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Natalia A. Shmatko, Valentina A. Permyakova

THE CONTRIBUTION OF ENTREPRENEURIAL SKILLS TO THE SOCIAL STRATIFICATION OF HIGHLY QUALIFIED R&D PERSONNEL: THE CASE OF RUSSIA

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Natalia A. Shmatko[1], Valentina A. Permyakova[2]

THE CONTRIBUTION OF ENTREPRENEURIAL SKILLS TO THE SOCIAL STRATIFICATION OF HIGHLY QUALIFIED R&D PERSONNEL: THE CASE OF RUSSIA[3]

The focus of the analysis in the paper is how entrepreneurial skills contribute to the social stratification of researchers working in research and development (R&D) organizations. One of the main trends and challenges for the contemporary labour market is increased demand for complex skills that cannot be transferred to automata: entrepreneurial thinking, initiative, creativity, and the ability to solve complex analytical problems. The paper examines the prevalence and level of ownership of entrepreneurial skills among those personnel engaged in R&D by science and higher education institutions, industry, and services in Russia. A composite index of entrepreneurial skills including 7 singular skills was used for it. In addition, the relationship between entrepreneurial skills and the professional achievements of researchers is estimated.

To investigate the social differences between crucial researcher's characteristics and assess the "premium" for entrepreneurial skills, we used mixed methods. The main tool is perception mapping and the corresponding analysis, which results in the combination of statistical techniques and is a graphical way to represent relationships and differences in data. The results made it possible to build a social space of scientific personnel engaged in R&D organizations and to identify the main differentiating factors. Among them, the application of entrepreneurial skills, scientific productivity, as well as the job sector (educational, research, government, commercial sectors). The "premium" from the application of entrepreneurial skills mostly expressed in a higher wage. Respondents who regularly apply entrepreneurial skills have the highest incomes of all interrogated researchers.

JEL Classification: J24, E24, O15

Keywords: entrepreneurial skills, highly qualified personnel, human capital, scientific effectiveness.

[1]Head, Division for Human Capital Studies, HSE Institute for Statistical Studies and Economics of Knowledge (ISSEK). E-mail: nshmatko@hse.ru

[2] Research Assistant, Division for Human Capital Studies, ISSEK; Master's degree student, National Research University Higher School of Economics. E-mail: vpermyakova@hse.ru

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Introduction

In the Fourth Industrial Revolution era, the speed of development and implementation of advanced technologies plays a key role. This involves reshaping production and business processes, creating new jobs where automatic and software solutions are combined with human competencies [BCG 2018; WEF, 2019; Deloitte, 2020]. In response to these challenges, the labour market shows increased demand for complex skills that cannot be transferred to automata: entrepreneurial thinking, initiative, creativity, the ability to solve complex analytical problems [European Commission, 2017; Lyu, Liu, 2021]. According to the World Economic Forum (2020), innovation, analytical thinking, initiative, originality and creativity should top the 10 most in-demand work skills in 2025.

The realm of science is changing significantly under global calls. Therefore, scientists' competence should include professional research skills and skills that contribute to a more prolific production of innovations, accelerated creation of scientific knowledge, and its transfer into practice. In other words, a scientist's portfolio of competencies should include interdisciplinary skills, the ability to multitask, create innovations, initiative and entrepreneurship [Shmatko et al., 2020].

Attention to the development of entrepreneurship among scientists has been paid earlier – the problem of the interaction between science and production has a long history. However, in the context of increased global competition for breakthrough and disruptive technologies, the commercialization of scientific knowledge and related to that - academic entrepreneurship - has become particularly relevant. One of the critical points in this direction in Russia was the Act on the "creation of business companies for the practical application (implementation) of the results of intellectual activity"[4], which was adopted in Russia in 2009. In line with it, universities and research institutes have the opportunity to create small innovative enterprises and supply their scientific discoveries and developments to the market. However, the commercialization algorithm was not sufficiently developed due, on the one hand, to the imperfection of the legislative and regulatory framework and, on the other, to the lack of motivation of scientists for entrepreneurial activity. Recently, particularly in connection to the national projects "Science", "Science and Universities", as well as to the federal project "Integration", the main task of which is to unite the forces of universities and industry, many universities have taken some steps to facilitate the transfer of knowledge and technology. In particular, Russian universities are increasing their research activity: if in 2010 less than half of universities (46.4%) carried out research and development (R&D), then in 2019, its share was already 83.3% (603 out of 724).

[4] Federal Act of August 2, 2009, No. 217-FZ "On Amendments to Certain Legislative Acts of the Russian Federation on the establishment of economic companies by budgetary scientific and educational institutions for practical application (implementation) of the results of intellectual activity" // Rossiyskaya Gazeta URL: https://rg.ru/2009/08/04/int-dok.html (accessed: 04/01/2021).

According to the Global Entrepreneurship Monitor (GEM)[5], in 2020, 7.6% of early entrepreneurs in Russia had a high-tech business, which is significantly higher than in 2019, when the share of such entrepreneurs was only 2.4%.

Despite the increased need to go beyond purely technical research competencies, additional education of scientists in Russia is rarely aimed at developing flexible, entrepreneurial skills. Currently, existing courses, training and seminars in business education, as a rule, are not considered by researchers as an effective solution for professional development and obtaining the necessary skills in the market. Some exceptions are researchers employed in industry and the service sector, for whom obtaining a business education is the third most popular form of advanced training [Volkova, 2019]. In general, in Russia, only 12% of the population aged 25-64 years is involved in retraining, while in European countries, this figure reaches 40-60% of residents [World Bank, 2018].

The problem lies in the contradiction between the increasing importance of developing and implementing innovative technologies and the continuing weakness of mechanisms for commercializing knowledge and innovative developments in Russia. Attention to the third mission of universities, to the agenda of the science-market dialogue, is faced with a low level of ownership of entrepreneurial skills, which are also very unequally distributed among scientists. In these conditions, it is essential to assess the impact of owning entrepreneurial skills for researchers to identify the relationship between entrepreneurial skills and social stratification in science.

Accordingly, the main questions of the study are:

1) What is the role of entrepreneurial skills in the stratification of the scientific community?

2) Is there a return on entrepreneurial skills applied in the professional activities of researchers? and

3) How can the latter be assessed in the case of Russian R&D personnel?

The structure of this paper is as follows: first, an overview of empirical studies will be presented, followed by a methodological section describing the method of data collection and analysis, as well as the sample design; then the results and interpretation of the data obtained will be presented, and, finally, the conclusions are given.

Literature review

The research is based on the concept of social stratification formulated by Pierre Bourdieu (1976) and his followers. This concept is one of the central elements in the analysis of

[5] National report "Global Entrepreneurship Monitor" (GEM). Russia 2020/2021. URL: https://gsom.spbu.ru/images/cms/data/2010_12_13_cil_seminar/otchet_2021-red-3.pdf

scientific and other social spaces. The essence of social stratification, according to P. Bourdieu, consists of the unequal distribution of active properties or capitals among operating agents. In fact, possessing a specific combination of various active properties or capitals allows the agent to take a distinct position in the field and receive appropriate dividends [Bourdieu, 1976]. There are several types of capital: economic capital, cultural, social, and symbolic capital, expressed in reputation, prestige, and status [Bourdieu, 2004].

The scientific field represents a system of objective relations between the achieved positions that can be considered as a space of competition [Bourdieu, 1976]. The gain in this space brings to the agent the right to scientific authority, which makes it possible to speak and act legitimately on behalf of science. Three main characteristics enable to measure the position of an individual in the social space: the total volume of all types of capital that they own, the relative importance of any one capital in their total volume and the process of acquiring or losing capital [Swartz, 1998].

Social stratification in science is a phenomenon caused not so much by external as by internal factors. The stratification conditions are directly related to scientists themselves, their work, skills, experience [Kwiek, 2019]. Differentiation of scientists' positions in the field of science can be addressed from different points of view: inequality in knowledge production and research productivity; income inequality, including the relationship between scientific productivity and income; inequality associated with involvement in international cooperation of researchers [Kwiek, 2019; Lewis, 2013; Hansen, 1992; Xie, 2014].

The competencies that are part of the cultural capital and serve one of the stratification factors are based on the received education. During periods of high uncertainty [Kodde, 1986] and rapid technological changes [Galor, Tsiddon, 1997], the demand for higher education is growing, and the return on general knowledge compared to special knowledge is increasing. Broad education provides the skills flexibility and the ability to rapidly adapt to new technologies. As a result, the probability to become an entrepreneur supposed to be increased [Lazear, 2002]. Mostly, it can be assumed that today the ratio of general and specific human capital demanded by the labour market of transition economies has changed in favour of general, non-specific capital with developed flexible skills [Denisova, Kartseva, 2005]. Today, the demand for skills that are often not a product of higher education is rising [Volgin, Gimpelson, 2021].

Lately, interest and understanding of the importance of flexible skills for effective interaction and development have been steadily increasing worldwide. Thus, the Organization for Economic Cooperation and Development (OECD) implemented the Definition and Selections of Competencies (DeSeCo) project in the field of relevant competencies and skills of youth and adults [OECD, 2018].

According to the DeSeCo project's conceptual framework, the competencies in-demand can be grouped into three categories per the activity's objectives (Fig. 1). Modern professional should:

- freely use a wide range of tools for effective interaction with the environment: information technology, various languages, etc.;

- be able to interact and communicate with other people from different backgrounds and cultures;

- take responsibility, act autonomously and take the initiative.

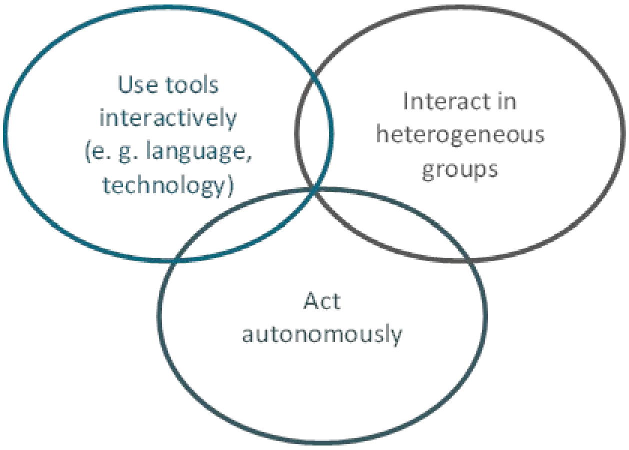

Fig.1. Key Competencies in Three Broad Categories (OECD, 2018)

Each category includes specific gradations. However, already at the upper level, the unique role of innovative, inventive leadership skills is evident, which form the basis of entrepreneurship described in Schumpeter's theory [Schumpeter, 1954]. According to this theory, entrepreneurship is a property of human character that does not depend on the class and social affiliation – "entrepreneurship is not a profession" [Schumpeter, 1954]. Such qualities characterize an entrepreneur *as someone having the desire for innovation, the ability to take risks, faith in own's strength, a sense of independence and autonomy* (we see the indication of the latter in the competencies of the 21st century developed by international organizations). Furthermore, Schumpeter believed that an entrepreneur is a leader – both of his own business and other people since he "has weight", "has authority", "knows how to make people obey" [Schumpeter, 1954].

It is essential to understand that entrepreneurial skills are inseparable from managerial and leadership qualities, and very often, they are challenging to differentiate. For example, in our work, the entrepreneurial skills of a scientist include the ability to manage other people, while it is the qualities of a leader that matter and not the formal position of a manager.

The World Economic Forum in 2015 developed the framework of 21st-century competencies [WEF, 2015]. In addition to hard skills (digital literacy, financial literacy, etc.), the importance of soft skills, including critical thinking skills, problem-solving, communication and cooperation, as well as such qualities as creativity, leadership, initiative and adaptability were emphasized (Fig. 2).

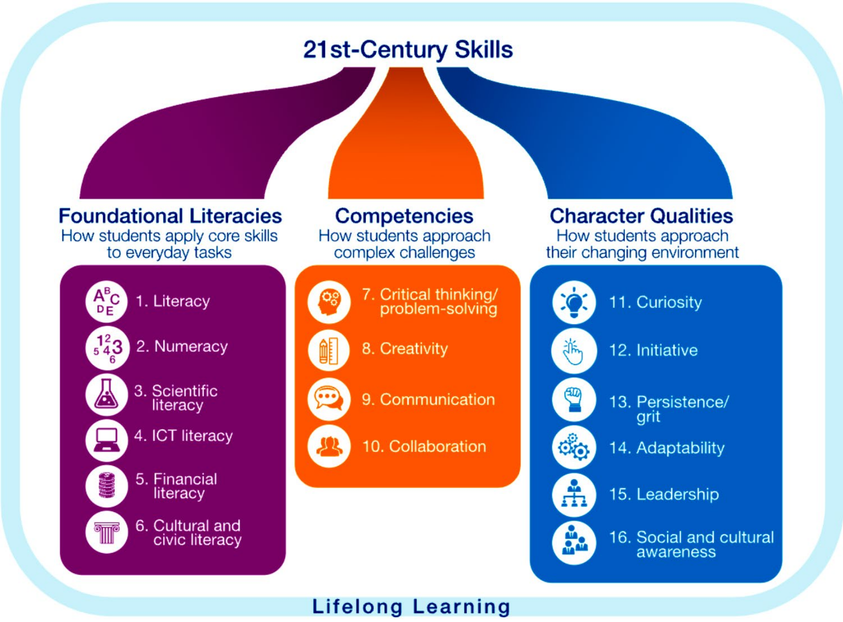

Fig.2. Required 16 skills for the 21st century (World Economic Forum, 2015)

These skills included to this framework do not relate to any specific professions, that makes them universal. 21st century Skills Framework has been developed based on global economic trends and is supported by research conducted by various international organizations. Many of these skills form the core of entrepreneurial competencies, in particular, they include creativity, leadership, the desire for innovation, collaboration and communication, as well as initiative[6]. According to the reviewed competence framework of the OECD and the World Economic Forum, the importance and necessity of entrepreneurial skills are recognized by the world's leading organizations. These skills are also essential for scientists.

Some sociologists tried to make a list of entrepreneurial skills during their empirical research [Pelletier, 2006; Cadieux, 2007; Baum, 1995]. For example, Pelletier [2006] defined several characteristics that are linked to entrepreneurship such as self-confidence, motivation, responsibility, initiative, team spirit, resourcefulness, and determination. Cadieux [2007] defined six key categories of entrepreneurial skills: strategic and general corporate management, results-led day-to-day running of the firm, problem-solving and decision-making, interpersonal relations and influence, self-management. Baum [1995] defined five meta skills for entrepreneurship: cognitive capacity, organizational capacity, decision making, technical capacity, identifying opportunities.

Lorrain with the colleagues [Lorrain, 1998] interviewed 300 entrepreneurs, and the result was a list of 39 skills that were divided into 12 areas such as: strategic vision and identifying opportunities, business and time management, marketing, managing operational aspects of the

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[6] The source is an interactive data prepared by World Economic Forum URL: https://intelligence.weforum.org/topics/a1G0X000006DO7RUAW?tab=publications

firm, managing personnel, decision-making, financial management, laws and regulations management, social networking.

Based on the results of previous research, we can develop a conceptual framework that defines entrepreneurial skills and divides them into two main components: hard entrepreneurial skills and soft entrepreneurial skills (fig. 3).

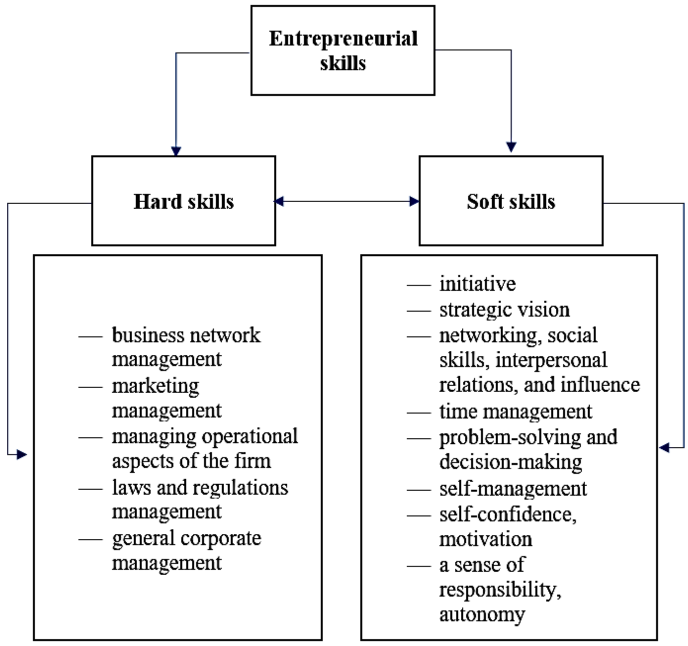

Fig. 3. Entrepreneurial skills paradigm based on previous researching results

In this paper entrepreneurial skills are considered as a set of innovative, transferable skills, including leadership [Schumpeter, 1954], autonomy and initiative, social skills [OECD, 2018; WEF, 2015] and self-regulation skills [Cadieux, 2007].

Researchers and decision-makers are increasingly discussing how to support and expand entrepreneurship in innovative areas. There is an apparent growing need for high-quality research as the basis of entrepreneurial activity. Krabel and Muller (2009) pointed out that excellent scientific research leads to innovative ideas that can be implemented in new products or contribute to new, improved processes. Among the various channels available for linking science and the market is the commercialization of academic knowledge, including patenting and licensing of inventions and academic entrepreneurship [O'Shea et al., 2008; Krabel, Mueller, 2009].

Academic entrepreneurship, like all other types of entrepreneurial activity, can take quite diverse forms which spectrum can go from setting up private research companies to ordinary daily consulting, expertise, commercialization or promotion research results to the market, etc. Entrepreneurial skills are also relevant in existing organizations, when the workers have a intention and wish to change existing routines. Several main plots can be traced, one of which is related to determining the influence of socio-demographic factors on the intention of researchers participating in entrepreneurial activity [Miao et al., 2021]. Strategies regarding commercialization and academic entrepreneurship have pronounced gender differences. Men are more likely than women to start their own business, create research companies, work on business contracts and engage in consulting [Abreu, Grinevich, 2017; Goel et al., 2015; Ding et al., 2006]. However, no significant gender gap has been identified for patenting and licensing inventions.

Age is a contradictory predictor of academic entrepreneurship propensity. Stuart & Ding [2006] suggest that older scientists more easily manage the high risks of entrepreneurship since potential failures cannot affect their already established scientific careers. Some other researchers confirm the positive relationship between age and academic entrepreneurship since older scientists have greater access to various resources: social, material, human resources and more particular the resources of networking that can bring both social and material gains [Haeussler, Colyvas, 2011; Bercovitz, Feldman, 2008].

Socio-demographic characteristics play a significant role in the development of entrepreneurial skills. For example, men are more inclined to academic entrepreneurship and commercialization and have a higher level of ownership of entrepreneurial skills [Abreu, Grinevich, 2017; Goel et al., 2015; Ding et al., 2006], as well as older scientists [Haeussler, Colyvas, 2011; Bercovitz, Feldman, 2008]. In addition, scientists in natural sciences and engineering are more inclined to academic entrepreneurship and commercialization of their research findings than scientists in social sciences and humanities [Goel, Grimpe, 2012; Laird et al., 2008].

Many research results also show that scientists in engineering are more proactive in creating firms, patenting and licensing compared to scientists of other disciplines [Huyghe et al. 2015, 2016]. For example, Goel and Grimpe [2012], emphasize that representatives of engineering sciences are more likely to become academic entrepreneurs. Laird [Laird et al., 2008] in his works indicates that scientific findings in mathematical and technical sciences are commercialized more often, and scientists of STEM register intellectual property and receive patents more often than their colleagues in social sciences and humanities. The studies also confirm the positive relationship of the job position with the entrepreneurial activity of the scientist [D'Este, Perkmann, 2011; Haeussler, Colyvas, 2011]. For example, Clarysse and his colleagues [Clarysse et al., 2011] found that professors are twice as likely to create firms than simple researchers since the latter is more focused on scientific and publishing activities to obtain higher positions.

The connection between publication activity and entrepreneurial attitudes of scientists is considered in many studies [for example, K. Louis, D. Blumenthal et al., 1989; R. Goel, S. Grimpe, 2012; T. Stuart, W. Ding, 2006]. The authors have found that the availability of scientific publications positively affects the propensity for scientists to create their own companies. However, the availability of publications affects academic entrepreneurship only at the early stages of a scientific career [M. Mõttus, O. Lukason, 2021]. This is due to researchers' greater productivity and desire at the beginning of their careers to publish as many scientific papers as possible and engage in many activities simultaneously, including the commercialization of their research products. However, over time, the differences are levelled since many scientists focus exclusively on academic activities.

The possession of metacognitive skills, including entrepreneurial one, become a competitive advantage of an employee in the labour market. According to modern employers engaged in research and development, the competence of a scientist should include not only professional technical skills but also skills that contribute to a more fruitful production of scientific knowledge, not only for themselves but for the organization as a whole. In other words, a scientist's portfolio of competencies should include interdisciplinary skills, the ability to multitask, communication skills in various social environments, and the propensity to innovate [Shmatko et al., 2020].

Despite the fact that the issues of academic entrepreneurship have been of interest to sociologists and economists for quite long time, some important aspects remain insufficiently studied. One of such aspects touches the contribution of entrepreneurial skills to the stratification of the scientific community. In our study, we tried to close this gap and obtain data on how entrepreneurial skills are related to other differentiating factors, and whether the effect of accumulation of professional achievements applies to professional skills of researchers.

Methodology

This study identifies the contribution of entrepreneurial skills of researchers to the social stratification of the scientific community. To achieve it, there are several issues to be solved:

1. To identify the factors influencing the level of entrepreneurial skills;
2. To identify the relationship between scientific performance and entrepreneurial skills;
3. To construct a social space of scientific personnel and determine the factors of its differentiation, including stratification based on the possession of entrepreneurial skills;
4. To evaluate the impact entrepreneurial skills on the scientific community.

The key hypothesis of the study is that entrepreneurial skills structures / stratifies the scientific community. It is known that more qualified researchers with more advanced technical competencies are more productive and successful in their core research and development activities. They publish more, they hold higher positions, etc. [Gimpelson, 2021; Xie, 2014]. However, our survey shows that the level of entrepreneurial skills is equally important for the stratification of the scientific community. The highest level of entrepreneurial skills is combined with the highest scores for other professional achievements. Researchers with a high level of entrepreneurial skill receive a “premium” on this resource in the form of higher income.

The study provides a secondary analysis of data from the Monitoring survey of Highly Qualified Scientific Personnel. The research methodology is coordinated with the international project "Careers of Doctorate Holders (CDH)" implemented by OECD, Eurostat, and UNESCO Institute of Statistics. In the survey, a multi-stage stratified sample was used. Respondents are academic degrees holders whose activities are related to R&D. The total sample size is 1,742 respondents.

The indicators measured during the monitoring and used in the analysis (Table 1) reflect the properties of scientists that determine their position in the scientific community and, more broadly, in the R&D space. These include indicators of professional achievements, indicators of scientific productivity, orientation towards the practical application or commercialization of their results, and the possession of entrepreneurial skills.

In this study, the standard skill labels were reformulated in the form of questions accessible to respondents' perceptions. To assess creativity and initiative [WEF, 2015] we asked about the skill «Putting forward new ideas, developing new products, technologies». Assessment of communication, collaboration skills [WEF, 2015], and ability to interact in heterogeneous groups [OECD, 2018] was conducted by asking about «Establishing, maintaining, and developing contacts and cooperating with colleagues, partners from other organizations». The question about «Completing the task within the designated time frame and with the allocated resources; being autonomous at work» matches the ability to act autonomously and take responsibility [OECD, 2018]. «Studying, retraining, mastering new methods, technologies, installations, etc.» are in line with the ability to freely use a wide range of tools for effective interaction with the environment: information technology, various languages [OECD, 2018], and adaptability [WEF, 2015]. «Presenting publicly (to customers, colleagues) the results of their work, a new product, service» is related to self-confidence and presentation skills. «Managing the project: design and implement all the processes, resources, deadlines, cost» matches the strategic and critical thinking. «Finding practical application of the obtained results» can equally be attributed to the two families of skills: 1) decision-making and problem-solving skills, and 2) using of a wide range of tools for effective interaction with the environment.

Tab. 1 – The main variables involved in the analysis

Concept	Interpretation	Operationalization
Professional achievements	Academic degree	1. Candidate of Sciences 2. Doctorate of Sciences 3. PhD.
	Position at the main job	1. Head, deputy head of the organization 2. Head, deputy head of the department 3. Technical specialist (without management functions)
	Income	The value of the average monthly income measured

		in RUB
Main employment	The branch of science with which the main work is connected	1. Natural Sciences and Mathematics 2. Engineering 3. Medical Sciences 4. Agricultural Sciences 5. Social Sciences 6. Humanities
	Employment sector	**Education sector:** − Universities, educational organizations of higher education − Research institutes and centers, design and technological organizations, experimental enterprises, clinics, hospitals and other institutions at universities **Public sector** − Scientific organizations of academies (RAS and other state academies) − Scientific organizations subordinate to state and municipal government bodies − Bodies of state and municipal administration, state funds for the support of scientific and scientific-technical activities − Institutions, other than scientific and educational, subordinate to state and municipal government bodies **Business sector** − Branch and corporate research institutes, engineering bureaus − Enterprises of the productive sector of the economy − Commercial companies in the service sector (financial, consulting, auditing, insurance, etc.)
Additional employment in the non-academic (entrepreneurial) sector	Type of organization	− Branch research institutes, engineering bureaus − Enterprises of the real sector of the economy (industry, agriculture, construction, transport, communications and services) and their management companies − Commercial companies, sole proprietors (financial, consulting, auditing, insurance, etc.; self-employment, freelance.)
Entrepreneurial skills (ES)	Set of single entrepreneurial skills	− Putting forward new ideas, developing new products, technologies − Finding practical application of the obtained results − Establishing, maintaining and developing contacts and cooperating with colleagues, partners from other organizations − Managing the project: design and implement all the process, resources, deadlines, cost − Being autonomous at work: complete the task within the designated time frame and with the allocated resources − Studying, retraining, mastering new methods, technologies, installations, etc.

		− Presenting publicly (to customers, colleagues) the results of their work, a new product, service
Entrepreneurial attitudes	Frequency of application of entrepreneurial skills at work	− Not once − 1-2 times a year − Rarely − Periodically − Constantly
	The importance of putting your ideas into practice	− It does not matter at all − It does not matter much − Important − Very important
Scientific productivity	Number of publications	Number of articles published in scientific journals
	Availability of patents for the invention	Number of patents as author/co-author
Socio-demographic and economic characteristics	Sex	− Male − Female
	Age	Indication of the number of full years of the respondent

To assess the contribution of individual skills to the overall resources available to the researcher, we need to consider the practical application of a particular skill along with the mere fact of possessing it. Based on a set of seven entrepreneurial skills (ES) listed in the table, and measured by the 5-point Likert scale, a composite index ES was created. The possibility of combining the scores for different skills was tested using Cronbach's Alpha criterion which was found to be 0.83. The correlations of all judgments were high, which indicates good internal consistency of the scale, hence, its summarizing is justified.

The responses of each respondent measured from 1 to 5 points and were summarized: each respondent received a score between 7 and 35 (Tab. 2). The average frequency of ES among high qualified personnel is 25.1 out of 35, which is a high score.

Tab. 2 – Frequency of apply ES in the main job

Statistics		
Skills		
N	Valid	1714
	Missing	28
Mean		25,17
Median		26,0
Std. Deviation		6,2
Range		28,0
Minimum		7
Maximum		35

The main analytic tool in our study is a graphical way to represent relationships and differences in data. Perception mapping involves plotting a set of individual or groups of values of variables or categories of variables on a plane obtained as a result of statistical analysis. We use a correspondence analysis—a method of multidimensional scaling of qualitative data that allows studying the data of conjugacy tables by graphically representing the rows and columns as points in a low-dimensional space [Shaphir, 2009].

The purpose of using this method in our study is to visually cluster the objects into specific groups, in other words, to build a social space of scientists engaged in R&D and to identify clusters that unify scientists with similar values for key qualities in the social space. For visualization, the ES composite index was recoded into five categories, based on the frequency of practical application by respondents these skills:

- ES1 – never apply entrepreneurial skills in the professional activities (7-11 points)
- ES2 – rarely apply entrepreneurial skills in the professional activities (12-17 points)
- ES3 – 1-2 per year apply entrepreneurial skills in the professional activities (18-24 points)
- ES4 – occasionally apply entrepreneurial skills in the professional activities (25-30 points)
- ES5 – regularly apply entrepreneurial skills in the professional activities (31-35 points)

The resulting space enables us to identify the main axes along which differentiation occurs into separate quadrants, in which scientists with specific active properties (strata) are grouped. The possession of ES is very unevenly distributed in the scientific community and can play the role of a stratification factor. The axes of space can be interpreted as factors that make the most significant contribution to the differentiation of the social space of scientists engaged in R&D.

Results

To construct the social space of those working in R&D and to determine the factors of its differentiation, including the level of ES, we turned to more comprehensive procedures of statistical analysis. By the chosen methodology and the objectives, we conducted a symmetric correspondence analysis.

According to the singular values, a two-dimensional distribution explains 89,7% of the inertia, which is an indicator of the model's high quality. The correspondence map contains points that simultaneously correspond to rows and columns. In this case, the position of the columns (income) in the space of the rows (social characteristics of scientific personnel) is considered.

The most differentiating attributes lie on the axes that organize the social space. To determine them, we turned to the table of the contribution of the point to Inertia of Dimension. To select the points most significant for the interpretation of the axis, we use the points with the contribution is higher than the average. The average contribution of a point to inertia of Dimension is calculated as dividing 100% (the sum of the absolute contributions on each axis) by the number of lines, in our case, 1/43 = 0.02%. The contribution of point to inertia of an axis (absolute contribution) serves as the basis for interpreting and identifying the axis, while the contribution of Dimension to Inertia of Point (relative contribution) shows how the point is explained by the chosen axis [Greenacre, 1984]. Determining the position of a particular social characteristic on the axis was done using the factor loadings table (Tab. 2) and the visualization in Figure 4. The frequency of using of ES is marked on the map with a blue dotted line.

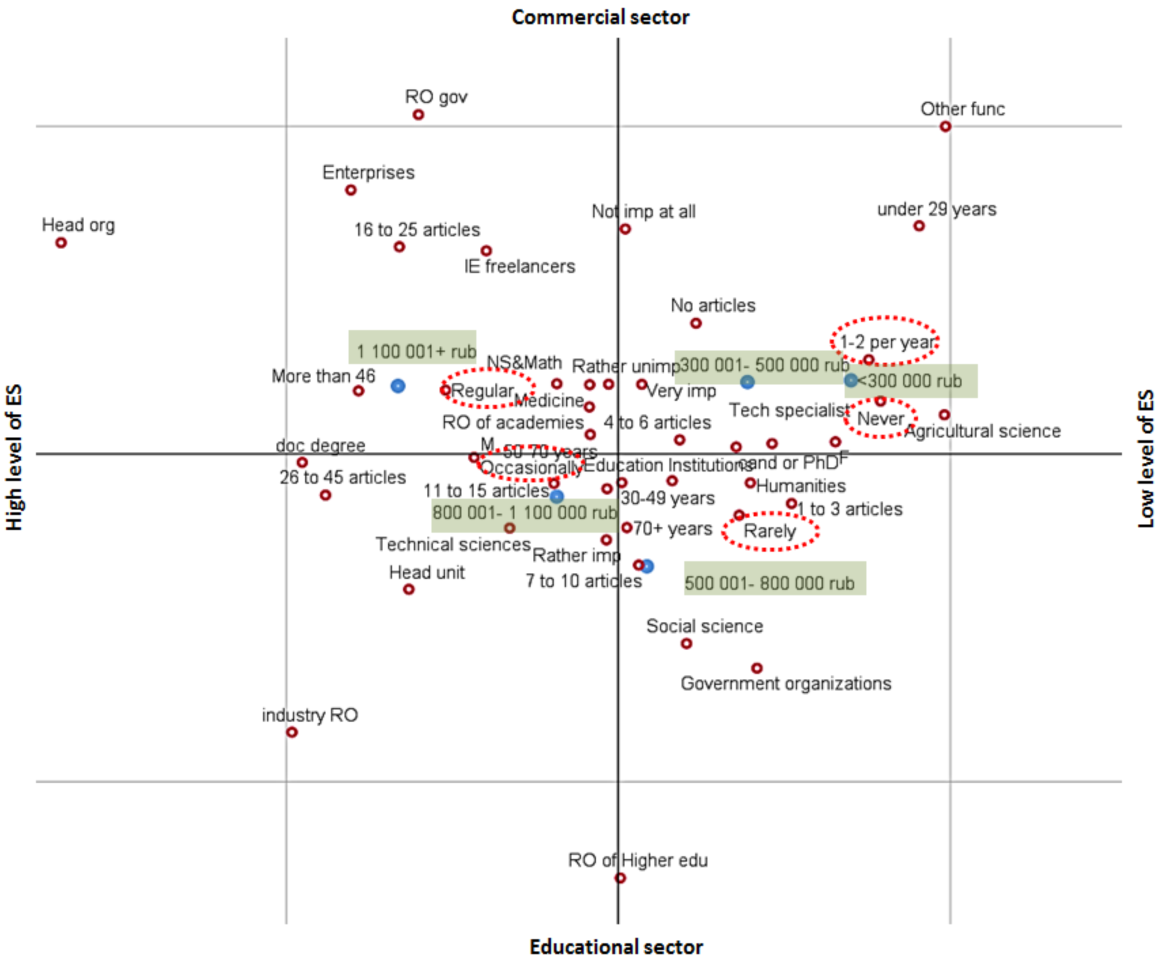

Fig. 4. Correspondence map

The following parameters are most closely associated with the right side of the horizontal axis: women, Candidates of Sciences/PhD in humanities and/or agricultural sciences, age under 29, employment in technical positions in educational institutions (institutions of higher education; other educational institutions) or the government sector (scientific organizations of the RAS, scientific organizations of other state academies, scientific organizations subordinate to government, etc.); the number of publications from 1 to 6 articles, rarely or not using entrepreneurial skills in professional activities. The left part of the horizontal axis is correlated with such characteristics as men, aged from 50 to 70, Doctors of Sciences in natural or engineering sciences and/or mathematics, heads of research institutes/organizations (industrial research institutes), enterprises of the productive sector of the economy, and commercial companies in the service sector (financial, consulting, auditing, insurance, etc.). Also correlated with this part of the axis are high publication activity (from 16 articles to 46 or more), an extra (second or third) job in the entrepreneurial sector, and regular apply of entrepreneurial skills in the main job.

The upper part of the vertical axis is most closely associated with a degree in the medical sciences and the unimportance of the practical application of one's ideas. The lower part of the vertical axis is associated with age 30-49, a degree in the social sciences, employment in research institutions, the importance of the practical application of the ideas, from 7 to 10 articles, and the occasional apply of entrepreneurial skills.

The application of the method made it possible to identify two dimensions and four sectors, in which certain social parameters are located. For a more detailed analysis, the bisectors dividing the plane into four sectors were drawn. Since the main task is to assess the contribution of entrepreneurial skills to productivity and income, groups of scientists by income are depicted on the map. The points of each sector correlate as much as possible with the parts of the axes it contains. Figure 4 shows the correspondence map for the two-dimensional solution.

On the horizontal axis, the most differentiating factor is the academic degree—the contribution of the variable is 0.996. On the vertical axis, the most differentiating factor is the respondent's place of work (research institutes, educational organizations, enterprises, etc.). Its contribution is 0.951.

The category with the lowest income (less than 300,000 rubles) is related to the left side of the horizontal axis and correlated with such social characteristics as female gender, under 29, a candidate of sciences or a PhD in humanities and/or agricultural sciences, low publication activity (1-6 articles), employment in educational organizations or the government sector. Scientists in this category rarely or never apply entrepreneurial skills in their professional activities.

Scientists with the highest income (1,100,000 rubles or more) are located in the left sector of the horizontal axis and have the opposite characteristics—a doctorate of sciences in engineering, natural sciences, and/or mathematics, from 50 to 70 years old, high publication activity (11 articles to 46 or more), heads of the organization/department/unit in research institutes subordinated to state or municipal authorities, in industrial enterprises. In addition, scientists from this sector often have a second or third job in the commercial sector (individual entrepreneurship, freelancing, commercial organizations, etc.), and also regularly apply entrepreneurial skills at work.

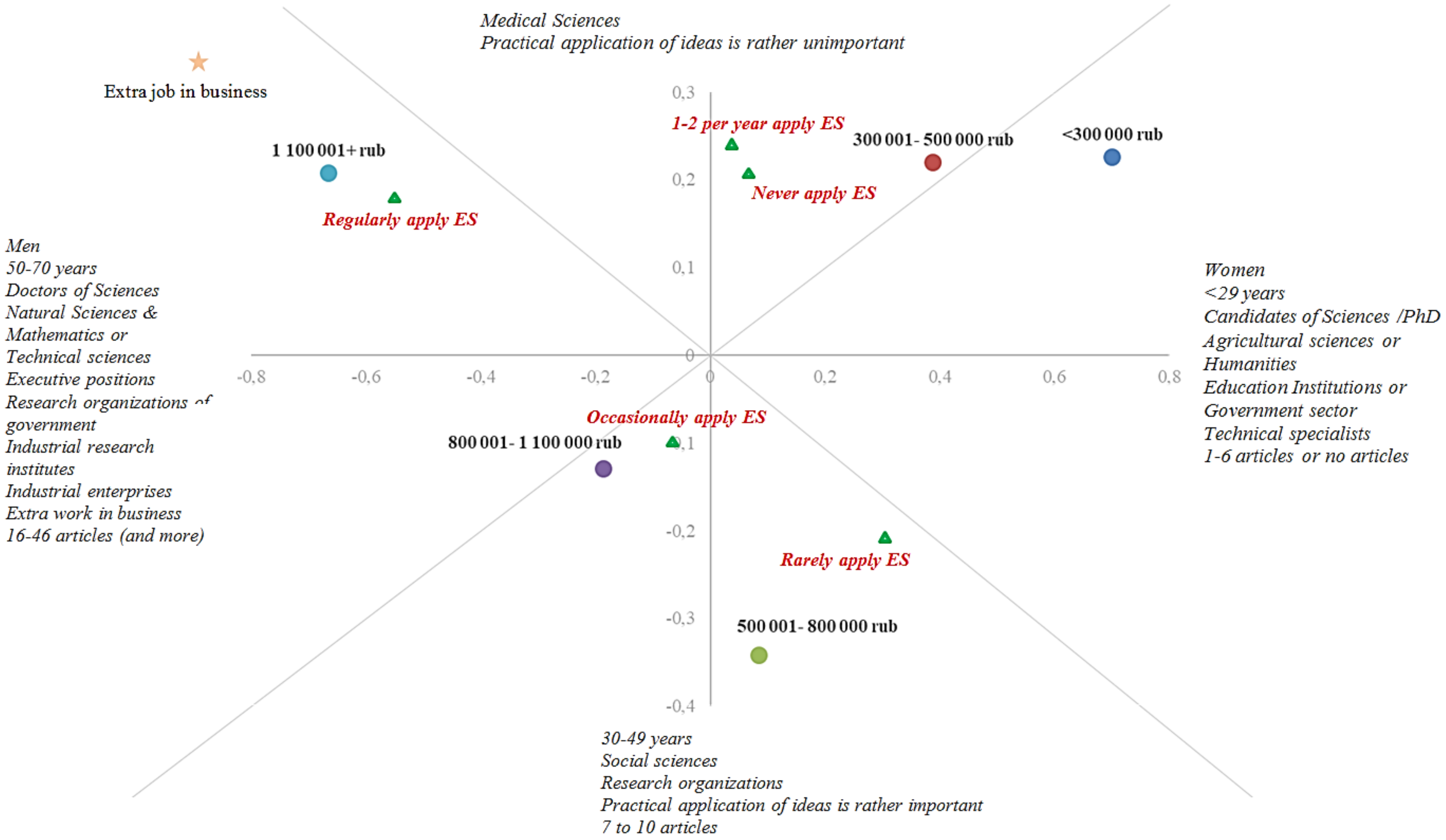

Fig. 5. The visualization of the "premium" for entrepreneurial skills is expressed in the amount of wages

Scientists with incomes between 500,000 and 800,000 are characterized by employment in research organizations and institutes, age 30 to 49, 7 to 10 scientific articles, an academic degree in the social sciences, and occasional apply of entrepreneurial skills at work. Scientists with income from 800,000 to 1,100,000 lie next to the bisector of the angle, which suggests that this group is correlated with both axes. Hence the social characteristics of scientists with the highest incomes (over 1,100,000 rubles) may be characteristic of respondents in this group.

The same situation is observed with scientists whose income is 300,000–500,000 rubles, in addition to their employment in the medical field and the unimportance of the practical application of their scientific work, they may also have the characteristics of those whose income is in the range up to 300,000 rubles.

Thus, it is clear that the application of entrepreneurial skills at work is rewarded in the amount of wages. Scientists with high incomes have opposite traits to those with low incomes and are located in the social space opposite each other. Our results show that possessing entrepreneurial skills becomes a competitive advantage for an employee in the labor market. High scores for entrepreneurial skills are combined with high scores for other indicators of professional achievement. The possession and use of entrepreneurial skills allows us to separate the more successful in the labor market and in the field of research and development of scientists from their less successful colleagues.

Conclusion

To investigate the social differences between crucial researcher's characteristics and assess the "premium" for the application of entrepreneurial skills, we used mixed methods. The main tool is perception mapping and the corresponding analysis, which results in the combination of statistical techniques and is a graphical way to represent relationships and differences in data.

The visualization of the social space of scientific personnel allowed us to identify the main differentiating factors. Among them, the application of entrepreneurial skills, publication activity, as well as the job sector (educational, research, government, commercial sectors). The "premium" for entrepreneurial skills is expressed mainly in the amount of wages received.

We established how entrepreneurial skills stratify the social space of researchers engaged by R&D organizations. Our results showed at least four well-defined groups of researchers according to the application of entrepreneurial skills. The researchers with the most advanced entrepreneurial skills constitute one specific group that accumulates a set of top professional achievements in research and development. This group of researchers holds Doctorate in engineering, natural sciences or mathematics, they publish extensively, and they also hold high positions in their organizations or departments. In addition to a main job, they often have a second or third job in the entrepreneurial sector, i.e. they are engaged in individual entrepreneurship, freelancing, or work under contract with commercial companies. The age of researchers in this group is between 50 and 70 years old. The average income in this group is the highest in the sample of respondents and amounts to 1,100,000 rubles, and more.

Those who periodically apply entrepreneurial skills have incomes of 500,000 to 1,100,000 rubles. On the contrary, those respondents who do not apply those skills have lower incomes (up to 300,000 rubles). There is also a correlation between scientific productivity and the possession of entrepreneurial skills, since scientists who regularly apply such skills in their work show also a higher publication activity.

Among the surveyed Russian researchers almost 30% constantly apply entrepreneurial skills in their main professional activity. Only 4% have never applied such skills at work, which indicates a high prevalence of entrepreneurial skills among scientists. The most common skill is time management. The least common skill among scientists is the ability to find practical applications for their scientific achievements.

According to the correspondence map, we can see the payoff from the entrepreneurial skill expressed in money. Respondents who regularly apply entrepreneurial skills have high incomes (over 1,100,000 rubles).

In the further development of the study, it would be interesting to consider whether there is a reward for the possession of certain groups of skills not only in monetary, but also in an intangible (symbolic) sense, for example, in the form of peer recognition or prestige in society.

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APPENDIX 1.

Tab.1 – Statistics for Correspondence analysis

Overview Row Points[a]									
Row	Mass	Score in Dimension		Inertia	Contribution				
					Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
		1	2		1	2	1	2	Total
Male	0,066	-0,423	-0,029	0,002	0,061	0,001	0,984	0,002	0,985
Female	0,044	0,657	0,055	0,004	0,098	0,002	0,984	0,002	0,986
<29 years	0,004	0,901	0,784	0,001	0,018	0,043	0,649	0,156	0,805
30–49 years	0,052	0,019	-0,100	0,000	0,000	0,008	0,062	0,544	0,606
50–70 years	0,052	-0,077	0,055	0,000	0,002	0,002	0,671	0,107	0,779
70+ years	0,002	0,034	-0,200	0,000	0,000	0,002	0,003	0,032	0,034
Doctorate degree	0,030	-0,938	-0,060	0,005	0,135	0,002	0,992	0,001	0,994
Cand PhD	0,081	0,360	0,028	0,002	0,054	0,001	0,992	0,002	0,994
Natural Sciences & Mathematics	0,038	-0,176	0,186	0,000	0,006	0,021	0,537	0,191	0,727
Technical sciences	0,028	-0,319	-0,198	0,001	0,015	0,018	0,618	0,076	0,694
Medical sciences	0,009	-0,079	0,209	0,000	0,000	0,006	0,263	0,575	0,838
Agricultural sciences	0,008	0,979	0,188	0,002	0,041	0,005	0,855	0,010	0,865
Social sciences	0,008	0,214	-0,561	0,000	0,002	0,039	0,280	0,610	0,889
Humanities	0,018	0,407	-0,149	0,001	0,016	0,007	0,530	0,022	0,553
Education Institutions	0,059	0,168	-0,069	0,000	0,009	0,005	0,803	0,043	0,847
Research organizations	0,003	0,022	-10,31	0,000	0,000	0,071	0,001	0,905	0,906
Research organizations of government	0,031	-0,078	0,111	0,000	0,001	0,006	0,194	0,124	0,319
Government sector (institutions)	0,004	-0,590	0,920	0,001	0,007	0,055	0,381	0,294	0,675
Industrial research institutes	0,004	0,425	-0,627	0,000	0,004	0,025	0,462	0,320	0,782
Industrial enterprises	0,003	-0,969	-0,806	0,001	0,015	0,033	0,710	0,156	0,866
Individual entrepreneurship, self-employment, freelancers	0,004	-0,795	0,754	0,001	0,013	0,038	0,751	0,214	0,965
Education Institutions	0,001	-0,396	0,722	0,000	0,001	0,011	0,090	0,095	0,184
Practical application of ideas is not important at all	0,002	0,021	0,762	0,000	0,000	0,020	0,001	0,362	0,362
Practical application of ideas is rather unimportant	0,010	-0,022	0,196	0,000	0,000	0,006	0,020	0,514	0,534

Practical application of ideas is rather important	0,052	-0,027	-0,261	0,000	0,000	0,057	0,027	0,779	0,806
Practical application of ideas is very important	0,047	0,077	0,201	0,000	0,001	0,030	0,258	0,552	0,810
Head, deputy head of the organization	0,008	-10,66	0,619	0,005	0,119	0,052	0,912	0,040	0,952
Head, deputy head of department /unit	0,034	-0,617	-0,426	0,003	0,066	0,099	0,852	0,129	0,982
Technical specialist	0,062	0,468	0,035	0,003	0,069	0,001	0,997	0,002	0,999
Others	0,005	0,983	0,998	0,001	0,025	0,083	0,742	0,243	0,985
Never apply entrepreneurial skills at work	0,004	0,790	0,212	0,001	0,012	0,003	0,899	0,021	0,919
1-2 per year apply entrepreneurial skills at work	0,009	0,759	0,246	0,001	0,026	0,009	0,848	0,028	0,877
Rarely apply entrepreneurial skills at work	0,022	0,372	-0,211	0,001	0,016	0,016	0,786	0,080	0,866
Occasionally apply entrepreneurial skills at work	0,045	-0,026	-0,101	0,000	0,000	0,007	0,046	0,214	0,259
Regularly apply entrepreneurial skills at work	0,029	-0,511	0,194	0,002	0,039	0,018	0,890	0,041	0,931
No articles	0,012	0,237	0,408	0,000	0,003	0,032	0,475	0,446	0,921
1 to 3 articles	0,020	0,526	-0,127	0,001	0,028	0,005	0,946	0,018	0,963
4 to 6 articles	0,022	0,191	0,057	0,001	0,004	0,001	0,292	0,008	0,301
7 to 10 articles	0,022	0,072	-0,370	0,000	0,001	0,048	0,071	0,590	0,661
11 to 15 articles	0,015	-0,184	-0,115	0,000	0,003	0,003	0,486	0,061	0,547
16 to 25 articles	0,011	-0,651	0,617	0,001	0,024	0,069	0,776	0,221	0,997
26 to 45 articles	0,006	-0,868	-0,153	0,001	0,025	0,002	0,868	0,009	0,876
More than 46 articles	0,003	-0,774	0,210	0,000	0,009	0,002	0,727	0,017	0,744
Extra work in business (second or third)	0,010	-0,815	0,476	0,002	0,033	0,036	0,837	0,091	0,928
Active Total	10,00			0,047	10,000	10,000			
a. Symmetrical normalization									

Tab. 2 – Factor loadings of contributions of variables into axis

Characteristic	Horizontal axis	Vertical axis
Male	-0,992	
Female	0,992	
<29 years	0,806	
30-49 years		-0,738
50-70 years	-0,819	
70+ years		
Doctors of Sciences	-0,996	
Candidates of Sciences /PhD	0,996	
Natural Sciences & Mathematics	-0,733	
Technical sciences	-0,786	
Medical sciences		0,758
Agricultural sciences	0,925	
Social sciences		-0,781
Humanities	0,728	
Education Institutions	0,896	
Research organizations		-0,951
Research organizations of government	-0,617	
Government sector (institutions)	0,680	
Industrial research institutes	-0,843	
Industrial enterprises	-0,867	
Individual entrepreneurship, self-employment, freelancers		
Practical application of ideas is not important at all		
Practical application of ideas is rather unimportant		0,717
Practical application of ideas is rather important		-0,883
Practical application of ideas is very important		
Head, deputy head of the organization	-0,955	
Head, deputy head of department /unit	-0,923	
Technical specialist	0,998	
Other job functions		

Never apply entrepreneurial skills at work	0,948	
1-2 per year apply entrepreneurial skills at work	0,921	
Rarely apply entrepreneurial skills at work	0,887	
Occasionally apply entrepreneurial skills at work		-0,463
Regularly apply entrepreneurial skills at work	-0,943	
No articles	0,689	
1 to 3 articles	0,973	
4 to 6 articles	0,540	
7 to 10 articles		-0,768
11 to 15 articles		
16 to 25 articles	-0,881	
26 to 45 articles	-0,932	
More than 46 articles	-0,853	
Extra work in business (second or third)	-0,915	

Contact details:

Natalia A. Shmatko

Head, Division for Human Capital Studies, HSE Institute for Statistical Studies and Economics of Knowledge (ISSEK).

E-mail: nshmatko@hse.ru

Valentina A. Permyakova

Research Assistant, Division for Human Capital Studies, ISSEK; Master's degree student, National Research University Higher School of Economics.

E-mail: vpermyakova@hse.ru