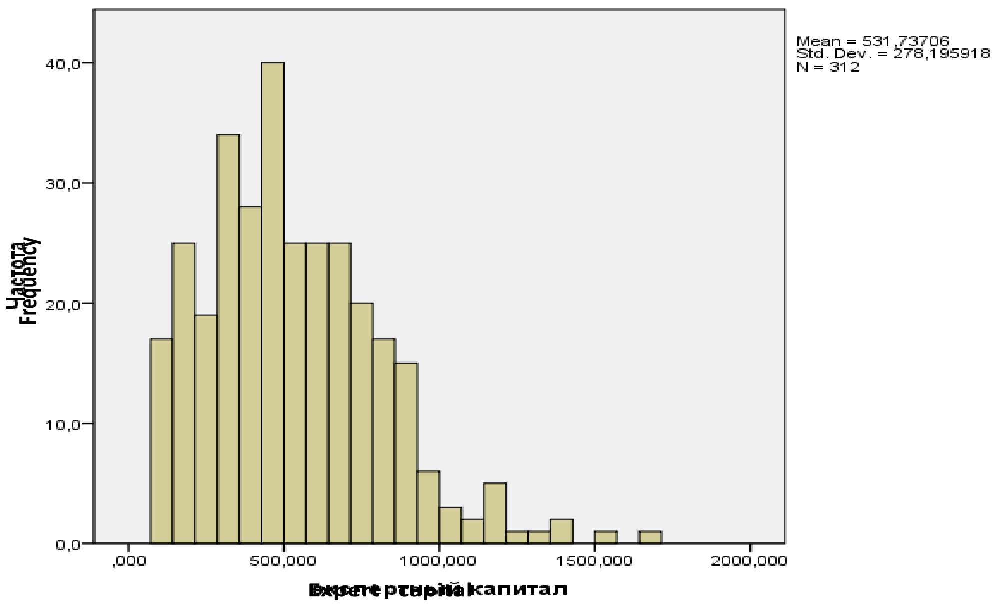

Figure 4 – Histogram of the distribution of expert capital

The distribution of scientific capital and the distribution of expert capital are both subject to the same law of probability – gamma distribution (cf. figures 5 and 6). In applied mathematical statistics, a gamma distribution can be used to describe the distribution of the population's income and savings in certain specific situations (Aivazyan, 1983, p. 199), so the appearance of this distribution in the case of distributions of the probability of expert and scientific capital serves as confirmation of the fact that we have adequately operationalized the corresponding notions.

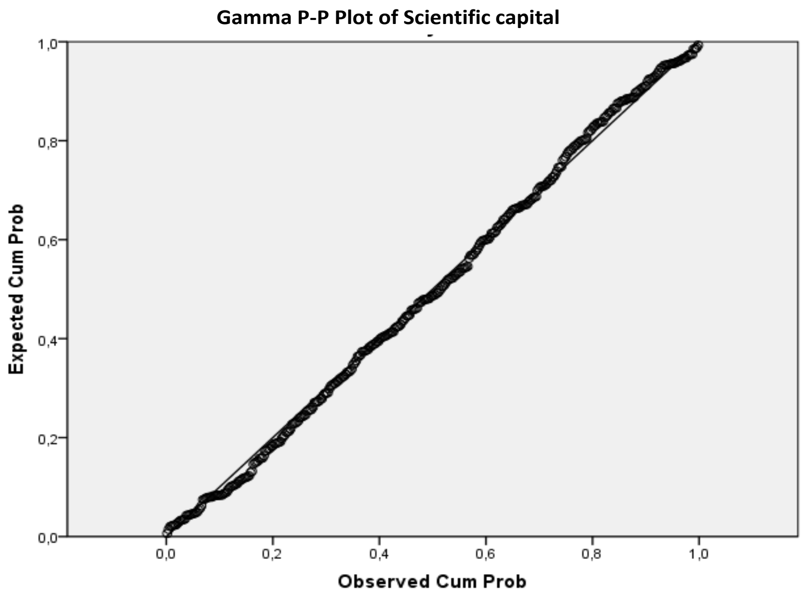

Figure 5 – Probability graph of the empirical function of the distribution of scientific capital on the assumption that it follows the gamma distribution

However, despite the fact that the empirical functions of the probability distribution of scientific and expert capital are subject to the same law of probability, there are no statistical links between them: the Pearson correlation coefficient is 0.229 and the Spearman correlation coefficient is 0.247 (both achieving a statistical significance of 0.01). The scatter diagram in figure 7 points to the lack of correlation between these two forms of capital in the studied sample.

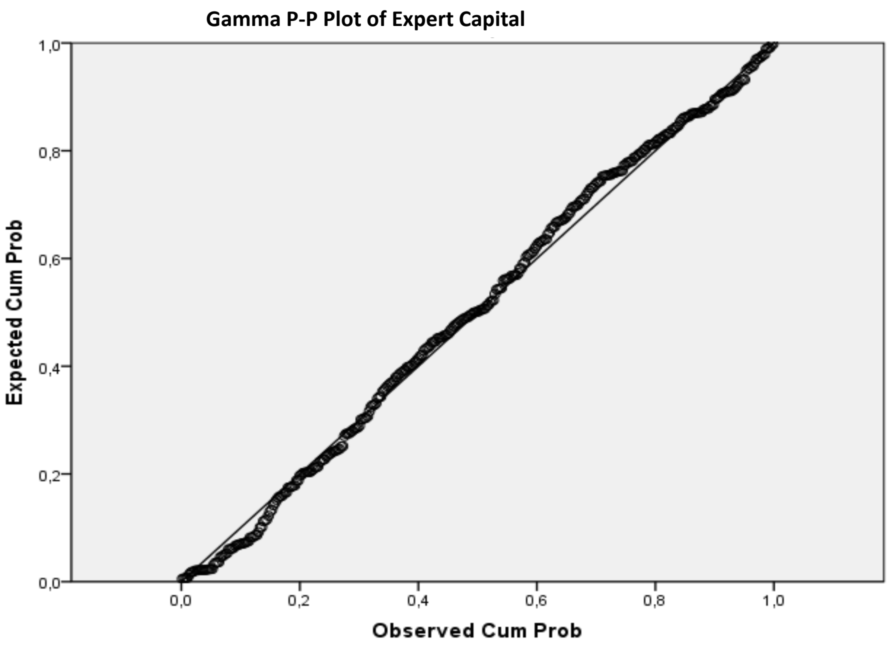

Figure 6 – Probability graph of the empirical function of the distribution of expert capital on the assumption that it follows the gamma distribution

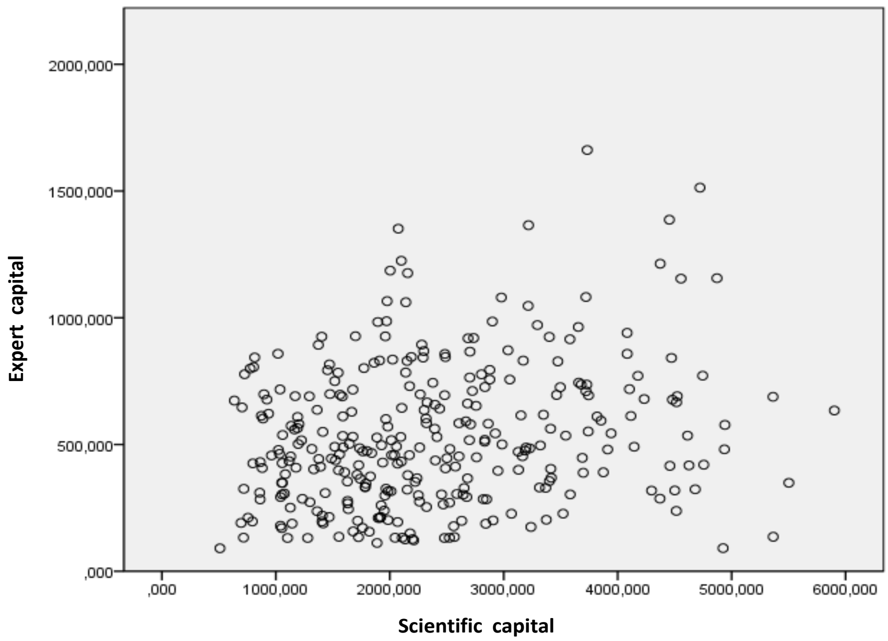

Figure 7 – Scatter diagram for scientific and expert capital

Thus, based on the results of the sample study, there was *no relationship observed between scientific and expert capital*. This can be explained as follows.

There are periods when scientific production is stable, predetermined by its previous states, and can be predicted. However, there are intervals when it is "shaken up", as it were (Katok, 2005; Khaitun, 2007): scientific production "forgets" its patterns, and that which was previously stable starts to become unstable and washes away; fluctuations start to appear which, over time, are not suppressed and turn out to be critical, destroying the correlation between events. In such intervals the link between scientific capital and mobility is accidental: every time it is shaped by a multitude of incalculable circumstances, in particular those external to factors relating to scientific production, the dispositions of agents developing over time, etc.

In other words, there are moments in the evolution of scientific production when the reproduction of its patterns are predetermined stably by more general social conditions. We will refer to such moments as "ordered". However, there are also "chaotic" stages when the reproduction of patterns becomes unstable or stochastic. It is at these points that new patterns are selected. It is significant that the selection is chance in nature inasmuch as, firstly, it is conditioned by a multitude of dissimilar and divergent factors and, secondly, alternatives are practically equally probable and on the same footing. It should be stressed that the emergence of new patterns of scientific production can be represented as the fixation of a random selection of a certain variant (ensemble) of regularity out of several variants belonging to the same set, so that the a priori probabilities of different choices are essentially the same. It was not without good reason when we say “Such a state of affairs has developed over time” as we mean that it occurred by chance.

Generally speaking, the evolution of scientific production can be likened to the dialectic triad: thesis – antithesis – synthesis. It is not hard to notice that the stages of evolution designated by “thesis” and “synthesis” are ordered (but “synthesis” belongs to a higher level of evolution, though, of course, involution is possible), where as “antithesis” is chaotic (Chernavskiy, 2009). It turns out that new patterns of scientific production events arise during the “chaotic” period of development, that chaos breeds innovation.

It can be argued that the sociological information obtained during the course of our research can be associated precisely with the “chaotic” stage of the evolution of Russian scientific production: previous patterns did not already exist, new ones were not yet developed, and so the external and internal efficient causes do not yet give rise to the usual consequences. Such a historical situation explains the lack of statistically significant links between the expert and scientific capital of scientific production agents.

But what caused the current “chaotic” state of Russian scientific production? It is well known that a significant proportion of scientific research is funded by state institutions and the military, which are both interested in fundamentally new technologies and technical facilities. When the state and military contracts dry up, some leading scientific and military centres deteriorated and others started to attempt to radically change their approach, copying Western examples of organization and research. As such, this generation of managers has not changed, but there was a mass emigration of the most active researchers, with the remainder left, by trial and error, to develop strategies to adapt to the new socio-economic conditions. A situation then developed where the diversity of the characteristic conduct and active properties of scientific production agents started to increase rapidly. This led, we believe, to a mismatch between expert and capital capital.

The results obtained point to the conclusion that *a gap has been growing between scientific and expert activity in Russia, hindering effective communication between researchers and decision-makers on science and science and technology policy* who are also acting as experts in this area. In all likelihood, people whose scientific capital does not have any fundamental value tend to become experts in structures developing and implementing science and technology policy. What is more important is administrative capital, based on the positions occupied and existing ranks. With regard to the notion of gatekeeping, we can conclude that this phenomenon has not yet been fully developed in Russia. There are simply not the structures capable of effective communication between researchers and regulators.

Gatekeepers' expert activity strategies in priority science and technology development areas: main results from the interview analysis

Qualitative data on the activities of leading Russian academics in various high-tech fields (organization of research, implementation of developments, involvement in expert reviews of projects, collaboration with the authorities and society) was collected through in-depth interviews. 31 scientific research managers in the high-tech field were interviewed. When determining the list of respondents, the priority went to those who only carry out active scientific activity, but also occupy managerial roles in their organizations and have experience of carrying out work ordered by commercial structures and collaborating with state bodies.

The interviewed managers worked across a wide range of high-tech projects. The most represented fields were nanotechnology and new materials (7 people) and biotechnology (5 people). In the ICT, energy and energy saving, nuclear technology, and ecology and environmental management fields there were 3 interviewed managers each. 2 people worked in each of the earth sciences, space research, aviation and transport systems fields. Microelectronics was represented by 1 respondent. From the perspective of geographical distribution, the majority of interviewed gatekeepers currently work in Moscow (22). 5 work in St. Petersburg, 2 in Novosibirsk and 1 in Sarov (Nizhny Novgorod Oblast).

The main topics discussed with the gatekeepers at the interview were:

- Their activity in the high-tech sector: research, developments, implementation (forms of work and the nature of interactions with customers; patent activity; interaction with other researchers and developers);
- Their expert activity (involvement in the work of government bodies; involvement in expert reviews; involvement in the development of forecasts, plans, programmes; writing textbooks; academic authority; attitude towards "questionable" projects);
- Their active promotion of scientific and technological priorities ("lobbying" activities) in executive bodies and the media (GR and PR strategies and tactics in gatekeeping).

As for the content of the work actually carried out by the interviewed gatekeepers, they fell into two groups: fundamental scientific research and applied market-oriented scientific research. Scientists working in the academic sector tend to occupy themselves with the first type of research. However, the majority of them regularly carry out work to solve real business problems or to generate a marketable product. In this respect, many scientists remark that such "subject-oriented work" allows them to discover new solutions to more fundamental problems.

From the perspective of receiving funding to carry out their own work, three main marketing strategies among Russian academics and the research organizations managed by them can theoretically be identified. In a number of cases, a combination of several strategies is used:

1. An orientation towards fundamental research carried out with funding from the Russian state budget and foreign grants.

2. Working on applied developments, the main customer of which is the state, including state corporations (for example, the defence industry, aviation, nuclear energy).

3. Working on applied developments for non-state companies.

In one form or another, applied developments for non-state companies are the focus of almost half of the interviewed respondents. In a number of cases, the customers are transnational corporations, which offer a global area for the work being carried out.

When working with customers on the open market, the main problems identified by the interviewed gatekeepers include low demand for innovation, the existence of monopolies and monopsonies, corruption in commercial structures, and the lack of skilled workers prepared to work with new technologies. For our part, being self-critical, there is a lack of specialists at research organizations capable of effectively commercializing their work. Nonetheless, there are examples of long-term cooperation between research centres and customers and the use of strategic collaboration agreements.

An overwhelming number of the interviewed gatekeepers (up to 90%) in one form or another oriented their work towards order-based projects or work for the state. In these conditions, the possibility of receiving a state contract or initiating a dialogue with the state becomes one of the key skill sets of managers at research organizations and of leading Russian academics. Moreover, in a number of cases, it has been observed that the existence of a substantial state contract allows certain members of research institutions to not have to exert serious effort to work on the market.

Among the problems of working with the state mentioned in the interviews, the most serious were the ineffective system used to manage state contracts in the research and development sector and corruption. But the bulk of the grievances were directed at the control system, which suffers from excessive bureaucracy and pointless paperwork. Despite the high over-organization of the state contract procedure, the tender system allows applicants to win which do not have the appropriate qualifications and are often predisposed towards the role of racketeering intermediaries. In terms of conceptual complaints regarding the system of awarding state contracts, some remarked that it is geared towards encouraging imitation of research and incompatibility with thorough long-term research.

The current system of grant-based support for the science is viewed positively, but some noted that the grants allocated were too short-term, which stands in the way of more comprehensive work. Work with small grants and small-scale contracts (including state contracts) is associated with prohibitively high costs in terms of securing them and keeping records thereafter in view of the small amount of funding on offer, which often makes them turn primarily to organizations with extremely low labour costs. In reality, this type of funding is actually, in its own way, a type of benefit to support employment in the scientific field.

The research carried out showed that far from all Russian academics devote sufficient attention to working actively and comprehensively to patent the results of their work. The highest level of patenting activity is exhibited, predictably, by members of the fundamental sciences. The main obstacle to securing international patents is the high cost and difficulty that academics experience in assessing the commercial prospects of their inventions on the global market. In some cases, patenting is done without any deliberate pressing reason, but in many cases it is down to inertia, or “just in case”. Most alarming is the lack of understanding by many scientists regarding the purpose of patents and the lack of perceived links between patenting and commercial activities.

Most of the scientists interviewed actively interact with colleagues in their scientific division, maintain informal interpersonal ties and cooperate with others in their work. This communication performs an important function: forming and supporting a scientific environment. A number of respondents observed that in Russia the unique feature of this scientific environment was the formation of “scientific schools”. The system of interaction within a scientific environment presupposes, above all else, the exchange of information on research being carried out and the results of research. Often, this type of interaction takes place through scientific committees, groups and associations. Within these committees, information is not only intensively exchanged between scientists, but the future directions of research are determined and the work carried out by different groups is organized.

The expert activities carried out by Russian gatekeepers fall into three main groups: 1) involvement in the work of various collective bodies: commissions, committees, working groups; 2) involvement in the appraisal of planned decisions, carrying out expert reviews of various projects proposed to the state or corporations for further funding and development; 3) involvement in the development and drafting of various future forecasts, plans, development programmes.

Roughly half of the respondents mentioned involvement in the work of various committees. In the main, the work was as part of committees set up by a government authority. Unlike countries with a well-developed parliamentary culture, the Russian legislative bodies make inadequate use of the opportunity to involve scientists in the work of parliamentary committees. Although, in recent years, there have clearly been some positive changes, and the position has changed significantly thanks, in part, to the efforts of the Ministry of Education and Science’s Science Council, which was set up on 1 April 2013. There are 22 Russian scientists on the Council. 10 of them represent the institutions of the Russian Academy of Sciences, 10 are from leading universities and 2 are from industry research organizations. The Science Council was set up at the ministry as an advisory body to prepare proposals to raise the effectiveness of science and technology activity and innovation activity, including to discuss state science programmes and to carry out expert reviews of corresponding legislative enactments.

Expert work evoked more positive feelings among the scientists than involvement in the workings of state or corporate committees. In their minds, they are more closely in tune with their skill sets. When working with external customers, scientists are most actively involved in expert reviews of various applications for funding for scientific research and evaluating the results of these studies. They are called upon to evaluate various investment projects and also to draft findings on the causes of emergencies, accidents or shoddy workmanship. One of the main problems with expert activity is not only the closed nature of the procedure, but also the narrowness of the scientific community itself and the lack of truly qualified specialists in Russia across the entire spectrum of on-going research, in addition to specialists offering opposing views. They also pointed to the relative weakness in Russia of expert reviews on projects of an applied nature. This, in their view, is one of the most serious obstacles to furthering innovation and attracting investment in this area.

Scientists not only participate in expert reviews of documents already prepared by somebody else, but also play a role in drafting them themselves. In this respect, such work is done not only in relation to dealings with the authorities, but also on the initiative of scientists themselves. One of the priorities for scientists in this regard is participating in the drafting of forecasts and lists of future science and technology development priorities, as well as preparing state programmes, strategies and plans. However, the majority of the scientists interviewed believe that these lists of priorities depend on “scientific fashions” and the situation at the time, and programmes and strategies do not always take into account the position of the scientific community. Gatekeepers believe that work needs to be undertaken on a regular basis to track trends in the development of science and technology and to draft corresponding surveys and forecasts.

When carrying out expert activities, the majority of gatekeepers repeatedly come across projects that are “questionable” from the perspective of modern scientific approaches and feasibility. “Questionable” projects become particularly dangerous for society when they start to be pushed through by the authorities on various levels, bypassing the conventional system of scientific expert reviews. Many respondents noted that the Russian scientific community tries as much as possible to resist the onslaught of “lobbyists” supporting such projects, who are, in the powerful words of one gatekeeper, “the forces of ignorance, incompetence and greed”.

Writing textbooks is one of the main areas of activity of Russian gatekeepers, aimed at promoting scientific ideas, making them more popular and establishing certain standards in the discipline or area of research. However, far from all leading Russian scientists are involved in textbook writing. This is linked not only to the large amount of work involved, but also to the fact that many scientists are diverted away from the educational process. Closing this gap helps to strengthen collaboration between academic institutes and universities and to involve scientists in teaching activities.

A substantial number of respondents have good stable relations with the authorities. The importance of attention to high-tech projects from the executive authorities was stressed repeatedly by the respondents. In Russia, where the state is still the main source of funding for the sciences, good relations with the authorities are a key factor not only for success, but sometimes also for the very survival of scientific organizations. Moreover, government attention to specific developments not only makes it easier to obtain state funding, but also offers administrative support and raises the status of projects in the eyes of private investors.

The respondents considered one of the key objectives of gatekeeping to be the ability to "enlighten the authorities", to communicate the results and the development prospects of scientific work. In this regard, the task of gatekeepers is not so much one of obtaining direct funding, but rather asserting positions that are important for society or the country as a whole. For example, when adopting state programmes or legislative acts that are important to a specific industry.

The respondents identified the main problem in terms of efficient high-tech gatekeeping as being the unwillingness of executive authorities to change their approaches or to correct decisions that they have adopted. Furthermore, in their opinion, the executive authorities are too immersed in solving short-term, operational objectives and require the same fast and ready recommendations from the sciences.

Appealing to public opinion is an alternative direct approach that scientists can use to appeal to the authorities. Currently, this type of public appeal is not especially common in Russia. However, there are some positive examples where even partial success can be seen as a victory.

Almost all respondents reported public relations as being important. But only some respondents were prepared to engage in targeted PR activities: establishing stable relationships with the media, preparing special information reports, and engaging with issues of public importance. A proportion of the respondents understood PR to be a mostly educational activity. The majority of respondents, in expressing approval and supporting the need to further their studies, did not have any clear stance with regard to PR activities or the whole PR system. In the main, they are satisfied with a website and giving presentations at scientific conferences, with them often not making any serious efforts even to develop these limited forms of work.

Conclusion

The analysis of the data collected on Russian gatekeepers in priority science and technology development areas in Russia has shown that they perform several important social functions.

First, they *guide scientific research*. They determine the direction of the work by the scientific organizations that they manage and which objectives are viewed as priorities. To a large extent, their personal qualities determine whether the work will exclusively be a research project or whether the achievement of an applied result sought by the market will be among the priorities. During the interviews, we encountered both those engaged in fundamental areas who are successfully developing applied research geared towards the market as well as scientists who refuse on principle to work with applied research, despite the demand. They – the gatekeepers – are also responsible for the ways in which the research will be conducted and how the results are used: how scientists communicate within an institution, whether to cooperate with colleagues from other organizations, or whether to set up small innovative companies to commercialize the developments.

The second important function is their involvement in *shaping the content of the projects carried out*. Amid the uncertain demand for scientific research from Russian industry and the ever changing priorities of the state's science policy, Russian scientific gatekeepers are forced, to a certain degree, to become generators of research projects. Many respondents are working on developments on their own initiative. This shows their willingness to take risks and a good knowledge of modern scientific trends and the target market environment. The ability to correctly formulate the content of a long-term project, to submit it to potential customers and to defend its importance and topicality is one of the essential attributes of a gatekeeper.

In this regard, we can identify a third function of a gatekeeper – *communication between a research organization and a potential customer*. The talents of these skilled communicators determines whether a research contract will be awarded, the value and duration of funding, who will act as the lead organization, and whether the project will be developed further. The involvement of an organization in large-scale, long-term projects carried out by the state, establishing long-term sustainable partnerships with major corporations, or involving an institute in the implementation of corporate strategic development programmes are the result of top class communications.

It is important to highlight a fourth function of a gatekeeper as *a carrier of certain moral standards* and attitudes in the scientific community. And since these rules may change over time, it is gatekeepers that ensure that ideas about what is “normal”, proper and improper are formulated and preserved. It is their position as moral authorities that reflects the current state of these notions.

Alongside this function, there is a closely-related fifth function – *upholding professional ethical standards* and complying with formal procedures for the functioning of the scientific community. Despite the difficulties of the last few decades, Russian science as a whole has been able to hold on to ideas of scientific ethics and the system to screen for “questionable” projects. To counter the “questionable” projects, the scientific community uses a set of institutions and measures, chief among which are presenting the results of work carried out to the public, peer reviews and expert evaluations of publications, open discussion of results, and the need to confirm theory through experimentation. The purpose of gatekeepers is to uphold and develop these institutions. As the interview results show, leading Russian scientists understand the importance of this task; all of the respondents agreed with the need for thorough compliance with these procedures.

Upholding standards and protecting experience makes sense when there is somebody to inherit these standards and experience. Therefore, the sixth function of gatekeepers is to *relay existing experience to scientists* and successors. As such, gatekeepers engage in teaching and educational activities: they give lectures, train graduate students, write textbooks and establish scientific schools. Many of those surveyed remarked that today the question of who will replace the older generation of scientists is coming to be one of the most critical and challenging of all questions. However, not all of them are actively involved in the activities listed above. This is linked not only to the large amount of work involved, but also to the fact that many of them work in academic institutes, away from the educational process. Attempts to closing this gap by strengthening collaboration between academic institutes and universities and involving scientists in teaching activities are met with appreciation by those surveyed. However, the majority of respondents still take a rather passive stance towards this question.

The seventh function of gatekeepers is to *represent the opinion of the scientific community to the state*. To do this, they establish personal relationships with authority officials, take part in the work of the collective bodies formed by the authorities, work as experts on draft decisions and evaluations of results, and participate in the development and drafting of various future forecasts, plans and development programmes. Every time, by taking part in such activities, a scientist is not only able to convey his or her stance and or view of the future development of a scientific area to the decision-makers, but is actually able to represent the entire scientific community, science as a whole, and to defend its interests.

By performing this role, scientists have to translate the ideas about the world, results of research, and views on the country's and the world's development prospects developed by them and their colleagues into a language that can be understood by the leaders of a country, an industry or a region: a language of laws, orders, estimates and investment project wordings. Admittedly, today the majority of respondents do not find this activity very satisfying. Above all, this is because they are only drawn into such work sporadically, and the result obtained seems to be far from ideal. Nevertheless, the majority of respondents are prepared to continue their activities to promote high-tech.

Finally, the eighth function of gatekeepers is to *communicate with society as a whole*. In this regard, their purpose is not only to explain the results of the research carried out, but also to educate the population. Nowadays, scientists have to explain to your average Russian man in the street not only the effectiveness of investment in specific research projects, but also the need for science for society at large. Unfortunately, few contemporary Russian scientists are ready for such a dialogue with society. And it is not for want of trying.

Almost all respondents reported public relations as being important. But few are willing to devote serious attention to this type of activity. The majority, while expressing approval and supporting PR for scientific research, do not have an integrated PR system and simply content themselves with keeping a website and giving presentations at scientific conferences. And even such limited forms of work are often not undertaken with any serious effort. Even in the interviews, many could not clearly speak about their work and their results, could not give examples of focused work with the media, and could not give examples of effective PR companies.

Overall the study has shown:

1. An orientation towards the development of high-tech is linked to the implementation of the social strategies of experts and laboratory managers, which can be split into three groups:

- those wishing to receive recognition from competent colleagues (a strategy of maximizing scientific capital);
- those wishing to receive economic benefit from commercializing research and development (a strategy of maximizing economic capital);
- those wishing to receive support and recognition from state and administrative institutions (a strategy of maximizing social capital).

2. The involvement of a laboratory manager (and, correspondingly, the laboratory itself) in high-tech development is linked to the particular structure of the characteristics reflecting the configuration of the practices and properties both of the manager him or herself and of the group

as a whole. An orientation towards work “at the forefront” of science and technology is linked to “high-value”, “rare” specific forms of social and personal characteristics in a manager.

3. The activity of a laboratory manager in carrying out high-tech research is shaped not so much by external factors, as the internal structural dynamics of the scientific field and the situation that the laboratory and the manager him or herself occupies within it.

4. A gap has been growing between scientific and expert activity in Russia, hindering effective communication between researchers and decision-makers on science and science and technology policy who are also acting as experts in this area. In all likelihood, people whose scientific capital does not have any fundamental value tend to become experts in structures developing and implementing science and technology policy. What is more important is administrative capital, based on the positions occupied and existing ranks. With regard to the notion of gatekeeping, we can conclude that this phenomenon has not yet been fully developed in Russia. There are simply not the structures capable of effective communication between researchers and regulators.

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