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**ASSESSMENT OF LOCALIZED KNOWLEDGE SPILLOVERS  
IN REGIONAL INNOVATION SYSTEMS**

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**Abstract**

In the study, the authors prove that knowledge is the basis of any innovation system. Therefore, the determination of the mechanism for obtaining, accumulating and using knowledge can serve as the basis for the development of state policy aimed at creating and strengthening regional and national innovation systems. The authors propose a toolkit for identifying and evaluating methods, types and channels of knowledge spillovers and, using the example of a specific region, Stavropol Krai, show the results of using the developed toolkit.

**Keywords**

information spillovers – Innovation systems – Sociological research

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## Introduction

The fact that in the global, intercountry and interregional aspects only innovators win no longer requires evidence. Thus, the more innovative the system, the more successfully it develops. One of the pillars of any innovation system is knowledge, human capital, as indicated by leading foreign scientists in the field of innovation systems research, such as Cooke, Lundvall, etc.<sup>1</sup> Its volume, quality, level and practical application determine the final indicators of the functioning of the innovation system. At the regional level, an important issue is determining how knowledge is acquired, accumulated and developed. The success of a regional innovation system (RIS) depends on this. This issue is considered from two perspectives in the global scientific discussion. If the neoclassical school considers this knowledge simply as information that has the ability to reproduce itself, then representatives of neoinstitutionalism present this knowledge as experience acquired in the process of practice. In any case, for practical activities, the study of the very mechanism of the emergence and acquisition of knowledge at the level of RIS will be valuable and relevant. This, in turn, is associated with the increasing role of the regional level in global innovation processes. At the regional level, the quality of the innovation system depends on how the accumulation and absorption of knowledge from the internal and external environments occurs and how the processes of knowledge transfer and exchange help reduce transaction costs that arise in the innovation chain. Thus, if one understands how new knowledge is formed at the regional level, one can influence it with certain methods of state or regional policy. Therefore, the identification of the processes of accumulation of knowledge at the regional level is an urgent scientific problem and the purpose of this study.

## Materials and Methods

How to evaluate the process of knowledge transfer between the subject of an innovation system, or how is this process defined in the monograph “Synergy of Space: Regional Innovation Systems...”<sup>2</sup>, how to evaluate the process of localized knowledge spillovers in RIS? To identify and evaluate localized knowledge spillovers in RIS, we developed two questionnaires.

In the first questionnaire, information channels were evaluated using a point system. Each channel was awarded a point by respondents – from 1 to 10, then all points were summed up and the average channel score was determined in accordance with the number of the respondents. This questionnaire is a tool for assessing not only the importance of knowledge spillovers channels for each organization, but also identifying which channel – vertical or horizontal – prevails among information spillover. Answers to the questions of the questionnaire allow identifying which method of knowledge management is more preferable for the RIS: personified or codified.

The analysis of the second questionnaire revealed the prevailing forms and types of knowledge spillovers: intraorganizational and interorganizational; intraregional and

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<sup>1</sup> P. Cooke; M. G. Uranga y G. Etxebarria, “Regional innovation systems: Institutional and organizational dimensions”, *Research Policy* Vol: 26 num 4-5 (1997) 475–491 y B- A. Lundvall, *National systems of innovation: towards a theory of innovation and interactive learning* (London: Pinter, 1992).

<sup>2</sup> A. N. Piliasov, *Sinergija prostranstva: regionalnye innovatsionnye sistemy, klustery i peretoki znaniia* (Smolensk: Oikumena, 2012).

interregional; spillover of existing knowledge or orientation to demand; direct transfer without technical adaptation (imitation) or solutions adapted in accordance with the needs of consumers (adaptation).

Processing the results of the questionnaires was carried out using the methods of point and rating estimates, analysis, synthesis, comparison, generalization and comparison. All channels were assigned points on the following scale: “0” – the channel is not used in the organization or there is no information on its use; “0.5” – the channel is used sometimes; “1” – the channel is actively used. As a result, the average scores for each channel were calculated, characterizing the frequency of its use.

### Theory/Calculation

Numerous studies show that knowledge spillovers are much more important for innovation than trade or foreign direct investment<sup>3</sup>.

It is noteworthy that the questions that we set for ourselves relate to the field of knowledge management, which is involved with a wide variety of sciences. Among Russian and foreign researchers in this field of knowledge, one can distinguish the works of N. Bontis, U. Borgoff, U. Bukovich, K. Wiig, T. Wilson, E. Volkodavova, A. Gaponenko, J. Grossman, T. Davenport, M. Jenneks, A. Dinur, P. Drucker, V. Dresviannikov, T. L. Ishchuk, R. Kaplan, G. Kleiner, K. Collison, T. Koulopoulos, D. Cowen, B. Lev, R. Meyer, M. Marinicheva, V. Makarov, N. Manokhina, B. Milner, I. Nonaka, E. V. Pogorelova, T. Orlova, IU. V. Ragulina, P. Romer, L. Prusak, L. V. Saakova, K.-E. Svebi, P. Senge, D. Skirm, T. Stepanova, T. Stuart, H. Takeuchi, IU. Telnova, R. Williams, K. Frappaolo, G. Hamel, T. Chini, D. Schwartz, L. Edvinsson, M. Earl, etc.<sup>4</sup>

The work of economists related to knowledge and knowledge management is mainly devoted to the study of the general aspects, categories and concepts of the knowledge economy. Many works examine individual innovation aspects and problems in the knowledge economy. Most works are devoted to identifying patterns in knowledge management at the level of individual enterprises, teams and areas. A separate group of works is related to knowledge management in the education system. However, the issue of knowledge exchange, transfer and management in the context of the integration of the main participants in innovation processes is almost not considered. A small number of studies and the lack of development of the above provisions determine the relevance of the problem.

For the development of modern RIS, one of the important factors is the processes of knowledge exchange between the subjects of the innovation system. Information and knowledge resources are the most important type of assets of any organization, especially organizations that are related to the innovation system. The knowledge of each specific

<sup>3</sup> G. Madden y S. J. Savage, “R&D Spillovers, Information Technology and Telecommunications, and Productivity in ASIA and the OECD”, *Information Economics and Policy* Vol: 12 num 4 (2000): 367–392; D. T. Coe y E. Helpman, A. W. Hoffmeister. *International R&D Spillovers and Institutions*. IMF Working Paper WP/08/104. International Monetary Fund. 2008; J. Bentzen y V. Smith, “Spillovers in R&D Activities: An Empirical Analysis of the Nordic Countries”, *International Advances in Economic Research* Vol: 7 num 1 (2001): 199–212 y G. Peri, *Knowledge Flows, R&D Spillovers and Innovation*. Discussion Paper № 03-40. (Mannheim: ZEW, 2003).

<sup>4</sup> E. V. Pogorelova, *Teoreticheskie i metodologicheskie osnovy upravleniia znaniiami v organizatsii: avtoref. dis. D-ra. ekon. nauk* (Samara, 2011).

subject of the innovation system is manifested in the subject's existing skills, abilities and competencies. It is this knowledge that ultimately can be embodied in innovative products, services and technologies. Thus, knowledge is the basis of the innovation activity of each organization – the subject of the innovation process. For the emergence and development of any innovation system, that is, the transition from individual, subject innovations to an innovation system localized in a certain territory, in our case, in the region, the constant exchange of knowledge between the subjects of the innovation system is necessary. The more effective and intensive this exchange is, the more efficiently and intensively the RIS develops. The assessment of channels, types and intensity of knowledge spillovers is a necessary element for the development of tools for direct and indirect state support for innovation in business and the development of mechanisms for effective state policy aimed at RIS creation and development.

To begin with, one should determine how knowledge is acquired in organizations. In what conditions does it appear, accumulate, distribute and coordinate? How to characterize it for the development of state policy? This refers to mechanisms for managing the interaction between manufacturers, suppliers, competitors, state sector of science and consumers of final products in the value chain of innovative products and services. According to J. Guinet and D. Meissner, the purpose of managing the creation of innovations is to optimize the innovation strategies of all participants in the innovation process and create favorable framework conditions for this process<sup>5</sup>. Thus, all participants in the innovation chain of product creation who are involved in stages, such as coming up with an idea, developing a concept, developing a product, developing a process, preparing production and launching production, must have synchronous innovative strategies, as well as an optimal supporting infrastructure. First, "to build new knowledge, the organization must take certain actions aimed at stimulating the acquisition of information and converting it into knowledge"<sup>6</sup>. Knowledge can be implicit and explicit, individual and group. Depending on this, the process of storage and transfer of knowledge is carried out. Explicit knowledge is usually recorded in instructions, rules, patents, know-how, etc. Implicit knowledge is stored only in people's heads and transmitted accordingly in the process of communication between people with this knowledge. Depending on what knowledge is involved in the process of spillovers between subjects of innovative activity, the ways their spillovers differ. For example, explicit knowledge can be a simple market product, that is, bought and sold or exchanged in the manner of barter, etc. Implicit knowledge can have different channels of spillovers. One of the channels is the sale of implicit knowledge as a service (for example, consulting, training, coaching, etc.). Another channel is the transfer of implicit knowledge embodied in the medium as an object of sale. The third is the transfer of implicit knowledge with a knowledge carrier in the form of employment, transfer to another job, etc. The type of knowledge (implicit or explicit) affects the behavior of the subjects of the innovation process, who use this knowledge and are interested in the spillovers of these types of knowledge. If explicit knowledge is usually transmitted in codified form and does not require geographical proximity between participants in spillovers, then implicit knowledge verifies the need for spatial proximity between participants<sup>7</sup>.

<sup>5</sup> J. Guinet y D. Meissner, "Otkrytye innovatsii: efekty dlya korporativnykh strategiy, gosudarstvennoy politiki i mezhdunarodnogo "peretoka" issledovaniy i razrabotok", Foresight-Russia Vol: 6 num 1 (2012): 26-36.

<sup>6</sup> R. A. Fatkhutdinov, *Innovation Management* (St. Petersburg: Peter, 2012).

<sup>7</sup> W. Keller, "International Technology Diffusion", *Journal of Economic Literature* Vol: XLII (2004): 752–782; S. Breschi y F. Lissoni, "Knowledge Spillovers and Local Innovation Systems", *A Critical*

Spillovers can be either targeted or random, that is, in fact, an unwanted leak of important commercial or innovative information. In this case, for one subject – the producer of new knowledge – these spillovers can be dangerous. That is why producers of knowledge, technology and other innovations should use mechanisms for protecting intellectual property<sup>8</sup>.

Spillovers can also be focused, that is, carried out with an aim, for example, of selling information, barter, knowledge exchange, etc.

In the processes of knowledge spillover, an important role is played by the infrastructure that helps to implement such a spillover. These are centers of scientific and technical information, patent offices, business incubators, consulting agencies, innovation centers, technology parks and technopolises, venture capital funds, as well as various exhibition centers and loft spaces. Through these objects of innovation infrastructure information that has an open codified character usually flows. Uncodified, implicit, classified information usually flows in the process of conducting joint research, acquisitions and mergers or transition of employees who carry uncodified knowledge (skills and competencies)<sup>9</sup>.

D. Meissner identified the forms of knowledge spillover depending on the following criteria: directions, organizations, regions, interaction, process, adaptation<sup>10</sup>.

D. Meissner defined horizontal and vertical knowledge spillovers, depending on the direction: horizontal, when knowledge is exchanged between organizations of the same level; vertical, when the spillover occurs between organizations of different levels of the innovation process. It is believed that it is the vertical knowledge spillover (between suppliers and consumers of innovations, along the chain of creating innovations) that is of particular importance for the effective development of the subjects of the innovation process and, therefore, for the creation and development of territorial innovation systems<sup>11</sup>. Moreover, on the scale of global competitiveness, a significant fact is that for leadership in the industry plays an important role in obtaining innovative knowledge from suppliers and joint production of knowledge with suppliers, as evidenced by international

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Survey. Liuc Papers no 84. Serie Economia e Impresa Vol: 27 (2001): 1–30; E. Kesidou y A. Szirmai, Local Knowledge Spillovers, Innovation and Economic Performance in Developing Countries Empirical Evidence from the Uruguay Software Cluster (Netherlands: UNU-MERIT conference “Micro Evidence on Innovation in Developing Economies”, May 31 – June 1, 2007) y T. Döring y J. Schnellenbach, What Do We Know About Geographical Knowledge Spillovers and Regional Growth? A Survey of the Literature, Deutsche Bank Research, Research Notes, Working Paper Series, October 12, 2004.

<sup>8</sup> D. Czarnitzki y K. Kornelius, Spillovers of Innovation Activities and Their Profitability (Discussion Paper no 07-073). (Mannheim: ZEW, 2007); T. Döring y J. Schnellenbach. What Do We Know About Geographical Knowledge...; J. Vandekerckhove y R. De Bondt, Asymmetric Spillovers and Sequential Strategic Investments (Milan: Conference on Technology and Innovation, 2007); B. Johansson y H. Löf, “Innovation Activities Explained by Firm Attributes and Location”, Economics of Innovation and New Technology Vol: 17 num 6 (2008): 533–552 y Z. Griliches, The Search for R&D Spillovers (Working Paper no 3768, Reprint no r1758) (NBER, 1992).

<sup>9</sup> D. Leahy y J. P. Neary, “Absorptive Capacity, R&D Spillovers and Public Policy”, International Journal of Industrial Organization Vol: 25 num 5 (2007): 1089–1108.

<sup>10</sup> D. Meissner, “Ekonomicheskie efekty “peretoka” rezultatov nauchno-tekhnicheskoy i innovatsionnoy deyatelnosti”. Foresight-Russia Vol: 6 num 4 (2012): 20-31.

<sup>11</sup> D. Czarnitzki, K. Kornelius. Spillovers of Innovation Activities and Their Profitability (Discussion Paper no 07-073). (Mannheim: ZEW, 2007).

studies<sup>12</sup>. That is, vertical knowledge spillovers are the most important in the production of innovations that have a competitive advantage on a global scale. However, as many researchers emphasize, the success of creating diversified innovations through the integration of suppliers and manufacturers of products and services can take place only if there are favorable conditions in the form of an optimal multilevel infrastructure for innovation.

Depending on the criterion “organization”, there can be intraorganizational and interorganizational spillover. Accordingly, depending on the criterion “region” – intra-regional and interregional.

According to the “interaction” criterion, the forms of direct interaction (without involving third parties) and indirect interaction (with the participation of intermediaries) are distinguished.

According to the “process” criterion, D. Meissner identifies a form of spillover focused on the supply of technologies (spillover of existing knowledge) and a form of spillover focused on demand (search for a solution to existing problems).

According to the “adaptation” criterion, the forms of spillover are divided into simulation (direct transfer without technical adaptation) and adaptation (adapted solutions in accordance with the needs of consumers)<sup>13</sup>.

The channels of knowledge and information spillover have been studied and described in detail<sup>14</sup>.

## Results and Discussion

Based on the analysis of the available publications, we clarified and expanded the list of these channels for our study (Table 1).

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<sup>12</sup> E. Harison y H. Koski, “Applying open innovation in business strategies: Evidence from Finnish software firms”, *Research Policy* Vol: 39 (2009): 351–359; L. Dahlander y D. M. Gann, “How open is innovation?”, *Research Policy* Vol: 39 (2010): 699–709; S. P. Lee; Y. Gwangman y P. J. Byungun, “Open innovation in SMEs — An intermediated network model”, *Research Policy* Vol: 39 (2010): 290–300; E. Huizingh, “Open innovation: State of the art and future perspectives”, *Technovation* Vol: 31 (2011): 2–9 y D. Chiaroni; V. Chiesa y F. Frattini, “The Open Innovation Journey: How Firms Dynamically Implement the Emerging Innovation Management Paradigm”, *Technovation* Vol: 31 (2011): 34–43.

<sup>13</sup> D. Meissner, “Ekonomicheskie efekty “peretoka” rezultatov nauchno-tekhnicheskoy i innovatsionnoy deyatel'nosti”, *Foresight-Russia* Vol: 6 num 4 (2012): 20-31.

<sup>14</sup> D. T. Coe y E. Helpman, “International R&D Spillovers”, *European Economic Review* Vol: 39 num 5 (1995): 859–887; W. J. Gostic, *Aerospace Supply Chain Management. Thesis (M.B.A.)* (Cambridge: Massachusetts Institute of Technology, Sloan School of Management, 1998); M. Fritsch y G. Franke, “Innovation, Regional Knowledge Spillovers and R&D Cooperation. *Research Policy* Vol: 33 (2004): 245–255; D. C. Mowery, *Alliance Politics and Economics: Multinational Joint Ventures in Commercial Aircraft* (Cambridge, MA: Ballinger Pub. Co., 1987); P. Dussauge, “Les alliances stratégiques entre firmes concurrentes: le cas des industries aérospatiale et de l’armement”, *Revue Française de Gestion* Vol: 80 (1990): 5–16 y P. Dussauge y B. Garrette, “Determinants of Success in International Strategic Alliances: Evidence from the Global Aerospace Industry”, *Journal of International Business Studies* Vol: 26 num 3 (1995): 505–530.

All these channels are usually used jointly, and in the case of the transfer of implicit knowledge, spillover occurs without considering the needs of the consumer of knowledge, spontaneously. Each RIS subject is interested in obtaining as much knowledge as possible in the field of their activity and, possibly, related fields. Excessive information spillover will reduce the efficiency of its processing and cause difficulties with storing codified knowledge and growth in transaction costs. Therefore, each subject of the innovation system needs effective management of its knowledge.

Name of a channel	
1. Education	6. Trade in goods
- higher education, master's program	7. Internet communications
- skills development, internships	- professional communities
- staff training, tutoring, mentoring	- databases
- distance education	- publications
2. Scientific communication	- networks
- scientific publications (libraries)	8. Projects
- conferences, loft spaces, seminars, master classes	- research on contracting agreements
- centers of scientific and technical information	- cooperation in research and development (R&D)
3. Services	9. Joint scientific activity in various legal forms (networks, a public-private partnership (PPP), partnerships, etc.)
- service trade	10. Intellectual property rights
- transfer intermediaries	- licenses
4. Mergers (takeovers)	- patents, know-how
5. Personnel exchange, job change	- trademarks

Table 1  
Channels of information spillover in RIS

Usually, depending on the type of knowledge (implicit or explicit), knowledge management methods are divided into personified and codified<sup>15</sup>.

For the codified method, tools are various methods for documenting knowledge (creating databases, publishing monographs and articles, analyzing best practices, etc.). The tools of a personalized approach are conferences, mentoring, seminars, training, corporate training, etc.

The results of processing the obtained questionnaires allowed us to put forward a hypothesis that the type of RIS to a certain extent depends on the type or kind of information spillovers. Average scores for all groups of information spillovers are shown in Figure 1.

<sup>15</sup> V. Ribiére y F. Tuggle, "The Influence of Organizational Trust on the Use of KM Systems and on the Success of KM Initiatives", *Knowledge Management in Modern Organizations* (2007): 96–120.

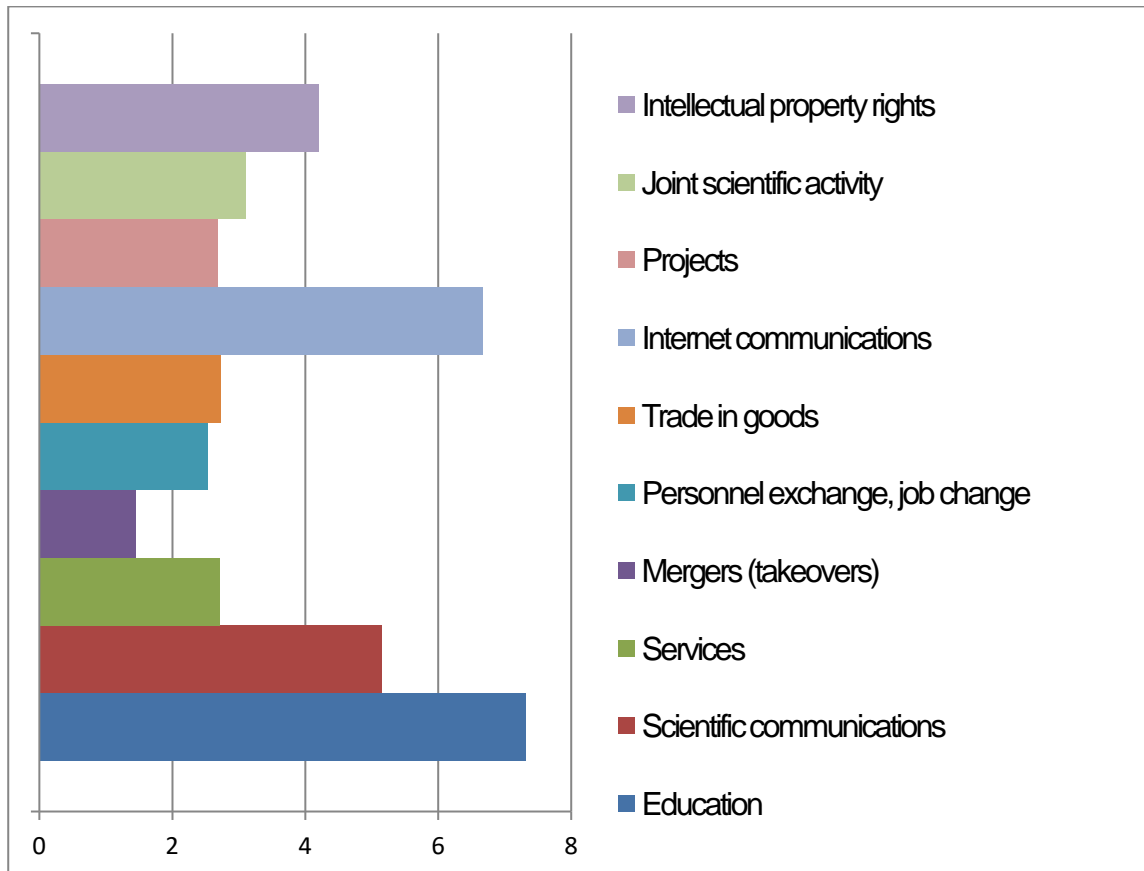


Figure 1  
Average assessment of the importance of information spillover channels for the innovative business of small and medium enterprises in Stavropol Krai

According to the results of processing the information of the first questionnaire, we can say that in Stavropol Krai the most important channel for the information spillover is “Education” (on average, this channel is estimated at 7.32 points). In the second place are “Internet communications” (6.68 points) and the third – “Scientific communications” (5.15 points).

Let us see the respondents’ assessments of the importance of information spillover within channels, collectively called “Education” (Figure 2).

Within the group of channels under the name “Education”, the most important is “Skills development” (8.73 points). The second most important is “Staff training, tutoring, mentoring” (8.36 points). Both of these channels are spillover channels, mainly of implicit knowledge.

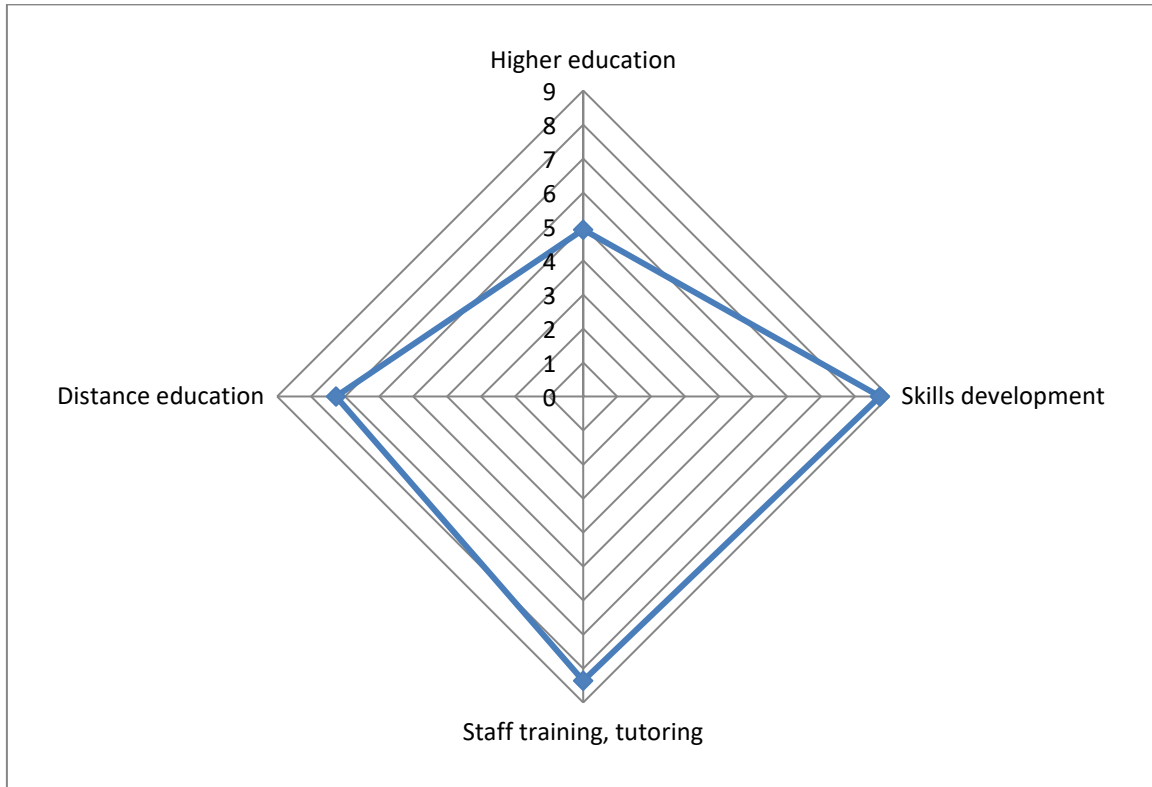


Figure 2  
Assessment of information spillover channels in the context of "Education"

On the one hand, during the transfer of implicit knowledge, it is possible to transfer important competencies and ideas that cannot be obtained through the transfer of explicit knowledge. On the other hand, this suggests that, in all probability, the transmission channels are explicit knowledge, not sufficiently developed for use in the production of innovative ideas or underestimated due to the lack of demand for innovative business in the region.

Among the channels of "Scientific communications", the spillover channels of implicit knowledge – "Conferences, loft spaces, seminars, master classes" – also turned out to be of the highest value.

Let us consider the value of channels among the "Internet communications" (Figure 3).

If the "Internet communications" group received an overall rating of 6.68 points for groups of knowledge transfer channels, in terms of Internet communication channels, the "Internet publications" channel, which was the most important for the respondents in general among all information transfer channels, received the highest score of 9.27 points. Communication in professional Internet communities was rated 8.36 points and communication on social networks by the importance of the flow of information received a rating of 7.64 points.



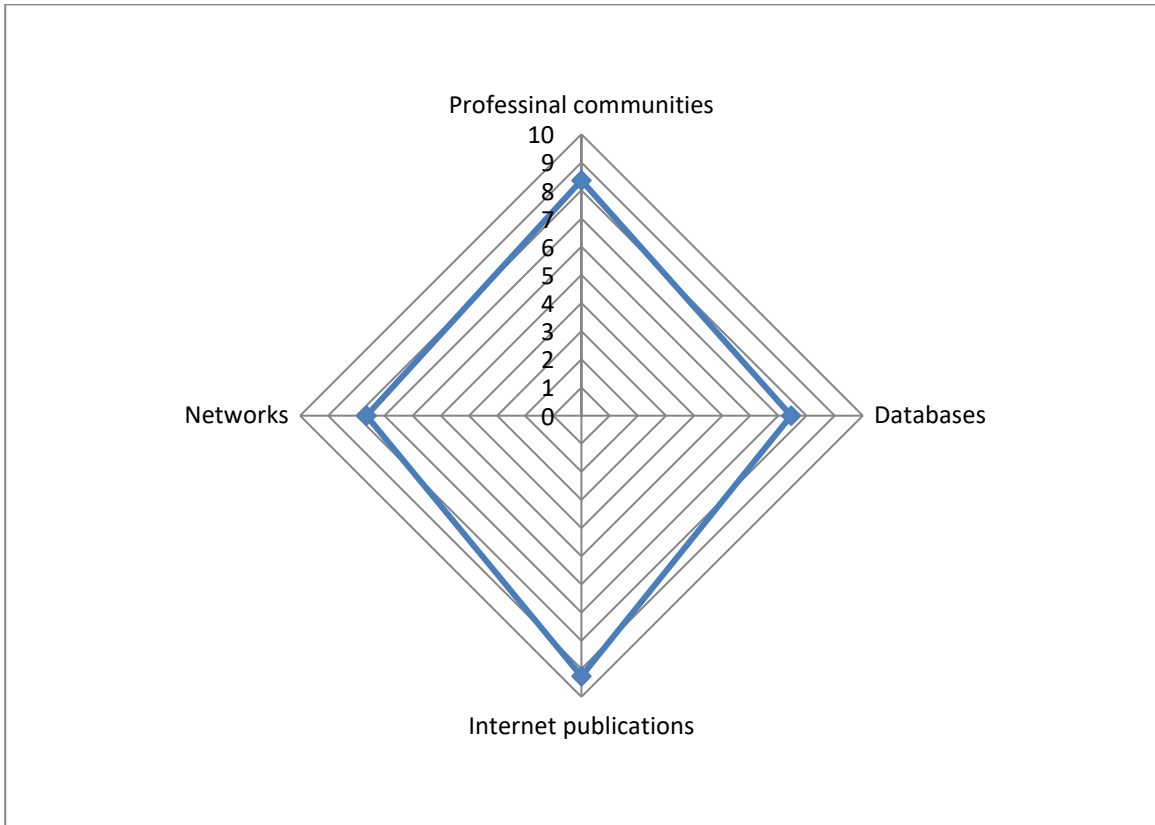


Figure 3  
Assessment of information spillover channels in the context of “Internet communication”

There were very weak spillovers of information between transfer intermediaries, through trade in services, goods and other channels of cooperation and joint scientific activity.

The channels of intellectual property rights also received a low rating: “Licenses” – 3.82 points, “Patents and know-how” – 4.64 points, “Trademarks” – 4.1 points.

The lowest-rated were “Transfer intermediaries” (0.91), “Mergers (takeovers)” (1.45), “Cooperation in R&D” (1.54), “Personnel exchange, job change” (2, 54), “Trade in goods” (2.73) and “Joint scientific activity in various legal forms (networks, PPP, partnerships, etc.) (3.1). This suggests that entrepreneurs almost do not cooperate in the field of innovation and horizontal and vertical integration of companies is poorly developed. A shift in staff work also often does not occur, since the situation on the labor market in the region is rather tense, which, in a certain degree, is associated with fairly intense flows of migrants from neighboring North Caucasian republics. The results of the second questionnaire showed that the predominant part of new ideas and new knowledge arose directly within the organization (91%). Among 40% of the entrepreneurs, the predominant part of partner organizations (sources of knowledge) was located within the region and 60% outside the region. For 90% of organizations, the search for new technologies for the production of products and services was relevant. 75% of the entrepreneurs adapted the knowledge gained from other organizations in accordance with the needs of their organization and 25% used the ideas that arise or are received from other organizations directly, without technical adaptation.

## Conclusion

Assessment of information spillover channels provides a basis for determining the type of territorial innovation system. Based on the studies, we found that in Stavropol Krai the RIS is characterized by the following knowledge spillovers.

There is mainly a transfer of implicit knowledge obtained in the form of skills development, training, tutoring, etc. This suggests that the infrastructure of innovation in the form of centers of scientific and technical information, patent offices, business incubators, consulting agencies, innovation centers, technology parks and technopolises, venture capital funds, etc. is poorly developed, which directly corresponds to our earlier analysis of the development of innovative infrastructure in the region. This type of spillovers requires the closeness of the participants in the innovation chain. The transfer of implicit knowledge through the channels of sale or change of work is almost not performed. Information spillovers are not deliberate and are random. The information spillover is mainly horizontal and there is almost no vertical knowledge spillover, which indicates the low competitiveness of the RIS and the absence of favorable conditions in the form of an optimal multilevel infrastructure of innovation.

This is the initial stage of our research; therefore, the classification of RIS based on the analysis of knowledge spillovers in them will be carried out after studying other subjects of the Russian Federation according to this methodology.

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