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The collaboration activities in the innovation system of Russia

Tatiana Kuznetsova, Vitaliy Roud, Sergey Bredikhin

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The collaboration activities in the innovation system of Russia

Tatiana Kuznetsova, Vitaliy Roud, Sergey Bredikhin
Laboratory of Economics of Innovation, Institute for Statistical Studies and Economics of Knowledge,
National Research University Higher School of Economics - HSE

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Abstract

Cross-border flows of knowledge are crucial factors determining the efficiency of national innovation systems. Under the conditions of global economy by no means can the countries rely on the sole in-house development and utilization of innovations.

In case of Russian socio-economic environment, the practice of cross-border collaboration remains lagging behind the high demand one could expect due to a number of reasons. Some of them relate to geographical disconnection which is still significant although eased by the advancement in telecommunications and transportation. Others imply the unequal macroeconomic conditions as well as heterogeneity of innovation performance and potential of the regions and sectors.

This study employs an extended set of statistical indicators in order to characterize the heterogeneity of Russian innovation landscape at the regions adjacent to the EU. Patterns of cross-border collaboration of Russian enterprises are explored using the specialized survey covering innovation activities of 760 manufacturing companies. Several case studies act as illustrations for the empirical findings.

This study contributes to the T4.4 "Analysis of the effects of firms networks in the process of cross-border technological diffusion and on the impact of the creation and diffusion of knowledge and innovation across regions" of the Sharing KnowledgE Assets: InteRregionally Cohesive NeigHborhoods (SEARCH) Project.

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Abbreviations and Definitions

EMS	European Manufacturing Survey (executed by the consortium of 18 countries, coordinated by Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany)
GRP	Gross Regional Product
HSE	National Research University "Higher School of Economics" (Russia)
INCO	International Cooperation
IPR	Intellectual property rights
NWFD	North-West Federal District of Russian Federation
R&D	Research and Development
S&T	Science and Technology
SME	Small and Medium Enterprise
STI	Science, Technology and Innovation

1. Introduction

Cross-border flows of knowledge are crucial factors determining the efficiency of national innovation systems. Under the conditions of global economy by no means can the countries rely on the sole in-house development and utilization of innovations.

In case of Russian socio-economic environment, the practice of cross-border collaboration remains lagging behind the high demand one could expect due to a number of reasons. Some of them relate to geographical disconnection which is still significant although eased by the advancement in telecommunications and transportation. Others imply the unequal macroeconomic conditions as well as heterogeneity of innovation performance and potential of the regions and sectors.

This study[1] is aimed at illustrating key specificities concerning the cross-border collaboration patterns within Russian innovation system combined with outlining dimensions of heterogeneity of Russia's innovation landscape. For the latter objective, we concentrate on describing the Northwestern Federal District, which is the only to border the European Union countries: Norway, Finland, Latvia, and Estonia.

This report is structured as follows:

- The next section provides extended description of the diversity of innovation performance within the North-west region, outlining key areas of efficiency as well as pitfalls hampering successful development.
- Section 3 provides an empirical analysis of patterns of cross-border cooperation within Russian enterprises.
- Section 4 presents a summary of several cases of international cooperation within the North-western Federal District.
- The last section concludes with key findings and implications.

[1] The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement No. 266864 (Project SEARCH). This study also has received support from the HSE Basic Research Programme.

2. Overview of innovation potential and performance of the North-western Federal District

2.1 Innovation-related specifics of the North-western Federal District

As a background for the analysis of innovation activities we start from studying economic conditions of the regions employing conventional macroeconomic indicator, gross regional product per employee. This measure provides substantial grounding for further interpretations of STI-specific indicators, controlling for the overall differences between regions in terms of "nominal" development level which largely defines prevailing economic models they use.

Table 1. GRP per person employed, in current prices *(% of country average)*

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Russian Federation	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Republic of Karelia	94	89	90	83	73	86	72	77	73	72	71	72
Komi Republic	140	150	135	138	137	136	143	128	120	143	141	149
Arkhangelsk Oblast	110	94	97	101	108	96	101	105	97	113	113	111
Nenets Autonomous Okrug	680	529	643	738	872	817	897	1125	866	1307	1239	1257
Vologda Oblast	128	98	100	109	131	117	98	97	99	75	81	83
Kaliningrad Oblast	63	72	68	62	69	64	65	73	78	81	79	75
Leningrad Oblast	82	84	92	94	96	91	93	85	89	104	100	95
Murmansk Oblast	133	113	111	107	136	108	104	108	97	96	97	95
Novgorod Oblast	71	74	75	69	72	74	72	68	74	79	73	72
Pskov Oblast	56	54	58	54	49	44	46	44	45	51	50	49
Saint Petersburg	93	97	105	105	105	99	95	103	109	117	115	116

Source: Federal Statistical Bureau of Russian Federation (Rosstat), HSE

The development paths of north-western regions are clearly reflected by ability to maintain their positions in the Russian economy during the oil prices-led boom. Nenets Autonomous Okrug, a typical sparsely populated and purely mining region, benefited greatly from that situation without much need to implement new technologies, and at the same time a few regions faced a strong downward trend in terms of their comparative performance. So we can suppose that even to keep

below-average levels stable requires some minimal innovation activity. However, low nominal productivity in any case limits the financial ability to effectively implement innovations.

The share of innovative firms serves as a common indicator of innovation activity although is somewhat vulnerable to the specifics of the industrial organization and regional economy structure.

Table 2. Innovative activity of enterprises
(the proportion of organizations implementing technological, organizational and marketing innovations in the reporting year, the total number of manufacturing enterprises), by regions of Russian Federation, (%)

	2009	2010	2011
Russian Federation	**9,3**	**9,5**	**10,4**
The Northwestern Federal District	**9,5**	**9,4**	**11,2**
Republic of Karelia	5,3	6,6	9,2
Komi Republic	6,3	7,5	6,1
Arkhangelsk Oblast	8,8	9,0	9,3
Nenets Autonomous Okrug	13,5	5,3	11,4
Vologda Oblast	7,6	7,4	9,3
Kaliningrad Oblast	5,5	3,2	3,3
Leningrad Oblast	8,6	9,4	9,1
Murmansk Oblast	7,6	9,7	8,5
Novgorod Oblast	9,7	8,7	7,5
Pskov Oblast	8,7	9,6	10,0
Saint Petersburg	14,0	13,0	18,9

Source: Rosstat[2]

It shall be noted that while the figures above are quite stable at the national level, the values for the regions are much more volatile. While there is a promising upward trend in a diverse group of regions, the others demonstrate the opposite. Still, these crude numbers are far below contemporary levels of innovation activity in EU.

One of the most direct indicators of innovation activity is the volume of new products, works and services. Meanwhile there are also cases of this index' inadequateness when a firm utilizes new technologies or innovative management practices only to decrease the production costs of a standard set of goods.

Table 3. Share of innovative products, works and services in the total volume of shipped goods, work, services, by the regions of the Russian Federation, (%)

[2] *http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/science_and_innovations/science/#*

	The share of innovative products, works and services in the total volume of shipped goods, works, services			The share of innovative products, works and services in the total volume of shipped goods, works, services in industry			The share of innovative products, works and services in the total volume of shipped goods, works, services in the tertiary sector		
	2009	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**
Russian Federation	**4,5**	**4,8**	**6,3**	**4,6**	**4,9**	**6,1**	**3,2**	**4,0**	**8,3**
The Northwestern Federal District	**3,1**	**4,1**	**5,2**	**3,2**	**4,3**	**4,8**	**2,7**	**2,3**	**9,5**
Republic of Karelia	1,7	1,3	0,3	1,7	1,0	0,0	2,4	6,5	5,8
Komi Republic	0,6	3,2	7,8	0,6	3,3	7,9	-	0,8	4,7
Arkhangelsk Oblast	0,3	0,4	0,2	0,3	0,4	0,2	0,1	0,3	0,3
Nenets Autonomous Okrug	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	-
Vologda Oblast	2,6	1,6	3,7	2,6	1,6	3,8	5,4	-	0,1
Kaliningrad Oblast	2,8	0,1	0,2	2,6	0,1	0,2	8,4	-	0,7
Leningrad Oblast	1,8	2,4	2,5	1,8	2,4	2,5	-	-	5,5
Murmansk Oblast	0,3	0,5	0,2	0,1	0,4	0,0	1,5	0,9	1,6
Novgorod Oblast	7,5	6,9	4,8	7,7	7,2	4,9	2,3	-	3,0
Pskov Oblast	1,4	2,7	2,3	1,4	2,7	2,4	-	-	0,2
Saint Petersburg	5,5	8,0	9,0	6,1	9,1	8,4	2,9	2,8	11,5

Source: *Rosstat*[3].

The whole District's industrial sector with its significant mining share produces not so many innovative goods as Russia on average, but several regions managed to demonstrate a much higher attention to service innovations in 2011. Thus we can see that sudden positive changes in, at least, innovation activity statistics, are more or less flexible and very likely to happen as a consequence of some kind of major effort to support them.

To identify the main drivers of these changes, there is a need to have more comprehensive and complicated indicator, which would incorporate different aspects of innovations, conditions of their emergence and proper use on a regional level. One of the key analytical resources in this regard is Russian Regional Innovation Development Scoreboard[4] published by the Higher School of Economics Institute for Statistical Studies and Economics of Knowledge (ISSEK). It comprises a comprehensive set of 35 region-wise indicators structured along four sub-indexes:

- Index of socioeconomic conditions for innovation activity (ISECIA)

[3] http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/science_and_innovations/science/#
[4] Gokhberg (ed.), 2012. Russian Regional Innovation Development Scoreboard *(in Russian)*. http://www.hse.ru/primarydata/rir2012

- Index of scientific and technological capacity (ISTC)
- Index of innovation activity (IIA)
- Index of innovation policy quality (IIPQ)

This report employs these data in order to characterize the innovation potential of Northwestern Federal district (Table 4).

Table 4. Ranking of innovation performance of Northwestern regions

Region	ISECIA-NW	ISTC-NW	IIA-NW	IIPQ-NW	RRII-NW
Saint Petersburg	1	1	1	2	**1**
Murmansk Oblast	3	2	7	4,5	**2**
Leningrad Oblast	4	5	4	4,5	**3**
Novgorod Oblast	5	6	3	4,5	**4**
Vologda Oblast	10,5	8	9	1	**5**
Komi Republic	10,5	3	8	4,5	**6**
Republic of Karelia	7	7	2	8	**7**
Kaliningrad Oblast	2	4	10	9	**8**
Pskov Oblast	9	11	5	7	**9**
Arkhangelsk Oblast	6	9	6	10	**10**
Nenets Autonomous Okrug	8	10	11	11	**11**

Source: Russian Regional Innovation Development Scoreboard, HSE.

2.2. Region-wise heterogeneity of innovation performance

This section presents case-by-case analysis of innovation performance of the Northwestern regions.

Table 5. Innovation performance of Saint Petersburg region

Indicator	Saint Petersburg	Russian Federation
Gross regional product to the cost of fixed assets	**0,63**	0,41
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	**6,81**	6,48
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	**20,81**	13,72
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	1359,72	**1418,69**
The share of organizations of the business sector in domestic expenditure on research and	**22,74**	16,41

development, (%)		
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	108,16	**119,53**
The share of persons aged under 39 years in the number of researchers, (%)	34,61	**35,54**
Share of persons with an academic degree in the number of researchers, (%)	25,91	**28,49**
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	3,89	**5,17**
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	**600,27**	563,36
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	**47,74**	11,45
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	**1,57**	0,42
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	**8,85**	5,92
The intensity of expenditure on technological innovations, (%)	1,00	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

The undisputed leader of the Northwestern Federal District is Saint Petersburg (Table 5), holding leading position next to Moscow far ahead of the rest in the socioeconomic conditions rating region. Among other indicators the share of persons with higher education and population and businesses with access to the Internet show very high values, nearly the best figures in the country. Reflecting gradually emerging post-industrial nature of the city, the share of employment in high-tech and high middle-tech industries in total employment is just over the national average level, and at the same time employment in knowledge-intensive services is 1.5 times higher. Saint Petersburg still has a large and diversified industrial sector with notable examples of civil and military shipbuilding, automobile cluster, machinery, food and electronic equipment industries etc.[5] Whole economy of this region can be considered the most effective within the District, with substantial level of GRP to fixed assets cost ratio.

[5] Source: http://gov.spb.ru/static/writable/ckeditor/uploads/2012/12/07/Investor_book_2012.pdf

There are obvious historical and geographical reasons for the region's "success" predetermined by its long stay in the status of the capital of the Russian Empire and the sea port possession accordingly. Also the presence of more or less appropriate infrastructure connecting the city with Moscow and smaller economic centers makes Saint Petersburg more attractive for foreign investors, especially from the European Union, than the other regions of the Northwestern District. Thus the proximity to Europe has in this case the greatest impact on the territories' development by facilitating potentially both Russia's goods and services market entry and technology transfer.

Under the given conditions rather competitive environment has emerged, which increases the need to innovate. The relative economic prosperity and demand for innovations from a number of firms (the share of organizations of the business sector in domestic expenditure on R&D is not very large but still well above the national average level) inevitably leads to concentration of science and technology potential in the city. This results in an obviously increased innovation activity. Such indicators as the numbers of patent applications for inventions per million of economically active people and advanced manufacturing technologies developed in the region; the share of organizations that had ready-made technological innovations developed in-house and the ratio of the volume of exports of technology to GRP – all are showing quite high values.

However, the relative number of articles published in peer-reviewed journals is below national level, the fact that probably means that the scientists are mostly engaged in business R&D. Moreover, there are not so many young researchers and PhDs. The likely reason for is that mainly public research organizations still do not have enough funds to attract highly-paid specialists from not directly related to science sectors of the economy.

Thus to improve its regional innovation system and become more attractive for foreign investors Saint Petersburg generally needs to maintain existing trends by facilitating science-industry links and also needs more favorable business environment creation.

Table 6. Innovation performance of Murmansk Oblast

Indicator	Murmansk Oblast	Russian Federation
Gross regional product to the cost of fixed assets	0,29	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	3,49	**6,48**
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	12,41	**13,72**

Gross domestic expenditure on R&D per 1 researcher, thousand rubles	**2134,69**	1418,69
The share of organizations of the business sector in domestic expenditure on research and development, (%)	15,78	**16,41**
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	**164,35**	119,53
The share of persons aged under 39 years in the number of researchers, (%)	29,89	**35,54**
Share of persons with an academic degree in the number of researchers, (%)	**52,02**	28,49
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	**7,41**	5,17
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	75,38	**563,36**
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	0,00	**11,45**
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	**3,31**	0,42
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	2,27	**5,92**
The intensity of expenditure on technological innovations, (%)	1,50	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Murmansk oblast gained its relatively high position in the overall region ranking (Table 6) mainly due to quite impressive ICT-related figures. Despite having the share of mining sector and fishery in its economy higher than the national average level, this region demonstrates comparatively advanced technological potential and good enough socioeconomic conditions for innovation activity. Moreover, the researchers, more than a half of which are holding academic degrees, are provided with rather considerable resources and demonstrate relatively high publication activity.

Still, it can be seen that corresponding opportunities are utilized mostly by information and communication sector, which probably enables to receive large amounts of money from export of technologies without strong numbers of manufacturing technologies and patents produced in the reference year. The situation in industrial production can be characterized as volatile because of its

dependence on the primary sector (resource extracting and fishing in this case)[6] – traditionally conservative types of activity - thus keeping demand for innovations in the region under pressure.

The only high middle-tech industry visibly present in Murmansk oblast is shipbuilding, largely controlled by the state-owned United Shipbuilding Corporation (OSK).[7] Officially having a task to improve competitiveness of Russian-build ships and effectiveness of dockyards, the OSK's leadership potentially could be interested in more intensive cooperation with the European partners. At the same time, such a collaboration would be restricted by strong engagement of those facilities in military-purpose activities, the fact that inevitably lowers both the will to introduce new management practices within the industry and official figures of the region's innovativeness (because only civil-purpose novelties are counted).

Generally, the relatively low level of GRP to capital assets could mean underutilization of facilities, implying that high growth rates could be achieved by proper management and fostered implementation of innovations without significant additional investments. The combination of energy abundance, large and diversified natural resources and access to the sea provides Murmansk oblast with opportunity to become highly attractive to European companies but mostly in low-tech industries. This situation (if properly used) could improve the region's economy by increasing productivity in more traditional sectors at the first stage and create favorable conditions for new innovative firms through tax breaks and infrastructure development at the second.

Table 7. Innovation performance of Leningrad Oblast

Indicator	Leningrad Oblast	Russian Federation
Gross regional product to the cost of fixed assets	0,41	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	5,54	**6,48**
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	9,95	**13,72**
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	**1732,35**	1418,69
The share of organizations of the business sector in domestic expenditure on research and development, (%)	13,40	**16,41**
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in	**135,72**	119,53

[6] URL: http://minec.gov-murman.ru/content/about/sub13/ (in Russian)
[7] URL: http://www.oaoosk.ru/organization_chart.html (in Russian)

Indicator	Leningrad Oblast	Russian Federation
the region, (%)		
The share of persons aged under 39 years in the number of researchers, (%)	25,59	**35,54**
Share of persons with an academic degree in the number of researchers, (%)	22,80	**28,49**
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	1,64	**5,17**
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	256,96	**563,36**
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	7,65	**11,45**
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	0,11	**0,42**
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	4,91	**5,92**
The intensity of expenditure on technological innovations, (%)	1,40	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Leningrad oblast (Table 7) benefits greatly from its proximity to the District's leader, Saint Petersburg, and the transport network linking it with Moscow region. Combination of access to a huge market of the country's second largest city and appropriate regional policy leads to concentration of diverse manufacturing plants across the oblast, as well as prosperity of the construction industry. Nevertheless, we can see that besides relatively high level of expenditures on R&D personnel the other indicators' values are not as positive as it could be expected.

Indeed, the region's science and technology potential and the results of innovation activities measured by the corresponding indexes are quite low for given circumstances mentioned above. It could be understood as the result of low value-added nature of visible industrialization of Leningrad oblast with an example of food processing industry and the automobile clusters concerned mostly with assembling, not full-cycle production yet.[8] Also there are likely not enough incentives for companies to place their headquarters and R&D departments within the oblast because of still significant well-being level difference between Saint Petersburg (where the most of high-skilled

[8] URL: http://new.lenobl.ru/about/programms/reports/2006_2011/inter_econom (in Russian)

specialists are mainly living) and inadequate infrastructure, while the insignificant number of peer-reviewed publications per 10 researchers means them being unfocused on academic activities.

However, already established links between the Russian and, particularly, European companies in the region allow to count on future development of more in-depth collaboration which would enable to gradually restructure the industrial sector towards more competitive and innovative activities. The numbers presented in the table above are not so far from average levels for Russia, but continuing intensification of international cooperation provides an opportunity to fully join global markets of products, services and technologies and benefit more from diffusion of innovations in the near future.

Table 8. Innovation performance of Novgorod Oblast

Indicator	Novgorod Oblast	Russian Federation
Gross regional product to the cost of fixed assets	**0,45**	0,41
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	**7,21**	6,48
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	10,10	**13,72**
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	1386,65	**1418,69**
The share of organizations of the business sector in domestic expenditure on research and development, (%)	**22,16**	16,41
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	**135,88**	119,53
The share of persons aged under 39 years in the number of researchers, (%)	35,42	**35,54**
Share of persons with an academic degree in the number of researchers, (%)	5,28	**28,49**
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	3,95	**5,17**
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	142,05	**563,36**
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	**11,60**	11,45
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	0,29	**0,42**

Indicator	Novgorod Oblast	Russian Federation
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	**6,58**	5,92
The intensity of expenditure on technological innovations, (%)	1,10	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Novgorod oblast (Table 8) is very industrialized region with diversified manufacturing sector[9] which experiences a hard competition for skilled labor force with its more rich northern neighbors – Saint Petersburg and Leningrad oblast. It is reflected in the unusual situation of comparatively low socio-technological potential but higher than average effectiveness of innovation activity, which implies the existence of demand for innovations restricted by limited capabilities of firms.

Quite noticeable presence of investors from the European Union[10] in food and forest industries is not enough to become a driver of based on innovation growth, but probably helps to keep current situation in the region's economy more stable and can facilitate new links creation in the long run. Another significant feature of the oblast's economic landscape is that it holds headquarters and main enterprises of the Acron Group, the largest mineral fertilizers producer in Russia.[11] Also despite relatively low overall level of productivity in nominal terms, Novgorod oblast has been successfully keeping pace with the national economy during an oil prices growth. Thus the whole situation could be characterized as contradictory.

Considering this environment the assumption could be made that to increase innovativeness and productivity across the region it is needed to help firms to abandon apparently used by them low labor cost model which defines current insufficient attractiveness of Novgorod oblast for establishing new high-performance enterprises and substantial upgrading of the existing ones. The presumed lack of domestic resources suggests necessity of inviting European partners to offer the least expensive innovative solutions (primary in management and marketing). Fostering more effective use of resources, both material and human, shall allow the region's firms to release enough funds to attract and retain highly-paid specialists.

Table 9. Innovation performance of Vologda Oblast

[9] URL: http://new.lenobl.ru/about/programms/reports/2006_2011/inter_econom (in Russian)
[10] URL: http://region.adm.nov.ru/economy/investment/foreigninvestment/ (in Russian)
[11] URL: http://www.acron.ru/about/geography/production/acron/ (in Russian)

Indicator	Vologda Oblast	Russian Federation
Gross regional product to the cost of fixed assets	0,30	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	**7,50**	6,48
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	9,67	**13,72**
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	876,96	**1418,69**
The share of organizations of the business sector in domestic expenditure on research and development, (%)	11,78	**16,41**
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	**128,17**	119,53
The share of persons aged under 39 years in the number of researchers, (%)	**61,77**	35,54
Share of persons with an academic degree in the number of researchers, (%)	22,02	**28,49**
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	**13,64**	5,17
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	120,04	**563,36**
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	1,52	**11,45**
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	0,00	**0,42**
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	2,97	**5,92**
The intensity of expenditure on technological innovations, (%)	0,60	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Vologda oblast represents another example of development inequality in terms of economy, science and technology indicators (Table 9). While it has the largest manufacturing sector within the North-Western Federal District, more than a half of that volume can be attributed to metal products shipment controlled by the OAO Severstal.[12] However, there are also firms concerned with the higher level of processing, for example in machinery, enabling to lift the share of persons employed

[12] URL: http://vologda-oblast.ru/en/region/economics/

in high-tech industries and high level middle-tech industries slightly above the national average level. Besides that, one's attention could be drawn to the large number of relatively young researchers engaged in R&D as well as more than 2.5 higher than average level intensity of publication activity, which shall be compared with much less impressive values of associated costs.

In combination with growing gap between the regional and the national level of productivity this situation can be seen reflecting inadequate linkages between the scientific community and the entrepreneurial sector of Vologda oblast. The overall level of socioeconomic development and technological capacities is quite low.

Still, it should be noted that this oblast received one of the highest positions in the rating in terms of innovation policy quality surpassing even the Saint Petersburg. Thus it becomes inevitable for the regional government to use this kind of opportunity for attraction of more innovative companies in order to establish sufficiently competitive environment as well as for reconfiguration of the innovation system of Vologda oblast towards more business-related researches.

Table 10. Innovation performance of Komi Republic

Indicator	Komi Republic	Russian Federation
Gross regional product to the cost of fixed assets	0,28	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	1,36	**6,48**
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	**14,02**	13,72
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	**1427,81**	1418,69
The share of organizations of the business sector in domestic expenditure on research and development, (%)	**52,20**	**16,41**
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	**161,76**	119,53
The share of persons aged under 39 years in the number of researchers, (%)	**46,97**	35,54
Share of persons with an academic degree in the number of researchers, (%)	**39,37**	28,49
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	**15,59**	5,17
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the	93,21	**563,36**

Indicator	Komi Republic	Russian Federation
region		
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	1,83	**11,45**
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	0,00	**0,42**
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	2,53	**5,92**
The intensity of expenditure on technological innovations, (%)	0,30	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Komi Republic can be characterized (Table 10) by its lowest share of manufacturing and highest share of mining in the region's economy within the District.[13] Despite being a relatively rich region, its socioeconomic conditions for implementing innovation are thought to be not very high, but on the other hand there is rather substantial demand of local enterprises for non-technological innovations reflected by the share of employment in knowledge-intensive service industries in total employment and unusually significant level of business engagement in R&D. Among other things there is comparatively strong academic sector capable of retaining young specialists and providing them with enough incentives to actively publish articles in the Russian peer-reviewed journals.

Nevertheless, with resource-extracting specialization of the Komi Republic given, the perspective of major increase of innovation activity intensity has to be recognized as limited. There are no obvious problems with financial aspect, such as R&D funding, but lack of economic incentives to create new manufacturing firms so far from domestic and international markets, when oil, gas and diverse mineral deposits are more or less available. At the same time already present interest in service and ecological innovations suggests another way of cooperation with Europe, concerned with joint development and use of so-called green technologies, especially if there would be an adequate regional economic policy framework.

Table 11. Innovation performance of Republic of Karelia

Indicator	Republic of Karelia	Russian Federation

[13] URL: http://rkomi.ru/en/left/info/prom/

Indicator	Republic of Karelia	Russian Federation
Gross regional product to the cost of fixed assets	0,32	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	2,09	**6,48**
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	11,21	**13,72**
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	1188,60	**1418,69**
The share of organizations of the business sector in domestic expenditure on research and development, (%)	8,58	**16,41**
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	**157,55**	119,53
The share of persons aged under 39 years in the number of researchers, (%)	**41,00**	35,54
Share of persons with an academic degree in the number of researchers, (%)	**65,69**	28,49
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	**8,12**	5,17
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	61,65	**563,36**
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	0,00	**11,45**
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	0,08	**0,42**
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	**8,79**	5,92
The intensity of expenditure on technological innovations, (%)	**2,30**	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Republic of Karelia (Table 11) is not very developed region noticeable for its intensity of expenditures on technological innovations. Actually it is has been rated rather high in the report due to receiving very positive score for its innovation activity results. Meanwhile, the numbers presented in the table above appear to be quite moderate except the share of researchers with academic degrees. Being one of a few regions directly neighboring the European Union, Republic of Karelia still does not have strong and elaborated economic ties with Scandinavia and generally

continues to exploit its natural resources.[14] As in the case of Novgorod oblast, it seems to be that local companies are trying to compensate for skilled labor force outflow to more favorable to reside regions partially by intensifying theirs innovation activity. Also there is an important factor of already gained status of well-known tourism destination, which opens opportunities to development of different service innovations.

In the current situation it seems to be rationale for the regional government to find a way of benefiting from economic and technological spillovers from the southern regions and Finland while keeping touristic attractiveness of the republic. Such a goal raises an issue of large-scale introduction of ecological innovations and, for example, modern forestry techniques across Republic of Karelia – the process which can become very interesting for some of European firms especially during the crisis.

Table 12. Innovation performance of Kaliningrad Oblast

Indicator	Kaliningrad Oblast	Russian Federation
Gross regional product to the cost of fixed assets	**0,49**	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	5,08	**6,48**
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	12,15	**13,72**
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	**1898,77**	**1418,69**
The share of organizations of the business sector in domestic expenditure on research and development, (%)	11,79	**16,41**
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	**146,81**	**119,53**
The share of persons aged under 39 years in the number of researchers, (%)	31,41	**35,54**
Share of persons with an academic degree in the number of researchers, (%)	18,59	**28,49**
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	**10,67**	**5,17**
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	166,75	**563,36**

[14] URL: http://www.gov.karelia.ru/Info/2011/eco_invest11_e.html (in Russian)

Indicator	Kaliningrad Oblast	Russian Federation
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	1,94	**11,45**
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	**0,73**	**0,42**
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	1,06	**5,92**
The intensity of expenditure on technological innovations, (%)	0,10	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Kaliningrad oblast (Table 12) can be described by its inertia of enterprises in the implementation of innovation. Lack of innovation activity is exacerbated by the implementing of low-impact innovations. This can be especially unexpected given its geographical position of an enclave bordered by two European Union countries (Poland and Lithuania) and its present status of the special economic zone.[15] At the same time it has obvious signs of benefiting from aforementioned factors in terms of general socioeconomic well-being. Kaliningrad oblast provides its citizens and enterprises with conditions for innovation activity surpassed only by Saint Petersburg, and the region's economy structure seems to be quite balanced representing many kinds of activity – manufacturing, mining, fishery, tourism etc.

However, the local industry is dominated by long-established automobile assembly facilities, which makes the whole situation similar to Leningrad oblast with its large and developing industrial sector but relatively low innovation activity. Gross domestic expenditure on R&D per 1 researcher and scientists' salaries are well over the national average level, but the share of innovative products, in the total volume of shipped industrial goods is minor, although publication activity is twice as high as it is in Russia as whole and technology export is rather substantial.

The problem is that many of the firms in the region are not independent but essentially subsidiaries of large multinational corporations with headquarters and R&D departments placed around the world, so innovations are being developed somewhere else and come the oblasts enterprises only as ready solutions. To reverse this trend it is needed to foster creation of full joint companies located in Kaliningrad oblast by providing some specific and unique economic conditions for western partners.

[15] URL: http://gov39.ru/ekonomy/ (in Russian)

Table 13. Innovation performance of Pskov Oblast

Indicator	Pskov Oblast	Russian Federation
Gross regional product to the cost of fixed assets	0,35	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	**6,49**	6,48
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	8,32	**13,72**
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	317,49	**1418,69**
The share of organizations of the business sector in domestic expenditure on research and development, (%)	0,00	**16,41**
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	58,74	**119,53**
The share of persons aged under 39 years in the number of researchers, (%)	**39,44**	35,54
Share of persons with an academic degree in the number of researchers, (%)	**38,89**	28,49
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	**12,28**	5,17
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	136,14	**563,36**
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	5,56	**11,45**
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	0,00	**0,42**
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	**6,64**	5,92
The intensity of expenditures on technological innovations, (%)	0,40	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

The least developed region, Pskov oblast (Table 13) also borders European Union, but looks like an inverse of Kaliningrad oblast, because its position in innovation activity rating is substantially higher than it could be expected from past and current economic conditions. Indeed, in many aspects this oblast is the most “depressive” within the Northwestern Federal District, but the shares of innovative products and companies are higher than in many other regions, including more prosperous ones.

In particular, gross domestic expenditure on R&D per 1 researcher are far below the national average level, although significant number of young and publishing researchers is still present and there are even rather many companies having in-house developed technological innovations. It shall be noted, however, that there are no business-related R&D expenditures, which means that regional scientific community actually has no strong ties with local enterprises.

There are not so many ways of making Pskov oblast more attractive for European innovative companies due to its comparative remoteness from main economic centers and transport arteries in combination with the lack of natural and human resources. The most obvious approach in this case is to develop high-quality ICT-infrastructure in order to support related services, to establishing some kind of full cycle "green" production facilities and recreation clusters.

Table 14. Innovation performance of Arkhangelsk Oblast

Indicator	Arkhangelsk Oblast	Russian Federation
Gross regional product to the cost of fixed assets	0,28	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	**10,68**	6,48
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	11,57	**13,72**
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	969,70	**1418,69**
The share of organizations of the business sector in domestic expenditure on research and development, (%)	**31,51**	16,41
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	0,00	**119,53**
The share of persons aged under 39 years in the number of researchers, (%)	**39,66**	**35,54**
Share of persons with an academic degree in the number of researchers, (%)	21,25	**28,49**
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	**7,38**	5,17
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	81,58	**563,36**
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	11,20	**11,45**

Indicator	Arkhangelsk Oblast	Russian Federation
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	0,15	**0,42**
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	4,73	**5,92**
The intensity of expenditures on technological innovations, (%)	0,19	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Arkhangelsk oblast (Table 14) generally resembles Murmansk oblast, the similarity largely defined by the region's access to the sea. At the same time the former has much larger share of high-tech and high-middle-tech industries in its economy. Furthermore, the share of organizations of the business sector in domestic expenditure on research and development is almost two times larger than national average. Both of those features are obviously influenced by emerging shipbuilding cluster which unites the largest enterprises and research institutes of the region.[16] However, most of the local manufacturing facilities belong to defense industry which makes production dynamic strongly dependent on public procurement processes.[17] In this context, the GRP to cost of fixed asset ratio probably reflects general underuse of military-related capacities in 2010.

Besides relatively large machinery sector, the Arkhangelsk oblast's economy is dominated by low tech enterprises concerned with food processing and woodworking, the feature which simultaneously restrains current innovation activity within the region, but at the same time creates opportunities for significant productivity increase in case of even minor innovations widely use. Also it shall be noted that due to the lack of separate data for Arkhangelsk oblast in terms of salary, zero value of this indicator has been attributed, thus lowering the total index score.

The region's dockyards generally determine its current and potentially long-term specialization on large-scale able to operate in cold waters sea-related "products" ranging from submarines to drilling platforms. Thereby growing economic activity in Arctic Ocean can create a sustainable demand for goods and services provided by Arkhangelsk oblast, improving its attractiveness for European investors and fostering innovativeness of local firms.

Table 15. Innovation performance of Nenets Autonomous Okrug

[16] URL: http://cluster.hse.ru/pilots/archan (in Russian)
[17] URL: http://www.dvinaland.ru/economy/ (in Russian)

Indicator	Nenets Autonomous Okrug	Russian Federation
Gross regional product to the cost of fixed assets	**0,46**	**0,41**
The share of employment in high-tech industries and high level middle-tech industries in total employment in the economy of the region, (%)	0,05	**6,48**
The share of employment in knowledge-intensive service industries in total employment in the economy of the region, (%)	12,92	**13,72**
Gross domestic expenditure on R&D per 1 researcher, thousand rubles	**1734,69**	1418,69
The share of organizations of the business sector in domestic expenditure on research and development, (%)	0,00	**16,41**
The ratio of the average monthly salary of employees engaged in research and development, to the average monthly salary in the region, (%)	30,57	**119,53**
The share of persons aged under 39 years in the number of researchers, (%)	**73,91**	35,54
Share of persons with an academic degree in the number of researchers, (%)	4,35	**28,49**
The number of articles published in peer-reviewed journals from the Russian Science Citation Index, per 10 researchers	0,00	**5,17**
The number of patent applications for inventions filed with Rospatent by national applicants, per million of economically active people in the region	0,00	**563,36**
The number of advanced manufacturing technologies developed in the region, per million of economically active people in the region	0,00	**11,45**
The ratio of the volume of exports of technology to GRP, per 1 thousand rubles of GRP	0,00	**0,42**
The share of organizations that had ready-made technological innovations developed in-house, in the total number of organizations, (%)	0,00	**5,92**
The intensity of expenditures on technological innovations, (%)	0,00	**1,50**

Source: Russian Regional Innovation Development Scoreboard, HSE.

Sparsely populated but oil-rich territory, Nenets autonomous okrug (Table 15) demonstrates very low positions in the overall region rating as it could be generally expected. Abundance of hydrocarbons predetermines extracting nature of the region's economy and developed mining infrastructure.[18] However, it can be seen from the second table that there is still some kind of noticeable innovation activity. Also the share of employment in knowledge-intensive service industries in total employment is not so far from the national average level. In this context, the region's innovative potential is largely determined by demand from the oil and gas extracting companies for new solutions to counter the challenges they are facing. Thus it shall be possible and desirable to establish new and support present cooperation links with the European partners in the field of mining industry to facilitate implementation of new technologies as well as to make the region more attractive for creation of a correspondingly specified R&D centers.

[18] URL: http://www.adm-nao.ru/?show=statics&id=39

3. Patterns of collaboration of Russian companies

This section employs the data of the specialized Monitoring survey of innovation behavior of Russian companies[19] in order to empirically characterize the phenomena of collaboration within Russian NIS, giving certain regard to the peculiarities of the patterns observed in the Northwestern Federal District.

3.1 General characteristics of collaboration

The abovementioned region-wise heterogeneity of innovation system performance and development is one of the key factors determining the scale and intensity of collaborative activities. Observed limited scope of innovation-active business efforts (engaged by roughly 10% of industrial companies – or 18% of manufacturing enterprises, as described in the previous sections) automatically affects the available space for international knowledge-driven cooperation. At the same time, during last 20 years Russia has been deeply integrated into the global innovation development chains, on one hand contributing with the accumulated skills and competences and on the other, maintaining highest demand for the advanced technologies. Empirical analysis allows us to explore the resulting regimes of innovation-related collaboration of Russian companies.

Almost all innovation-active companies report the fact of cooperation during the innovation development process with at least one other organization (Figure 1). Two most common types of engagement are interactions with clients and suppliers of machinery, equipment and components. The former linkage generally implies communications targeted at revealing and satisfying the clients' demand for product characteristics. The latter is mainly about implementing the changes in the production process aided by the efforts of suppliers (including purchase of the relevant equipment but also altering the bundles of components/raw materials exploited).

[19] See Annex I for details.

Figure 1. Collaboration of Russian innovation companies
(Share of innovation-active companies that engaged particular type of collaboration)

Partner	Frequency
Clients	75.6%
Suppliers	62.0%
Sub-contractors	35.0%
Services	31.4%
Competitors	15.3%
Research centres	27.7%
Universities	17.7%
Consulting	10.2%
Public authorities and local government	19.1%
At least one cooperation partner	**97%**

Source: HSE Monitoring of Innovation Activities of Enterprises.

Collaboration with institutional knowledge providers appears to be relatively rare (limited to only a quarter of all innovators), but it reflects the imitative nature of innovation strategies of Russian enterprises. In this line, communication with universities appears to be rather exotic (17% of all innovative companies).

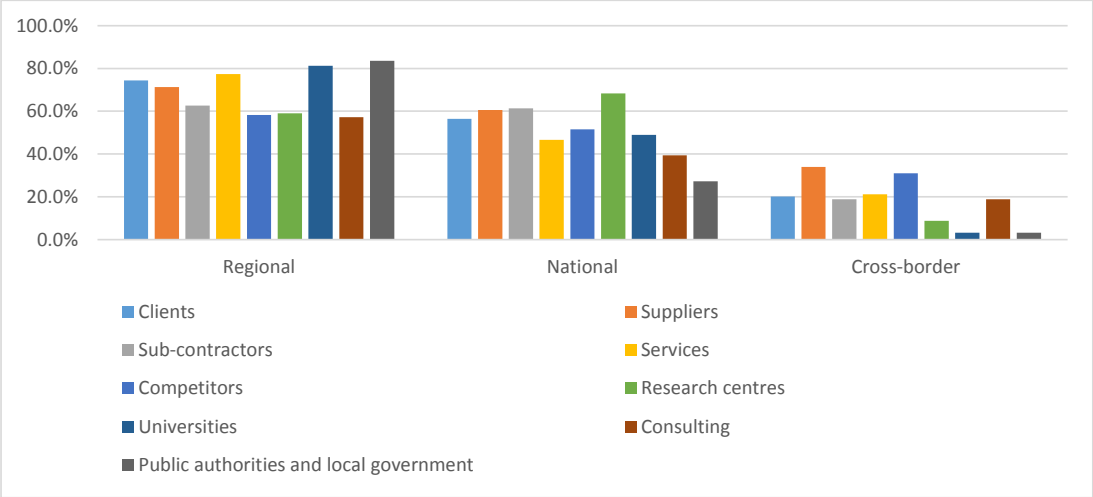
Figure 2. "Paternity" of innovation
(Share of innovation-active companies by the strategy of innovation development)

Innovations were developed	
In-house or by enterprises within your business group	66.7%
Mainly in-house in cooperation with other organizations	27.3%
Mainly by other organizations	6.1%

Source: HSE Monitoring of Innovation Activities of Enterprises.

Given highest cooperation intensity, firms tend to estimate the main concentration of innovation-related effort to be carried out mainly in-house. Only a quarter of companies praises the co-operative activities to be a legitimate and sensible source of innovation at their practice. Another 6% of companies completely outsources innovation development.

Figure 3. Importance of distance for the intensity of cooperation
(Proximity to cooperation partners as a share of all innovation companies engaged in the corresponding types of cooperation)



Source: HSE Monitoring of Innovation Activities of Enterprises.

The role of geographical proximity varies along different types of cooperative partnerships (Figure 3). Companies tend to cooperate with the closest organisations present, supporting general perception of importance of clustering for innovation development. One obvious dominant partner for close-range cooperation are local government bodies and authorities. Surprisingly, another one is universities. As a contrast, Russian research organisations are recognized at the national scale. Cross-border collaboration appears to accompany approximately 20% of all cooperation reports. Relative weight of cross-border interactions is the highest for linkages with suppliers and competitors (accounting for 35% of collaboration cases).

3.2. Cross-border collaboration

The estimates describe cross-border innovation-related collaboration as quite a scarce activity (Figure 4), engaged by no more than one third of all innovative manufacturing enterprises and no more than 5% of manufacturing enterprise total. In terms of absolute frequencies most notable channels of cross-border interactions are negotiations with clients and suppliers overseas. Interestingly, with regard to this indicator, the Northwestern Federal District exhibits little peculiarity, reproducing country-average distributions.

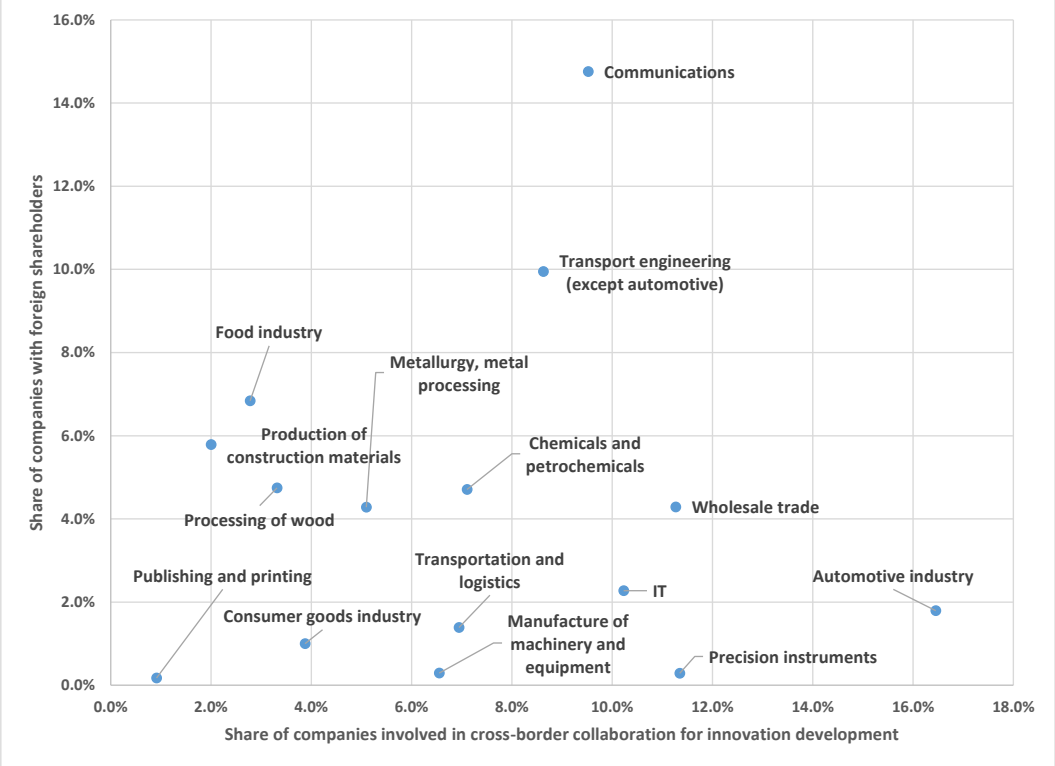
Figure 4. Scale of cross-border collaborative activities
(Companies that engaged cooperation with particular types of partners as a share of innovation-active firms and total firms)

Partners	Innovation-active		Total firms	
	NWFD	All	NWFD	All
Clients	11.5%	15.3%	1.2%	2.3%
Suppliers	21.4%	21.0%	2.2%	3.2%
Sub-contractors	2.6%	6.6%	0.3%	1.0%
Services	3.6%	6.6%	0.4%	1.0%
Competitors	2.6%	4.7%	0.3%	0.7%
Universities and research centres	2.0%	2.5%	0.2%	0.4%
Consulting	5.2%	1.9%	0.5%	0.3%
Public authorities and local government	0.1%	0.6%	0.01%	0.1%
At list one partner abroad	**31.5%**	**32.4%**	**3.2%**	**4.9%**

Source: HSE Monitoring of Innovation Activities of Enterprises.

Heterogeneity of sectors of economy is complimentary to region-wise variety. Although detailed industry-level case studies are outside the scope of present report, we brifly describe key stylized facts and observations (Figure 5).

Figure 5. Sectoral dimension of internationalization



Source: HSE Monitoring of Innovation Activities of Enterprises.

The sectors differ significantly both in rates of international collaboration and in the presence of international shareholders. Relating these indicators allows us to construct preliminary measures of sectors' internationalization. Three sectors appear to be the most integrated into the global innovation chains: telecommunications, automobile industry and other transportation equipment. The group of followers include chemicals and petrochemicals, it and manufacturing of precision instruments.

The estimates portray cross-border collaborators as large and highly profitable companies (Figure 6). The comparison allows us to distinguish between the performance of non-innovative firms (lowest, but also smallest firms), domestic-only innovators (average size, moderate performance) and enterprises exploiting cross-border cooperation (most profitable, and also largest). At the same time, cross-border patterns show the dominance of medium companies in the Northwestern Federal District.

Figure 6. Economic performance of collaborating companies
(Share of companies of particular type – size and profitability – among non-innovative/domestic innovators/firms engaged in cross-border cooperation)

		NWFD			All		
		Non-innovative	Domestic	Cross-border	Non-innovative	Domestic	Cross-border
Size	Small (<100)	39.9%	18.6%	7.4%	35.7%	18.6%	6.9%
	Medium (100-499)	51.6%	42.1%	68.7%	52.0%	43.5%	35.6%
	Large (>=500)	8.4%	39.2%	23.9%	12.3%	37.9%	57.5%
Profitability before taxes	Negative	14.6%	.6%	4.5%	10.9%	2.4%	4.6%
	0% - 2%	31.9%	9.0%	0.0%	23.6%	15.7%	8.0%
	2% - 5%	37.8%	49.3%	36.3%	34.7%	30.8%	26.6%
	5% - 10%	7.4%	28.0%	33.3%	17.8%	29.1%	25.5%
	> 10%	8.3%	13.1%	25.8%	13.0%	22.0%	35.3%

Source: HSE Monitoring of Innovation Activities of Enterprises.

Regardless of cross-border activities, Russian manufacturing companies gain the largest share of revenues from the national (or even more compact) market (Figure 7). International activities are accompanied with higher focus on the markets abroad and also makes the companies more optimistic at their strategic planning: more than one third of international collaborators considers international markets as the priorities for their business development as compared to 16% of domestic innovators.

Figure 7. Market priorities of collaborating companies

		Non-innovative	Domestic	Cross-border
Share of revenues	Local	37.7%	32.0%	20.4%
	Regional	30.0%	24.7%	19.3%
	National	27.2%	38.6%	45.5%
	CIS	2.9%	3.7%	8.0%
	Other countries	2.2%	1.0%	6.8%
Perspective market	Local	40.9%	31.9%	15.5%
	Regional	52.4%	47.5%	27.1%
	National	42.5%	57.5%	71.7%
	CIS	9.4%	16.2%	35.2%
	Other countries	6.2%	5.4%	29.7%

Source: HSE Monitoring of Innovation Activities of Enterprises.

Competitive strategies of manufacturing companies (Figure 8) appears to be somewhat stable both in regional dimension and regarding the involvement into cross-border relations. Non-innovative companies pursue a strategy of providing the appropriate quality given reasonable price. Domestic innovators pay more attention to the sophisticated characteristics of production, e.g. customization. Finally, cross-border collaborators are most often to report advantage of novelty of products and processes exploited, also showing even higher attention to the extended properties of their goods and services. Again, NWFD shows no statistically significant specifics with this regard.

Figure 8. Competitive advantages of collaborating companies
(Share of enterprises of the corresponding type that indicated particular advantages against the competitors)

	NWFD			All		
	Non-innovative	Domestic	Cross-border	Non-innovative	Domestic	Cross-border
Price	53.6%	44.6%	53.6%	50.8%	44.0%	40.2%
Quality	84.6%	85.7%	81.2%	76.2%	72.0%	82.8%
Novelty	9.2%	9.8%	19.2%	7.6%	17.3%	25.4%
Customization	11.3%	34.0%	23.2%	17.4%	33.8%	41.9%
Shipment time	51.0%	45.1%	44.3%	43.5%	37.0%	34.5%
Services	.7%	8.8%	21.2%	7.1%	8.1%	20.0%
Other	5.4%	3.1%	4.3%	1.8%	2.5%	.9%
No competitive advantages	2.1%	4.4%	1.4%	6.0%	3.8%	2.4%

Source: HSE Monitoring of Innovation Activities of Enterprises.

Firms cooperating with international partners tend to be more active in development and utilization of novel production processes, and also organizational methods and techniques (Figure 10). These areas of innovation activity distinguish cross-border collaborators as opposed to product innovation focus of domestic innovators. NWDF innovative firms also show extended interest in marketing innovation development.

Generally, intensity of innovation expenditure increases with the increased complexity of innovation strategy (Figure 9). A quarter of internationally networking firms invests more than 10% of their turnover into the innovation activity (compared to 15% of domestic collaborators showing this level of spending). NWFD region demonstrates averagely higher rates of investment into innovation (34% and 28% of highest grade of spending by international and domestic cooperative companies respectively).

Figure 9. Innovation performance of collaborating companies

		NWFD		All	
		Domestic	Cross-border	Domestic	Cross-border
Innovations	New to market products	24.0%	26.5%	20.4%	35.6%
	New to enterprise products	68.3%	63.6%	51.2%	68.3%
	New processes	41.5%	63.8%	44.2%	59.6%
	Organizational innovations	25.7%	17.8%	25.4%	38.7%
	Marketing innovations	9.0%	49.6%	23.9%	30.1%
Share of innovation expenditure in turnover	No innovation expenditure	2.8%	4.2%	6.0%	2.5%
	< 0,1%	.7%	3.9%	4.3%	2.8%
	0,1% - 1%	10.7%	16.8%	12.9%	11.4%
	1% - 2,5%	21.7%	13.4%	22.3%	19.3%
	2,5% - 5%	16.6%	24.0%	21.1%	16.7%
	5% - 10%	19.4%	3.4%	17.6%	20.9%
	>10%	28.1%	34.1%	15.8%	26.3%

Source: HSE Monitoring of Innovation Activities of Enterprises.

The Monitoring study also allows to generate the aggregate estimates of objectives for cooperation (Figure 10). Top priority for all cross-border relations is access to new markets (84% of cases, 94% for NWFD). Second-popular target is gaining access to new knowledge (81% of cases, 79% for NWFD).

Figure 10. Objectives for cooperation
(Share of cooperating companies that indicated objectives for their collaboration)

Objective	NWFD		ALL	
	Domestic	Cross-border	Domestic	Cross-border
Access to new knowledge	79.7%	78.8%	66.8%	80.7%
Human resources	20.7%	44.1%	31.6%	45.4%
Access to new markets	70.3%	94.4%	62.1%	84.3%
Cost reduction	25.1%	74.5%	52.5%	72.6%

Source: HSE Monitoring of Innovation Activities of Enterprises.

The abovementioned objectives strongly influence the common practices and forms of knowledge/technology transfer (Figure 11). Compared to domestic innovators, cross-border

collaborators on one hand act as the clients for more sophisticated development and engineering services, but on the other are even more active in the purchase of ready-to-use machinery and equipment. One should also note the overall higher share of cross-border collaboration resulting in technology transfer (as opposed to domestic activities, mainly implying management of expectations and demands – concentrating on clients as seen at Figures 2, 4).

Figure 11. Forms of technology transfer exploited by collaborating companies

	NWFD		All	
	Domestic	Cross-border	Domestic	Cross-border
Commercial agreements, including				
contract for research and development realization	23.4%	33.1%	22.7%	34.7%
patent for an invention	3.2%	0.0%	5.0%	6.9%
non-patent inventions	.8%	4.6%	1.7%	1.9%
utility model	4.7%	1.9%	6.4%	5.7%
patent license for invention	0.0%	2.6%	1.8%	4.0%
know-how	3.7%	0.0%	1.9%	4.2%
trademark	4.8%	11.6%	6.3%	8.5%
design invention	11.4%	4.7%	13.5%	17.3%
engineering services	9.1%	6.9%	7.4%	14.6%
Other forms of transfer				
Joint operation agreement	12.1%	7.8%	22.1%	20.0%
Collaborative research projects	6.7%	0.0%	6.0%	14.5%
Cooperative research centers	0.0%	0.0%	.7%	1.7%
Technology platforms	.6%	2.6%	3.2%	5.7%
Sale / purchase of off the shelf equipment	10.6%	29.8%	23.7%	34.8%
Targeted exchange of trained professionals	1.4%	0.0%	3.8%	4.8%
Informal ways to transfer results (conferences, exhibitions, personal communication of researchers, etc.)	8.3%	19.4%	16.3%	21.2%
Other forms of transfer	.6%	0.0%	.7%	0.0%
The company did not perform technology acquisition/transfer	56.5%	50.9%	36.1%	22.0%

Summing up the findings in this section, international collaboration appears to be a complex innovation strategy rarely seen and limited in scope, but highly effective. The flows of cross-border knowledge mainly take the forms of new technologies embodied in the R&D contracts, engineering services and other types of development, but also strong flow of machinery and equipment. North-western Federal District at the aggregate level doesn't show statistically significant diversion from country's averages, replicating common practices with regard to the specifics of regional economic performance.

4. Case studies of cross-border cooperation of Russian enterprises

This section summarizes results of several case studies of the existing cross-border networking in the field of knowledge exchange and innovation development.

As a leading economic and industrial centre of the Russia's North-Western federal district, the Saint Petersburg provides a natural entry point for European companies seeking for new partners to earn in enormous domestic market of the Russian Federation or utilize its competences and technological potential.

One of the examples of innovation-based cooperation is provided by the Finnish "Technopolis Oyj" company, constructor and exploiter of 16 technoparks (the largest operator in Europe with a history of 30 years), whose first abroad project is "Technopolis Pulkovo" technopark

started in St. Petersburg in 2007. The purpose of the technopark is to create an excellent platform for high-tech business development by providing international-quality services (each client is able to choose the set of services it really needs)[20]. The first building constructed as a first stage of this 6-staged project is a modern business-center of almost 23000 sq. meters and the result of more than 50 mil. euros investments in innovative ecosystem. It is important that about a quarter of the "Technopolis" clients in Finland are not already existed firms, but raised by the operator itself through the system of business-incubators[21]. The same scheme is implemented in Russia since the agreement was achieved between "Technopolis" and "Ingria" business-incubator, Russia's "Ingria Technopark" project[22]. Thus, not being directly involved in innovation activity as a source of knowledge, this company enables Russian North-West to further cooperate with Europe in S&T sphere.

Another way of cross-border cooperation of companies is a joint venture. In the case of the closed joint-stock company "Sartogosm," a part of "Sartorius" group, we can see an example of such a venture established in St. Petersburg as early as in 1991 by Russian (federal state unitary enterprise "St. Petersburg's "Gosmetr" plant") and German ("Sartorius" group) partners to unite industrial base and experience of the plant and "Sartorius's" technologies[23]. Nowadays "Sartogosm" offers not only made-in-Germany "Sartorius" products, but also jointly developed highly awarded for their accuracy laboratory and industrial weighing scales, as well as special software for them. These products are still manufacturing in Russia without having domestic competitors[24]. Besides that, "Sartogosm" provides all range of services for consumers of different "Sartorius's" goods, such as equipment for bio-laboratories. It means that there is a space for further localization of production of other sophisticated "Sartorius's" products, for example, devices for pharmaceutical and biotechnological industries.

However, there is no need to become a part of European companies to create reciprocal exchange of knowledge. Joint development of innovative products and technologies is possible through taking part in certain projects with western partners. Public corporation "Avangard" - is a leading company in Russia in the development of innovative technologies and production of radio electronics, instrument making, and microcircuitry. Today this St. Petersburg-based company has the modern technology of microelectronics, including those belonging to the list of critical

[20] http://i-ptr.ru/to-innovators/tehnoparki/13/
[21] http://www.kommersant.ru/doc/1283619
[22] http://www.ingria-startup.ru/o_biznesinkubatore/partnry/

[23] http://www.chemport.ru/labequipment110.html
[24] http://www.sartogosm.ru/about.html

technologies of the Russian Federation, and is actively working on creating a new generation of microelectronic sensors of physical and chemical variables of dual-use[25]. To support its competitive position, the "Avangard" corporation is openly seeking cooperation with other firms and institutions worldwide, European Union included. Since 2003, the Company UST GmbH (Germany) and the "Avangard" are carrying out joint development and organization of production of household gas detectors on the market of Russia and the EU. Since 2007 the "Avangard" is producing competitive gas sensors for gas fire detectors jointly with the "State Technical Centre of Finland VTT," at the same time working on the modernization and equipping of microelectronic production of the "Avangard" to manufacture innovative products. Moreover, since 2008, with participation of the University of Franche-Comte (France), the SenseoR SA (France) and the public corporation "Avangard", joint development and production of microelectronic sensors of physical quantities for use in wireless monitoring systems in the markets of Russia and the EU is taking place[26]. Thus, this corporation is one of the examples of successful relationships in science and technology between organizations of Russian north-west and European Union.

Besides that, being registered in the Saint Petersburg, many firms have their production facilities in neighboring regions. Such a case of the 'MC-Bauchemie Russia.' This company with the Russian-German Investments was established in 2001 based on the group MC-Bauchemie (Germany), and the company 'OTLI' (Russia). During this time, production of construction materials with 'Plitonit' trademark rose to world-class quality. That allowed the company to 'Plitoni' to become a leader in the manufacture of construction chemicals products in the North West region. In early October 2004 the main production of building materials was organized - an innovative and high-tech plant built in the Leningrad oblast town of Kirovsk. On this day this is the most advanced enterprise which is equipped with high-performance equipment that allows production of modern building materials, which are comparable in quality with the products of many European manufacturers. In the near future, the MC-Bauchemie Russia company plans to build new production facilities in other regions of Russia. Technicians and engineers from MC-Bauchemie Russia periodically visit the laboratory in the main group company MC-Bauchemie in Bottrop (Germany), and German staff members, for their part, are interested in Russian 'know how'. Internship opportunities and exchange of experience with foreign experts is being effectively used by MC-Bauchemie Russia departments of finance, marketing and sales[27].

[25] http://www.electronics.ru/journal/article/383
[26] http://www.avangard.org/index.php?option=com_content&task=view&id=3&Itemid=49
[27] http://www.plitonit.ru/company.html

As already mentioned, the Saint Petersburg with its closest neighbor, Leningrad oblast, is the most important centre of innovation activity of the Russian North-West, being a workplace and home for about a half of its population. However, there are still some examples of European and Russian companies' cooperation in other parts of this federal district.

As one of them, launching production line of cameras needed to thermal sights by 'Vologda Optical and Mechanical Plant' in 2010 became one of significant events for high-tech industry of Vologda oblast. 'Thales', the leader in the field of information technology and defense of France is actively working with 'Vologda Optical and Mechanical Plant' (VOMP) since 2006. With active mediation of the enterprise 'Rosoboronexport', French company offered to host the service and repair of cells delivered to Russia on the basis of VOMP. In June 2010 a contract was signed for the licensed production of control panels for the cameras. Now the 'Vologda Optical and Mechanical Plant' is still the only licensed facility for the production of cameras, 'Catherine FC.' For the Vologda Oblast and 'VOMP' it is another step in development of technological cooperation, in particular with the French companies, who are familiar with the latest achievements in this field. The opening of the production line at the optical-mechanical plant shows good prospects for mutually beneficial Russian-French military-technical cooperation[28].

Moreover, a modern trend of growing attention to the so-called 'green economy' can also create a basis for interactions between firms from Russia and European Union. For example, the history of another innovative enterprise of the north-west of Russia, 'EkoPromStroy,' began in 1998 with the Russian-Danish project to improve the methods of solid waste management in Novgorod. The strategy to ensure reliable protection of the environment was based on the ideology of organization of non-waste and low-waste production, as well as an integrated waste management. The main activity of the company is minimization of wood waste by developing and implementing technologies for its utilization, including the production of wood pellets and biomass burning, composting, production of building materials based on wood chip-bonded compounds and polymer additives. The company is the participant of several international projects with Denmark, Norway, Sweden, Finland, in the field of resource saving. On the basis of the company, Novgorod branch of 'The Russian-Swedish educational and informational center of bioenergy' (Biocenter), designed to promote resource conservation technologies and environmentally sound methods of bio-fuels for energy, is founded. Also, Innovative enterprise 'EkoPromStroy' is the participant of the 'Start' program with the project "Establishment of the production of building materials based on wood

[28] http://www.spb-venchur.ru/news/2294.htm

chip-bonded compounds in the composition of the polymer additives and different types of waste[29].' Thus, this company's activity provides a good example of simultaneous use of different ways of multinational cooperation of Russian and European organizations.

According to the presented cases, it can be seen that companies from North-Western federal district are interested in different kinds of cooperation with their European partners in the field of technologies and innovation and are capable to create and support trans-border links.

5. Conclusions and implications

(1) Innovation performance of North-western Federal District

Generally, the character of economic interaction of the Northwestern Federal District of Russian Federation and the European Union is predominantly determined by traditional channels of export and import so the economies of the two aforementioned entities are still not as strongly integrated as it could be without this interaction being largely restricted in the past. Despite a certain improvements in terms of international trade and technology transfer since the beginning of transition to market economy in Russia, the overall domestic situation had much more significant impact on industry thus influencing science, technology and innovation activity within the District.

Partly the current situation can be attributed to noticeable presence of primary and defense-related sectors of the economy, which statistically lowers innovation activity indicators. There are also more or less traditional innovative hotspots concentrated in Saint Petersburg due to its possession of disparate amount of human and financial resources. On the other hand, we can see the case of, for example, automobile industry cluster emerging in Leningrad oblast and growing number of joint enterprises across the Russian North-West – the inevitable consequences of integration into the world economy rather than intensified cooperation with European partners per se. In many terms the concerned eleven regions bear limited number of specific features which are not characteristic of the Russian economic conditions as a whole, probably because of unitary approaches used previously to operate a planned economy. Economic and innovative capacities of the District are still regarded as quite robust but general underperformance of local firms remains because of either lack of competition or lack of resources for investments.

At the same time continued after the financial crisis instability obviously makes much more needed and desirable for both sides to support already existing positive trends and establish more links

[29] http://innov.novsu.ru/innov/org/ecopromstroy/

between European and Russian companies. Also there is an interest in fostering innovation activity and creating sustainable demand for R&D from different firms and governments all over the Europe, so the northwestern regions are expected to have a chance to benefit from corresponding processes. Thus it can be said that today we have an opportunity to get away from largely chaotic bilateral interaction towards targeted development of Russia-EU partnership particularly in terms of science, technology and innovation.

There are several factors, determining actual intensity of innovation activity within this macro-region. They could be summarized as follows:

1) Geographical position of the Russian North-West enables it to benefit from neighboring with highly-innovative countries of Scandinavia and Germany, as well as high number of educated people and comprehensively advanced industrial base.

2) However, unequal distribution of human capital within that macro-region leads to concentration of innovation (and entrepreneurial) activity in a few centers, mostly in the Saint Petersburg.

3) At the same time, vast natural resources of the region are attracting foreign investments for their extracting and transportation, but mainly not for further refining. As a consequence, current economic structure of the Russian North-West has a little incentive to change in the nearest future.

(2) Cross-border collaboration within Russian innovation system

Empirical estimates characterize cross-border collaboration as a sophisticated but highly efficient innovation strategy targeted mainly at access to new markets (cooperation with clients) and technologies embodied into machinery and equipment (30% of cases) as well as outcontracting R&D and engineering services (another 30% of cases). Main specificity of international cooperation compared to the domestic networking is concentration on process and organizational innovations as the main objective of co-development. In the joint activities Russian companies tend to bring in human capital (in the shape of technological skills) as well as the capacities for production. They expect their partners to bring in technology capital (machinery and equipment) and knowledge of the international markets.

One of the main factors hampering development of cross-border cooperation is the limited scope of innovation activity in Russian economy accompanied with low role of innovation as the factor of competitiveness and short horizon of planning (more than 60% of firms consider the appropriate timespan of process innovation development to be one year). The study envisages the fragmentation of National Innovation System: only minor shares of collaboration cases concern cooperation with

institutional knowledge providers and also with the market actors not directly involved into interaction (e.g. cooperation with competitors, sub-contractors, service providers – beyond clients and suppliers).

Thus, the most efficient way for Russian government to foster international collaboration is to improve the framework conditions for innovation attracting more resources and competences into this area of activity. From the account of other actors, the success could be associated with wise integration with clear and feasible objectives as well as readiness to act as a risk-taker or at least efficient risk manager.

Annex: Monitoring of Innovation Behavior of Enterprises

This study largely relies on the data collected via the specialized survey "Monitoring of innovation behavior of Russian enterprises"[30] carried out within the framework of HSE Basic Research Programme. This activity is executed as a part of European Manufacturing Survey (EMS)[31] that unites the effort of research centres and universities from 18 countries. One of the key ideas behind the survey is to extend the set of available indicators of R&D and Innovation activities of the enterprises beyond the Community Innovation Survey, but maintaining the necessary level of complementarity with the Oslo Manual standards.

This study relies on the sample of 762 companies from Manufacturing (NACE rev 1.1 D) collected at the end of 2012. The results are representative at national and sectoral levels as well as at the level of eight federal districts. Frequency weights[32] are applied in order to provide proper corrections for sampling biases (see Table A1, A2).

Table A1. Sample overview

Size (number of employees)	Innovation activity				Cross-border cooperation				Total	
	Non-innovative		Innovation-active		Domestic		Cross-border			
	Count	Unweighted Count	Count	Unweighted Count	Count	Unweighted Count	Count	Unweighted Count	Count	Unweighted Count
Small (15-100)	1534	100	3204	162	2770	136	435	26	3204	262
Medium (100-499)	1701	80	4509	211	3258	146	1250	65	4509	291
Large (>=500)	255	28	1933	182	1083	103	850	79	1933	210

Table A2. Sectors in the sample

Sectors (NACE rev 1.1 codes)	Count	Unweighted Count
Food industry (15)	2660	75
Consumer goods industry (17,18,36)	614	82
Processing of wood (20, 21)	514	60
Publishing and printing (22)	2666	67
Chemicals and petrochemicals (23, 24, 25)	1040	69
Metallurgy, metal processing (27, 28, 37.1)	1127	66
Manufacture of machinery and equipment (29)	1441	104
Precision instruments (30, 31, 32, 33)	1112	58
Automotive industry (35)	349	49
Manufacture of transport except automotive (34)	323	59
Production of construction materials (26)	1290	74

[30] http://www.hse.ru/org/hse/aup/research/monitoring/innproc
[31] http://www.isi.fraunhofer.de/isi-en/i/projekte/fems.php
[32] Constructed using the data of National Innovation Survey executed by Federal State Statistics Service.