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TRENDS AND OUTLOOKS

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R95 **RUSSIAN ECONOMY IN 2017. TRENDS AND OUTLOOKS** / [Alexander Abramov etc.; Doctor of sciences (economics) Sergey Sinelnikov-Murylev (editor-in-chief), Doctor of sciences (economics) Alexander Radygin]; Gaidar Institute for Economic Policy. – Moscow: Gaidar Institute Publishers, 2018. – 544 p. – ISBN 978-5-93255-530-9.

The review "Russian economy in 2017. Trends and outlooks" has been published by the Gaidar Institute since 1991. This publication provides a detailed analysis of main trends in Russian economy, global trends in social and economic development. The paper contains 6 big sections that highlight different aspects of Russia's economic development, which allow to monitor all angles of ongoing events over a prolonged period: the socio-political issues and challenges; the monetary and budget spheres; financial markets and institutions; the real sector; social services; institutional changes. The paper employs a huge mass of statistical data that forms the basis of original computation and numerous charts confirming the conclusions.

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6.3. Science and innovations[1]

The year of 2017 can be described as a year of making plans, rather than assessing outputs, in the Russian scientific and technological sector. Preference was given to the development of a plan for the implementation of Scientific and Technological Development Strategy of the Russian Federation, including its integration with polices in progress as part of the National Technological Initiative of Russia (NTI), and to the endorsement of the state program for the development of a digital economy in the Russian Federation, including its synchronization with the NTI for the development of scientific and educational and technological competences. Finally, the 2017 full-year consideration of a new science legislation still continued at the end of year.

There were extensive debates about the application of bibliometrics as a scientific performance measurement tool because government agencies, scientific funds, research institutions and higher education institutions use bibliometrics for measuring the performance and rewarding of both individuals and institutions. The final results of a college monitoring, including its scientific and innovative component, and of performance measurement of subordinate institutions of the Federal Agency for Scientific Organizations (FASO) were made public.

A pilot program on support to medium-sized growth companies gained most of the momentum in the technological innovations sector, whereas there was no visible breakthrough in the innovation policy with regard to large and small innovative businesses. On top of that, the segment of technological business venture capital funding stalled.

6.3.1. National policy scientific and technological priorities

The implementation plan for the Scientific and Technological Development Strategy of the Russian Federation adopted in December 2016 (hereinafter "the Strategy") was endorsed in 2017. The State Program on Digital Economy of the Russian Federation[2] that also sets out scientific and technological development guidelines emerged in summer. The National Technological Initiative was somewhat tuned to the Strategy and the Digital Economy state program. The Strategy identifies the National Technological Initiative of Russia as a key tool designed to "ensuring that basic knowledge, exploratory and applied scientific research are translated into products and services to facilitate Russian companies in taking leading positions in promising markets pursuant to existing and newly emerging (including after 2030) priorities."[3]

[1] This section is written by Irina Dezhina, the Gaidar Institute, the Skolkovo Institute for Science and Technologies.
[2] The Program was endorsed by the Russian Government through Executive Order No. 1632-z dated July 28, 2017 http://static.government.ru/media/files/9gFM4FHj4PsB79I5v7yLVuPgu4bvR7M0.pdf
[3] Paragraph 23 of the Strategy. Source: http://kremlin.ru/acts/bank/41449/page/2

The Strategy provides for a linkage between "grand challenges" and scientific and technological priorities that can be forged not only through the NTI but also by redesigning a master science and technology program called the State Program for Scientific and Technological Development until 2020. The Program will be replaced with a new state program for Scientific and Technological Development of the Russian Federation for 2018-2025 that was not yet developed at the end of 2017. The new program intends to build a new integral model of public investment, ranging from the provision of support to qualified researchers and entrepreneurs to the introduction of mechanisms designed for the development of science and innovations across the entire knowledge life cycle. That was, in some ways, announcement of returning to the concept of "innovative elevator." The following key innovations were introduced: a multilateral funding rule, common approaches towards pilot project appraisal, and lifting of restrictions on program deadlines (planning horizons can possibly be extended to 3–7 years).[1] The Russian Ministry of Education and Science has de facto initiated ways of further business engagement in identifying priorities with an open invitation to companies to co-finance research within an industrial partnership.[2]

A new list of priorities set out in the Strategy adds to the list of most important scientific areas and appears to introduce for the first time the use of methods of social sciences and humanities to deal with problems. At the same time, they duplicate nearly 70 percent of the priorities adopted back in 2011 by a presidential executive order, with the former being more elaborated. For example, the previous priority was transport systems at large, whereas the today's priority is intellectual transport, logistic and telecommunication systems.

The number of NTI priorities has been cut substantially. The top priorities are 10 "cross-cutting technologies" that are duplicated in the Digital Economy state program (*Table 21*). These very priorities will supposedly be provided with extra resources.

Table 21

"Cross-cutting technologies" in NTI and in Digital Economy state program

NTI	Digital Economy state program
Big data	Big data
Artificial intelligence	Neurotechnologies and artificial intelligence
Distributed ledger systems	Distributed ledger systems
Quantum technologies	Quantum technologies
New manufacturing technologies	New manufacturing technologies
Sensor technologies and robot accessories	Robot accessories and sensor technologies
Wireless communication technologies	Wireless communication technologies
Neurotechnologies and virtual and augmented reality technologies	Virtual and augmented reality technologies
	Industrial Internet
New and portable power sources	
Technologies to control properties of biological objects	

Sources: http://www.nti2035.ru/technology/; http://static.government.ru/media/files/9gFM4FHj4PsB79I5v7yLVuPgu4bvR7M0.pdf

The changes represent an alternative approach towards the provision of a wide range of support to research. Resuming financing of a great number of subject areas can hardly be possible amid low-level target funding under the (new) Strategy. There are plans to increase R&D spending to 2 percent of GDP by 2035, that's what many countries have already achieved.

[1] An explanatory note to (Russian) government's draft executive order Concerning the Approval of the State Program of the Russian Federation "The Scientific and Technological Development of the Russian Federation." http://www.consultant.ru/cons/cgi/online.cgi?req=doc&base=PNPA&n=30448&dst=104152#0

[2] Kiseleva M. About science on the Science Day: An Exclusive Interview with Olga Vasilieva // Indicator, February 8, 2017 https://indicator.ru/article/2017/02/08/intervyu-olgi-vasilevoj/

Such a moderate way of targeting took place amid continuous decline in R&D spending as a percentage of GDP, from 1.13 percent in 2015 to 1.1 percent in 2016. Russia ranks 35th in R&D spending as a percentage of GDP. In absolute terms, Russia has moved down to 10th place in R&D spending, the country's ranking back in 1995. Russia continues to fall behind leading countries: Russia spends on R&D 13.5 times less than the United States, 11 times less than China, 4.6 times less than Japan, three times less than Germany. Over the past two decades a few catching-up countries have increased considerably investment in R&D, including investment from businesses. R&D spending over the same time has increased 2.6 times in Russia, 21.9 times in China, 4.5 times in Korea, 3.7 times in Israel.[1]

The shortened list of priorities reflects a policy of focusing on top-performers. The decision appears reasonable because of scarce resources. It's likely, however, that this will deliver a short-term result. The flip side of the approach is further narrowing of the scope of scientific appraisal in Russia while there is a small number of subject areas that meet the global level. Selective support of a small number of subject areas can lead to removing a series of research areas that could potentially underpin a future breakthrough out of the scientific landscape.

Lastly, Russia's presidential election has entered the pre-election period, and the Center for Strategic Research (CSR) has prepared an analytical report (*A new technological revolution: Challenges and opportunities for Russia)*[2] with the aim to create a new scientific and high-tech based technological image by 2024, by the end of the next presidential term. "Technological revolution" must bring about an economic growth of 4 percent of GDP a year that can supposedly be achieved though "profound technological and organizational changes in traditional industries" as well as building up new sectors. The report proposes that the NTI management should be improved because it lacks, according to the report, efficiency, and a "Russian science management system" should be launched.[3] The latter intends to create a new management mechanism "in the format of special federal executive body authorized to develop a national policy and a legal framework of higher education and science." Russia already has a federal executive body – the Ministry of Education and Science – with the same powers.

A great deal of strategic-level documents makes the objectives and principles of public scientific and technological regulation difficult to understand. On the one hand, there is a long list of research areas to implement in order to respond to "grand challenges." On the other hand, the NTI and the Digital Economy program rely on a small number of priorities that are extensively debated and developed worldwide and related to the development of digitization, big data and similar technologies. This set of topics in place makes it difficult to see the country's specific features and to understand what should be done fist and which development aspects are most pressing today and in the medium term. There is, by contrast, an approach announced in the UK. In November 2017, the British government unveiled the "Industrial Strategy for the UK" with the aim of making the UK the world's most innovative nation by 2030. The UK strategy provides a much shorter list of "grand challenges" and key technologies than its Russian counterpart. A fund – Industrial Strategy Challenge Fund (ISCF) – will be established for the development of new technologies. The government plans to invest £725 million over the next three years in the ISCF. The level of investment in research and

[1] Ratai T. Science spending in Russia and in world's leading economies // Science, Technologies, Innovations. September 7, 2017 M.: National Research University Higher School of Economics, p. 1.

[2] A new technological revolution: Challenges and opportunities for Russia. An expert-analytical report prepared under academic supervision of V. N. Knyaginina. M.: Center for Strategic Research, October 2017 https://csr.ru/wp-content/uploads/2017/10/novaya-tehnologicheskaya-revolutsiya-2017-10-13.pdf

[3] Ibid., p. 100.

development (R&D) will therefore be up from 1.7% to 2.4% of GDP by 2027.[1] The money will be spent to address problems related to four "grand challenges", namely artificial intelligence, clean growth, ageing society and future of mobility (of people, goods and services). Initial investment will go to transform the construction sector and help create affordable places to live and work that are safer, healthier and use less energy, as well as to technologies that help improve early diagnosis of illnesses and develop precision medicine for patients across the UK. The sectors of priority for research and development financing are construction and automotive sector, life sciences, artificial intelligence. Thus, there is a clear chain stretching from pressing grand challenges facing the UK to economic sectors and then to research and development to be first to invest in. This logic makes it possible to bind up the interests of the nation and business while providing science with targets in the form of subject areas of priority. Furthermore, the UK strategy will be implemented on a step-by-step basis and based on the latest achievements in developments related to new battery technologies and robotics.

The Russian Strategy sets out seven "grand challenges" of a very general concept: ranging from exhausted possibilities of economic growth based on extensive mineral extraction, provision of food security, development of new power systems, response to threats to national security to making an efficient use of space including the development of airspace and outer space, the global ocean, the Arctic and Antarctic regions. The "grand challenges" are therefore too comprehensive to be easily decomposed to the level of priority sectors and research areas. The NTI, in turn, as a key tool for the Strategy implementation makes the set of country's trending technologies too narrow, thus creating a dissonance between a wide range of problematics and a narrow range of selected subject areas that must be implemented to respond to the "grand challenges."

Viewing the national policy priorities from the perspective of budget allocation, rather than the contents of strategic documents, leads to a conclusion that serious moves in the structure of R&D appropriations still remain to be seen. There are, however, several noteworthy factors.

First, there is a plan to reallocate federal budget appropriations to support basic research over the next three years. However, the biggest gain will be driven by wage growth for researches employed by FASO's institutions and by the Russian Research Center 'Kurchatov Institute', a federal state budgetary institution, including its subordinate institutions. This will ensure the implementation of President's Executive Order *No. 597 dated May 7, 2012, under which* wages must be increased to a level that doubles the average wage in a region. Total basic research spending will advance at steady (*Table 22*), albeit slow, pace.

The share of basic research appropriations of total spending on civil scientific research and developments will also advance to 41.9 percent in 2018, 44 percent in 2019 and 45.5 percent in 2020. This type of funding structure corresponds to basic research spending in developed European countries. In France and in the UK, for example, basic research spending account for 45 and 40 percent of budget appropriations on civil R&D.[2] At the same time, the Europe average is more than 52 percent, similar to that (53 percent) in the United States.

Table 22

[1] Government unveils Industrial Strategy to boost productivity and earning power of people across the UK. Press release. November 27, 2017. https://www.gov.uk/government/news/government-unveils-industrial-strategy-to-boost-productivity-and-earning-power-of-people-across-the-uk

[2] What is the optimal balancer between basic and applied research? // UNESCO Science Report: towards 2030. http://www.unesco.org/new/en/natural-sciences/science-technology/single-view-sc-policy/news/what_is_the_optimal_balance_between_basic_and_applied_resear/

Changes in budget allocations on basic research

Program	Budget allocations in 2018, billions of rubles	Financing, percentage change, year on year:	
		2019	2020
Basic research (classification division)	151.7	101.8	102.0
Implementation of basic scientific research by institutions of state academies of science, financial provision for state academies of science	83.2	97.2	102.3

Source: Draft Federal Law On the Federal Budget for 2018 and the Planning Period 2019 and 2020.

Increased spending on military defense R&D (according to *non-classified budget items*) comes under notice in applied scientific research, that represent 85.7 percent of civil R&D appropriations in 2018, 85.8 percent in 2019, and 90.4 percent in 2020.

There was a positive trend toward annual growth (within a range of 5–16 percent) in civil applied research, particularly in healthcare spending, including topic subject areas such as translational medicine and precision medicine. Russia's Healthcare Development state program has moved up to 3rd place in volumes of R&D appropriations (*Table 23*) with a provision for annual growth in funding. However, applied R&D spending for a series of country's topic subject areas – energy and power saving, agriculture development – remain extremely low.

Table 23

Dynamics of R&D appropriations for state programs with biggest R&D funding (billions of rubles)

State program	2018	2019	2020
Scientific and technological development for 2013–2020	167.9	168.1	170.9
Use of outer space in Russia for 2013–2020	80.7	67.3	64.2
Healthcare development	24.7	26.7	31.0
Percentage share of the three programs of total civil R&D appropriations	*75.5*	*74.7*	*76.8*

Source: Draft Federal Law On the Federal Budget for 2018 and the Planning Period 2019 and 2020.

Budget appropriations on civil science for the next three years have negative dynamics (*Figure 5*), making it difficult to implement all the large-scale plans that are reflected in strategies and programs.

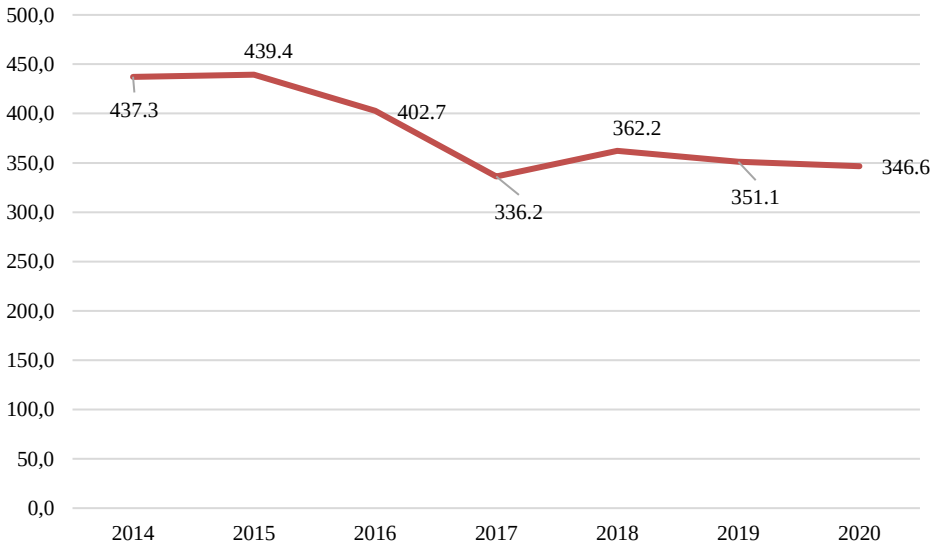

Fig. 5 Federal budget allocations on civil science, billions of rubles

Sources: Data for 2018–2020, according to The Draft Federal Law On the Federal Budget for 2018 and the Planning Period 2019 and 2020; data for 2014–2017, Ratai T. Russia's federal budget allocations on civil science // Science, Technologies, Innovations. June 28, 2017 https://issek.hse.ru/news/207116445.html

Strategic documents ignore the impact of sanctions which appear long term and therefore constitute a "challenge" and have an effect on, among other things, the policy of international scientific and technological cooperation. All the more so because Russia's major, albeit insignificant on a global scale, scientific exchange is taking place with the United States (according to co-publishing data).[1] The United States remain the world's scientific center, and the international cooperation in science is developing more intensively between the United States and countries such as China, UK, Germany, Canada, India, Japan and France. At the same time, it is the relationships between Russian higher education institutions and leading research countries that have been declining as research backed by foreign funds have been discontinued.[2] In addition, Russia's Federal Agency for Intellectual Property, Patents and Trademarks (Rospatent) has reported on the sanctions-induced decline in patenting of foreign inventions in Russia over the past 3–4 years.[3] Therefore, there is a decline in the diversity of sources of science funding and ways of implementing scientific research and in imports of technologies into the country.

The impact of sanctions on Russia's research and development has to be given more assessment. The problem has been acknowledged, as evidenced by increasing number of debates on the role of science as a "soft power" factor of positive effect and maintaining relations amid adverse international climate. The Russian Foundation for Basic Research, for example, has proposed placing a question of scientific diplomacy on the agenda of the Global Research Council, an informal association of research funding organizations. In particular, the emphasis can be placed on international support to research (Antarctica, near and deep space, cyberspace etc.) that cannot be afforded by just a few countries.[4]

6.3.2. Science in higher education institutions: achievements | and challenges

The main topics concerning science in higher education institutions were achievements and challenges facing leading higher education institutions participating in the 5-100 Project, the research development in core higher education institutions, as well as changes in authorizing higher education institutions to award an academic degree at their own discretion.

5-100 Project higher education institutions: Costs and cost-efficiency

The 5-100 Project higher education institutions have overall good research results, but they are still lagging far behind world's leading universities (*Table 24*).

Table 24 presents data suggesting there is a certain correlation between the intensity of publication activity and the citation of articles. Indeed, it's important that the type of a college

[1] According to data for recent decade. Source: OECD (2017), OECD Science, Technology and Industry Scoreboard 2017: The digital transformation, OECD Publishing, Paris. P. 128.

[2] Enikopolov R. Closed mind: Constraints facing Russia's science and education // RBC, June 2, 2017 https://www.rbc.ru/opinions/politics/02/06/2017/593116589a79472c6c142171

[3] Skorobogaty P. Who is to invest in a perpetuum mobile // Expert, No. 45, 2017 http://expert.ru/expert/2017/45/kto-dast-deneg-na-perpetuum-mobile/

[4] Belayeva S. Soft albeit strong. Research funds to help global diplomacy // Poisk, No. 46, November 17, 2017 http://www.poisknews.ru/theme/international/30290/

is taken into account. For example, articles of the National Research Nuclear University MEPhI show more citation potential because a great deal of research works are performed by large international teams using large installations. Only two classical universities offering a wide array of social sciences and humanities rank among top-5 on publication activity, thus making, in a natural way, the average figure smaller. At the same time, the leader among higher education institutions is the Novosibirsk State University, a classical university, because a major contribution to scientific achievements stems from the long lasting close relationship with research institutions that make up the Novosibirsk Science City ("Akademgorodok").

Table 24

Costs/research results ratio in 5 higher education institutions as part of 5-100 Project, with highest publication activities

University	Number of publications per teacher in WoS[1]	Average citedness of publications per teacher in WoS	Researchers' average salary, thousands of rubles monthly	Budget subsidy size, millions of rubles	Best ranking (in one of the three rankings), 2017
Novosibirsk State University	7.5	48	115.21	3884	250 (QS)
National Research Nuclear University MEPhI	6.1	44	128.55	4056	373 (QS)
Moscow Institute of Physics and Technology	5.4	23.8	113.83	4087	251-300 (THE)
National Research University of Information Technologies, Mechanics and Optics	4.9	10.1	193.7	4087	501-600 (THE)
Tomsk State University	4.4	11.2	174.40	3157	323 (QS)

Sources: Ponomarev V. Consecutive motions. Russian higher education institutions: 5-100 Project // Expert, November 27, 2017 http://expert.ru/expert/2017/48/posledovatelnoe-dvizhenie/; Kiseleva M. Achievements of 5-100 Project higher education institutions and what lies ahead of them // Indicator.ru. 04.09.2017 https://indicator.ru/article/2017/10/04/budushee-proekta-5-100/; Information and analytical materials based on the results of performance monitoring of higher education institutions. http://indicators.miccedu.ru/monitoring/?m=vpo

What's also remarkable is that the performance in science has little to do with researchers' average salary and government subsidies. Top-performing Novosibirsk State University pays moderate salaries compared with top income earners such as the National Research University of Information Technologies, Mechanics and Optics and the Tomsk State University, both having lower rankings on performance. The point to note is that the average salary in the 5-100 Project higher education institutions is much higher than in higher education institutions and research institutions across the country. According to data for January-September 2017, the gross payroll in R&D institutions was Rb 50,100 for chief, leading and senior researchers and Rb 39,200 for researchers and junior researchers (*Fig. 6*).[2] Heads of institutions were paid four times as much, Rb 173,100 on average across the country and Rb 257,700 on average in Moscow.

[1] Web of Science (WoS) is an online subscription-based scientific citation indexing service that provides analysis of publication activities of authors from various countries.

[2] Suslov A.B. Research institutions gross payroll by researcher official capacity: January-September 2017 // Science, Technologies, Innovations. December 6, 2017 M.: National Research University Higher School of Economics, p. 2. https://issek.hse.ru/data/2017/12/06/1161557911/NTI_N_76_06122017.pdf

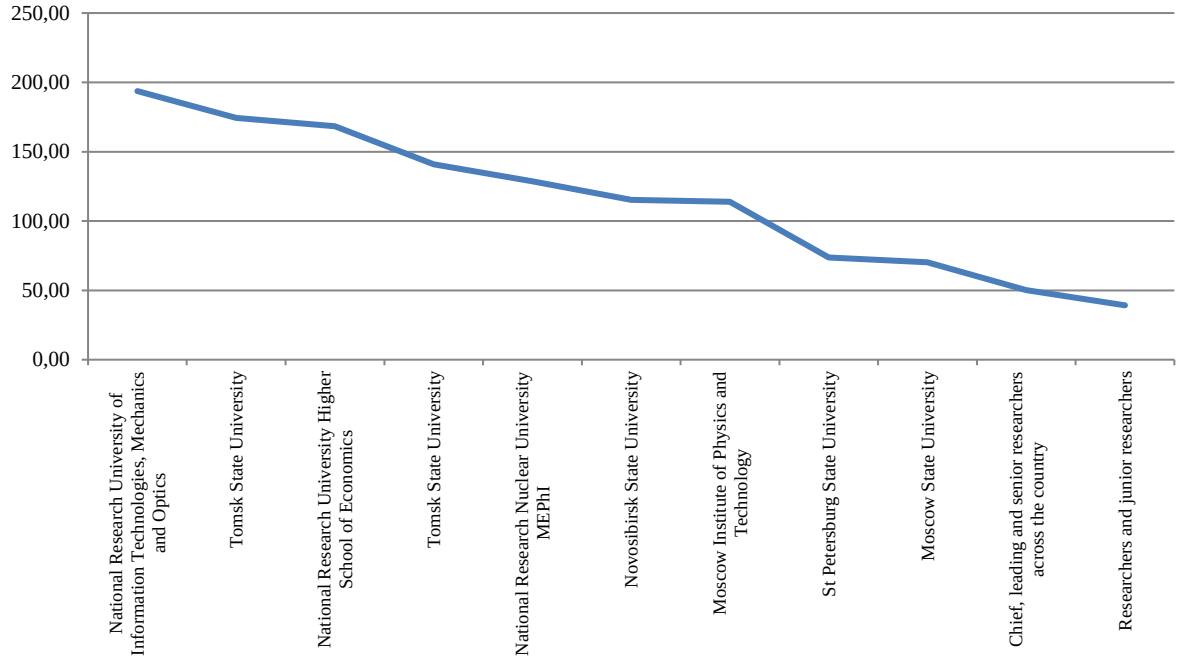

Fig. 6. Researchers' average monthly salary, thousands of rubles

Sources: Suslov A.B. Gross payroll by researcher's official capacity at research institutions: January-September 2017 // Science, Technologies, Innovations. December, 6, 2017 M.: National Research University Higher School of Economics, p. 2. https://issek.hse.ru/data/2017/12/06/1161557911/NTI_N_76_06122017.pdf; Information and analytical materials based on the results of performance monitoring of higher education institutions. http://indicators.miccedu.ru/monitoring/?m=vpo

Data for 2017 show a visible upgrade in overall rankings, albeit far behind the main objective of entering the top-100 world's universities ranking. Only the Novosibirsk State University managed to hit the QS top-300 ranking[1] as the Moscow Institute of Physics and Technology moved up to the THE top-100 ranking[2], whereas the rest fell far behind them, with the National Research University of Information Technologies, Mechanics and Optics even downgraded to the QS top-500 ranking. Therefore, there are serious divergences between a university's level of achievements and government funding and employee earnings. A major subsidy and high salaries do not guarantee the highest possible level of productivity.

Researchers of the National Research University Higher School of Economics have made an in-depth analysis of the publication activity of 14 higher education institutions participating in the 5-100 Project to compare with a control group comprising 13 higher education institutions that received no subsidies for entering global rankings. The higher education institutions of both groups were selected so that they have similar start positions (the study covered a period of 2010-2015).[3] Actually, it was found that the number of publications was increasing in both groups, but the 5-100 Project higher education institutions showed higher

[1] QS World University Rankings is a global survey including the world's top universities ranking compiled by Quacquarelli Symonds (QS), a British consulting company.

[2] THE World University Rankings is a global survey including the world's top universities ranking compiled by Times Higher Education.

[3] Poldin O.V., Matveeva N.N., Sterligov I.A., Yutkevich M.M. College publication activities: The effect of the 5-100 Project // Voprosy Obrazovaniya, 2017, No. 2, pp. 13–14.

growth rates leaving other higher education institutions further trailing behind them. In addition, the 5-100 Project higher education institutions have more quality publications (in first-quartile journals).[1] Apparently, the participation in the 5-100 Project has a positive effect on the scientific performance of higher education institutions, however, the question is how long the growth will continue and how the growth in the number of publications correlates with the quality of scientific novelty of research. The recent results published by Nature show that citation of truly innovative articles is lagging in time. It takes much longer for such articles to reach a high level of citation than it does for regular articles. Such articles can see their citation increase considerably no earlier than five years from the date of initial publication.[2]

Publication activity and unintended effects

The past year continued to see the effects of policies aimed at stimulating scientific performance with a view to increasing the number of scientific publications and thus making the Russian science more "visible". Institutions' performance is now assessed through the number of publications, the success of agency-funded projects and grants from funds. The Russian Research Fund has the minimum number requirements for articles that are annually indexed by WoS/Scopus.[3] The race for numbers has increased the number of publications in non-reputable journals that are denied by WoS and Scopus and easy to publish articles, including on a fee basis. The practice was expanding fast enough to be noticed by the government. The Ministry of Education and Science announced that funding of higher education institutions publishing articles in non-reputable journals as well as abusing self citation can be cut down. The Kazan Federal University, the Peoples' Friendship University of Russia and the Immanuel Kant *Baltic Federal University took the lead in the* quantity of publications in non-reputable journals.[4] Note that the 5-100 Project higher education institutions have somehow joined the all-out race for numbers, with a full-fledged industry of non-reputable journals having emerged worldwide in response to the demand. According to Nature's estimates, the number of non-reputable journals has recently increased over 100,000, equal to the number of reputable scientific journals.[5]

Another ambiguous trend is growing number of affiliations per author that is most markedly represented in the 5-100 Project that encourages engagement of foreign scholars as well as researchers of academic institutions to Russian higher education institutions. Over the last three years the number of affiliations per author in first-quartile articles of leading higher education institutions of the 5-100 Project has nearly doubled compared with the rest of Russian authors' articles. Hence, it follows that the growth in publishing activity of these universities is driven by, among other things, sponsors including, above all, foreign universities and institutions of the Russian Academy of Science.[6] Indeed, the number of engaged foreign teachers and

[1] Poldin O.V., Matveeva N.N., Sterligov I.A., Yutkevich M.M. College publication activities: The effect of the 5-100 Project // Voprosy Obrazovaniya, 2017, No. 2, pp. 13–21.
[2] Blinkered by bibliometrics // Nature, vol. 544, April 27, 2017. P. 411.
[3] According to Elsevier, a global information analytics business, Scopus is the largest abstract and citation database of peer-reviewed literature that can track scientific citation of publications.
[4] The Ministry of Education and Science to deny payment to 5-100 Project higher education institutions caught in self citation // Indicator.ru, 17 May,2017 https://indicator.ru/news/2017/05/17/vuzy-5-100-samocitirovanie/
[5] Kolata G. Many Academics Are Eager to Publish in Worthless Journals // The New York Times, October 30, 2017. https://www.nytimes.com/2017/10/30/science/predatory-journals-academics.html
[6] Sterligov I., Hodger T. Looking at science from the single-author articles perspective // Izmereniya Nauki, No. 2, 2017 https://okna.hse.ru/news/212247840.html

researchers in these higher education institutions has increased by 4.5 times.[1] On the one hand, they help Russian counterparts integrate into international research groups and projects. On the other hand, however, this may produce an effect such as the "purchase" of publications through entering into contracts with highly productive scientists from other countries.[2] This can be proved by the fact that foreign scientists working in Russia, mostly in Moscow-based higher education institutions, account for just 1.5 percent of the total number of researchers across the country.[3]

It would be difficult to further increase the presence of foreign high-level researchers because of a lack of ambitious objectives that could be more appealing than money for world's top class specialists. High-ranking government officials acknowledged that more than once.[4] The shortage of professionals who can formulate such objectives has recently become obvious.

Therefore, data on characteristics of scientific productivity and its linkage with ranking upgrade are highly controversial. There are, of course, some positive things to note: the number of the 5-100 Project higher education institutions that are now ranked has increased, whatever the ranking position is. While three higher education institutions participating in the 5-100 Project ranked among top-100 on subject areas in 2015, the number doubled to six in 2017. However, the number of non-participating higher education institutions ranked among top-100 higher education institutions on subject areas doubled during the same period.[5] What's unclear is the performance measure for the 5-100 Project in terms of how long it would take to be ranked. In the medium term, there are marked constraints to growth induced by the quality of human capital and the effect of some external factors that dampen its increase through foreign specialists engagement.

In the long term, an adverse effect of the race for publications and ranking can stem from higher stratification in the scientific community. Even in the group of leading higher education institutions the stratification is already apparent from the employee earnings perspective. Institutions of the Russian Academy of Science are facing a similar situation.[6] There is no regularity, however, that is commonly found in foreign higher education institutions where academicians and specialists in social sciences and humanities are always paid less than specialists in natural sciences, not to mention specialists in engineering. There are other types of stratification. One is that employee earnings within an institution differ largely because of, among other things, personal bonuses from senior management. The 5-100 Project has also made it possible to pay various types of bonuses. However, the principles of purpose and size of bonuses are sometimes not clear enough, except for a publication bonus that is paid are

[1] Ponomarev V. Consecutive motion. Russian higher education institutions: The 5-100 Project // Expert, 27 November 2017 http://expert.ru/expert/2017/48/posledovatelnoe-dvizhenie/

[2] Poldin O.V., Matveeva N.N., Sterligov I.A., Yutkevich M.M. College publication activities: The effect of the 5-100 Project // Voprosy Obrazovaniya, 2017, No. 2, p.31.

[3] Dyachenko E., Nefedova A., Streltsova E. Foreign scientists employment in Russian research institutions and higher education institutions: Opportunities and constraints // University management: Practices and analysis, 2017, Vol. 21, No. 5, p. 134.

[4] Medvedev Yu. Trubnikov: Russia to see world-class megascience cetners // Rossyiskaya Gazeta, Jnauary 9, 2018 https://rg.ru/2018/01/09/akademik-trubnikov-v-rf-poiaviatsia-megasajens-centry-mirovogo-urovnia.html;
Kiseleva M. Billions, wages and brains: A dispute between RAS professors and government officials // Indicator, 30 November 2017 https://indicator.ru/article/2017/11/30/sobranie-professorov-ran/

[5] Invanter A. Without GOELRO and a bomb // Expert, June 30, 2017 http://expert.ru/expert/2017/21/bez-goelro-i-bombyi/

[6] Volochkova N. Digging deep. Russian Academy of Science digs into institutions' problems // Poisk, No. 49, December 8, 2017 http://www.poisknews.ru/theme/ran/30916/

publicly disclosed. Accordingly, there is more guessing about it and discontent among scientists. Some say highest bonuses are paid to professors closely connected with senior management and to personnel "favored by senior management."[1] Therefore, this implies that the stratification leads to breaking the relationship between earnings and actual contribution to science and eventually has adverse effects on ethical norms.

The bibliometric pressure has expanded beyond the country's borders, affecting foreign counterparts cooperating with Russian scientists. The results of a recent survey of the specific features of the Russian-French Scientific Collaboration [2] show that the pressure to publish a prescribed number of articles has an adverse effect on foreign partners. Russian counterparts ask their foreign partners to publish as many articles as possible and to include as many Russian coauthors as possible in their articles. According to French scientists, Russian quantitative requirements for publications can sometimes be a problem for the normal course of work. In response to the publication requirement there is growing number of salami publications, in which novel ideas are cut into fragments, each being used for writing a separate article; the number of coauthors having little to do with the article is intentionally big. Bibliometric data show that the number of single-author articles is declining although there is much more single-author articles in Russia than, for example, in China. Over the past two decades the number of Russian single-author articles in first-quartile journals has been halved from 10.2 to 5.3 percent.[3] The fact to consider is that 19 percent of authors of such articles not only have Russian but also foreign affiliation and they have much better citation than plain Russian articles.

The key way of stimulating publishing activity is to pay extra to authors, in which case the size of payment depends on the impact factor of a journal.[4] Using scientific internship as an efficient way of improving publication activity is a much more rare practice by Russian higher education institutions. Foreign studies, however, show that citation of mobile scientists' articles is higher by an average of 40 percent than that of non-mobile scientists.[5] Mobility, in turn, also can be viewed as intensity indicator for international links. Recent studies of a relative effect of government funding and international cooperation on research paper citations[6] in OECD countries shows that international collaboration has a stronger impact on citation than an increase in government research funding. Furthermore, there is also some negative correlation between growth in funding and the probability of occurrence of most-cited articles.

Although the correctness of expert appraisal is questionable, it has increasingly been considered as a counter balancer to bibliometrics. The entire post-Soviet periods saw the number of Russian scientists decline, the proportion of "middle-aged" researchers worsen, and the Russian expertise degrade gradually with some extra suffering from a small number of

[1] Aglitskiy I. The way college professors turn into service workers // Nezavisimaya Gazeta – Science, May 24, 2017 http://www.ng.ru/nauka/2017-05-24/10_6994_students.html

[2] Dezhina I. Russian-French Scientific Collaboration: Approaches and Mutual Attitudes // Sociology of Science and Technology, 2018, no.1 (in press).

[3] Sterligov I., Hodger T. Looking at science from the single-author articles perspective // Izmereniya Nauki, No. 2, 2017 https://okna.hse.ru/news/212247840.html

[4] Impact Factor (IF) is a numerical measure of the importance of a scientific journal to assess the level of the journal, the quality of articles published by the journal, to provide financial aid to researchers and employ personnel.

[5] Nature Editorial. Science without walls is good for all // Nature, vol. 550, October 5, 2017. PP. 7–8. https://www.nature.com/news/science-without-walls-is-good-for-all-1.22742

[6] Leydesdorff L., Bornmann L., Wagner C. The relative influences of government funding and international collaboration on citation impact (December 13, 2017). https://arxiv.org/abs/1712.04659

specialists of certain subject areas, when a conflict of interests is inevitable. Grant-based financing became less available too by the time the period of upturn was over and research funding began to decline, and therefore expertise tuned into a tool aimed at promoting "insider" projects regardless of conflict of interests because vast academic disciplines had to compete with each other more often than not.

The bibliometric and expertise trap is difficult to overcome because of devaluation of scientific reputation. Policies such as purging of journals, detecting of plagiarists, criticizing the expertise and automatic appointment of experts have a positive, albeit an extremely slow, effect on public awareness.

Science in core universities

Core higher education institutions took the cue from leading universities and increased their scientific level.[1] Although research and development is not a core activity of core higher education institutions, it is are very important for them because they focus on interacting with regional enterprises in many subject areas including innovations, which is difficult to do without having a scientific background. That's the reason why core higher education institutions have scientific work targets among expected effects, as measured by R&D volumes and the number of publications in WoS/Scopus per academic. Some core higher education institutions are faced with the challenge of achieving required performance targets that require productivity be up by 7–10 times[2] and R&D volume per academic be up to a level 3.5 times the average across the national higher education system. To be able to deal with the problem of increasing publication activity, core higher education institutions started adopting practices of leading universities, including all pros and cons, namely the creation of an incentives framework as well as publication activity centers that also provide training for academics apart from exercising statistical functions. These policies intend to promote growth in the number and quality of publications though, among other things, stepping up competence in preparing for research and writing scientific papers. In addition, core higher education institutions tend to increase R&D investment: core higher education institutions received about 40 percent of total government funding of scientific research development.[3]

Overall, the effects of college special-purpose programs are positive from the perspective of encouraging universities to develop and apply new practices in research and education, management and entrepreneurship. A study of the National Research University Higher School of Economics aimed at seeking and streamlining best management practices of research institutions and higher education institutions[4] shows that universities have more successful practices than research institutions, including a higher level of practices designed to develop

[1] Core higher education institutions emerged in 2016, initially, as a result of consolidation of a few higher education institutions in a region, with the aim to promote the development of subjects of the Russian Federation through supplying highly qualified specialists to the local labor market, address pressing regional economic objectives and implement educational and innovative projects jointly with the region and regional enterprises. The consolidation requirement to make higher education institutions eligible for the core college status be has been removed since 2017. Russia has 33 core higher education institutions, with the aim to reach 100 by 2022.

[2] I.V. Arzhanova, A.B. Vorov, D.O. Derman, E.A. Dyachkova, A.V. Kalyagin. Results of the implementation of programs on the development of core universities in 2016 // University management: Practices and analysis. Volume 21, No. 4, 2017, p.13. DOI 10.15826/umpa.2017.04.045

[3] Calculations are based on data from I.V. Arzhanova, A.B. Vorov, D.O. Derman, E.A. Dyachkova, A.V. Kalyagin. Results of the implementation of programs on the development of core universities in 2016 // University management: Practices and analysis. Volume 21, No. 4, 2017, p. 20.

[4] https://goodpractice.hse.ru/

competences and support publication activity. However, there is a weak cooperation between research institutions and higher education institutions as well as between higher education institutions.

Updates to academic degree awarding

Finally, advantages and problems related to authorizing some higher education institutions to award an academic degree at their own discretion have become a stand-alone subject for debate. Moscow State University (MSU) and St. Petersburg State University (SPSU) were the first to be authorized to do so. However, a monitoring of the practice of organizing the thesis defense process and academic degree awarding should be launched. Last year, however, before the work on formation of new dissertation defense boards in the above universities had even started, the Russian government authorized another 19 higher education institutions and 4 scientific organizations to award an academic degree.[1] Such an abrupt extension of powers for higher education institutions appears a hasty decision amid reputation value erosion, growth in the number of publications in non-reputable journals, purchase and forgery of dissertations.

Meanwhile, MSU and SPSU took seriously the objective of setting new requirements for dissertation defense boards and academic-degree seekers. The task was found to be a challenge, with some options on how to handle it. As a result, the requirements of both universities are now much more strict than those of dissertation defense boards operating within the framework of State Commission for Academic Degrees and Titles, and therefore the number of academic-degree seekers has decreased with new dissertation boards in place. In MSU, for example, the number of dissertation defenses has dropped to about 40 a year from 700–800 in previous years.[2] Not only the transition period but also the reputational constraining factor should be taken in account here. It's important that both universities put a high value on the reputational factor at the expense of less quantities during the fledging period of boards. While MSU has set up standing dissertation defense boards, SPSU has adopted the western model that allows for setting a dissertation board tailored to each dissertation defense. Both approaches have advantages such as, for example, the MSU's model offers less bureaucratic proceedings than what is normally required for each dissertation defense. It's important that both universities have high quality requirements to publications of academic-degree seekers, and there are plans to conduct a monitoring of papers throughout the full dissertation preparation cycle rather than for a short period immediately preceding the dissertation defense.

Most of the higher education institutions authorized to award academic degrees have a certain (research, federal university) status or they are authorized to develop educational standards at the their own discretion. This gives promise that they will be able introduce dissertation defense principles to make these higher education institutions and research institutions more reputable. However, the cases of MSU and SPSU show that easier, albeit excessively bureaucratized, ways of dissertation defense are still in favor, thus evidencing of a small number of robust research papers. Statistics prove the same: the number of successfully defended Phd and doctoral dissertations has been decreased as a result of purge and cancellation of a series of dissertation defense boards. The number of successfully defended doctoral

[1] Russian government's executive order No. 1792-p dated August 23, 2017 http://static.government.ru/media/files/JnFTLJA581O4J7RuZuruWKeKZAyWC1V7.pdf

[2] Emelyanenkov A. Dissertation and reputation // Rossyiskaya Gazeta, November 29, 2017 https://rg.ru/2017/11/29/vladimir-filippov-doplata-za-uchenuiu-stepen-stala-perezhitkom-proshlogo.html

dissertations has almost halved as successfully defended Phd dissertations more than halved from 2012.[1]

6.3.3. Academic science

Last year, experts and mass media paid great attention to what was going on in FASO institutions and in the Russian Academy of Science (RAS), mostly in connection with the RAS president election. The sector itself underwent no substantial changes. There was a dispute about Russian scientists and RAS management's discontent of the recent RAS reform as well as the background of a new RAS presidential election.

The Russian academic community came into sharp contrast with FASO management's assessments as to what was going on in FASO institutions. the RAS Trade Unions jointly with the Academic forum 'Russia: Key challenges and solutions'[2] conducted an expert survey of 240 FASO employees. The survey shows that the science sector is faced with challenges in all research areas:

- lack of funding, low salaries, lack of opportunities for scientific expeditions and for attending scientific conferences;
- restricted access to information resources including databases on published research papers;
- further increase in the number of FASO bureaucratic requirements for updating statistical data, rankings, citation, time-consuming registrations on websites, etc.;
- therefore, there are serious problems facing young people engagement in FASO scientific and research organizations.

In June, the discontent was strong enough to develop into a protest rally demanding increase in funding of FASO institutions, including the state task[3], and RAS professors met in November with Russian presidential aid Aleksei Fursenko, expressing their complaints regarding low salaries and calling for new types of grants for middle-aged researchers.[4]

The FASO management, in turn, believe positive changes have been seen for the entire list of announced issues; in particular, FASO Director Mikhail Katyukov stated at a RAS General Assembly that:

- research funding was on the rise. The decline in federal budget funding was compensated by a considerable growth in off-budget funding, adding a total of 6.6 percent;
- average salary increased 29 percent (in 2016 from 2013);
- young scientists accounted for 45 percent of the total research workforce, proving there is no problem with young people engagement in science;
- the number of publications in journals indexed by WoS increased (up 12.7 percent in the period of 2013–2015).[5]

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[1] Emelyanenkov A. Dissertation and reputation // Rossyiskaya Gazeta, November 29, 2017 https://rg.ru/2017/11/29/vladimir-filippov-doplata-za-uchenuiu-stepen-stala-perezhitkom-proshlogo.html

[2] Sadykova R. The RAS reform is a proven failure: FASO to expand, institutes to lose their premises. February 23, 2017 http://www.mk.ru/science/2017/02/23/reforma-ran-priznana-provalnoy-fano-rasshiryaetsya-instituty-vyselyayut.html

[3] "Once again close to the poverty line": News from a rally of RAS employees // Indicator, June 28, 2017 https://indicator.ru/article/2017/06/28/miting-rabotnikov-ran/

[4] Kiseleva M. Billions, wages and brains: A dispute between RAS professors and government officials // Indicator, November 30, 2017 https://indicator.ru/article/2017/11/30/sobranie-professorov-ran/

[5] Shorthand notes of Mikhail Kotuykov's speech at a RAS General Assembly. March 20, 2017 FASO of Russia. http://fano.gov.ru/ru/press-center/card/?id_4=37994

There is a host of reasons for the disparity in assessing the situation. Researchers' base salaries are low indeed, salary growth records are based on data for total earnings generated from all sources. Earnings, however, are difficult to project, being an indefinite component that can change considerably depending on weather grants and contracts are available or not. In addition, many FASO institutions legally move employees from full-time to part-time status as well as switch to fixed-term employment agreements to ensure growth in salaries.[1] There is also a statistical casus of data for young scientists – they are growing in number due to, among other things, retirement of old-age researches.[2]

The transition to bibliometric accounting is a challenge too, particularly for older researchers who are used to work under no pressure from scientometric assessment. Furthermore, such assessments ignore the fact that any type of work is not necessarily supposed to deliver immediate results in the form of publications, that is to say, there is disparity between the periods of reporting on such figures and a period required for delivering the results that are worth of publishing.[3] Things got complicated late in the year, when FASO announced that salaries are supposed to rise proportionally to the increase in the number of articles.[4] That gave rise to a sharply negative response on the side of academic community because there is no linear relationship between the salary size and the scientific performance (productivity).

Finally, there were continuous jitters stemmed from a long-lasting preparation for the performance measurement of FASO institutions coupled with the actions performed by the Agency for consolidation of institutions into bigger scientific centers, without having to provide any solid rationale for such actions and clear-cut criteria for measuring the performance of the ongoing restructuring process.[5] In 2017, the work on establishment of such federal and regional centers was accelerated, however, they are not subject to performance measurement during the ongoing monitoring cycle. Further, 493 FASO scientific organizations underwent performance measurement by the end of 2017. The concern about managerial decisions that could be made following the performance measurement prompted RAS institutions and branches to virtually ignore it. According to the performance measurement protocol, RAS branches must prepare expert reports based on performance data from institutions. At a later stage, RAS branches must check whether institutions are equitably divided into categories and provide, if needed, their observations.[6] By October 2017, 90 percent of institutions ignored FASO's request to provide the required data.[7] Not until the election of new RAS President did the work on data collection for the assessment was accelerated, and expert reports were prepared by the end of October.[8]

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[1] Maksimov. Russia to see less scientists. RAS employees rally in Moscow. June 23, 2017 http://fedpress.ru/news/77/society/1808890

[2] Demina N. Scientists and government officials: Is dialogue possible? // Troitsky variant-nauka, No. 243, December 5, 2017, p.1. https://trv-science.ru/2017/12/05/uchenye-i-chinovniki-dialog-vozmozhen/

[3] Saburova L. Survival or development: Opportunities and risks stemmed from an academic science reform for the regional scientific community // Sociologia nauki i tekhnologiy. 2017. Volume 8, No. 4, p.50.

[4] Rubtsov A. Double up the reality: Russian science is forced to imitate // RBC, January 30, 2018 https://www.rbc.ru/opinions/politics/30/01/2018/5a702b549a794769102a5a0c

[5] Simplicity in relations with science is worse than robbery. An editorial, Nezavisimaya Gazeta. May 22, 2017 http://www.ng.ru/editorial/2017-05-22/2_6992_red.html

[6] Volochkova N. Stagewise. RAS institutions ranking// Poisk, No. 35, September 1, 2017 http://www.poisknews.ru/theme/science-politic/28378/

[7] Chernykh A. RAS members to face attendance checks // Commersant, October 11, 2017 https://www.kommersant.ru/doc/3434864

[8] Volochkova N. Academically speaking. RAS branches ranking institutions // Poisk, No. 46, November 17, 2017 http://www.poisknews.ru/theme/ran/30239/

It's characteristic that top-performers accounted for 58 percent of FASO institutions, whereas just 5 percent were recognized as low-performing institutions, according to data from RAS branches. Comparison of data from branches with quantitative (including scientometric) performance figures of institutions revealed that there were only 130 high-performing institutions (26 percent). High-performing institutions had 0.6 publications a year per researcher (less than in higher education institutions), whereas low-performers had 0.1. It's characteristic that there was no big difference in funding of high- and low-performers.[1] The results obtained revealed inappropriate funding and a relatively modest performance of institutions.

Overall, 2017 continued to see a negative environment stemming from the *continuing standoff between* RAS and FASO and from general discontent of the RAS reform despite the fact that many scientists and RAS members are conscious of the need for such a reform. RAS member Aleksei Khokhlov expressed his complaints in clear and unmistakable terms*: "The RAS Presidium has long been notoriously known for its nontransparent, behind-the-curtain functioning and a highly archaic infrastructure. What is more, no changes in its style of operation have been seen since the 2013 RAS reform in response to external changes."*[2] That's exactly why the academic community had high hopes for the election of a new RAS President.

No RAS presidential election took place in March 2017. The official reason was that the the RAS presidential election procedure needed updating. RAS is a state-funded institution and therefore Russian government's opinion about RAS performance and president is instrumental. It appears that previous RAS President Vladimir Fortov who ran for the presidency in March was not considered a person able to continue the RAS reform and forge relationships with other government agencies. However, it is Vladimir Fortov who was in fact the sole the favorite to win the presidency. All the candidates eventually dropped out, and the RAS presidential election was slated for late in September. Amendments to the legislation were introduced in August. The idea is that not only RAS branches may nominate candidates for RAS presidential elections. RAS members themselves may run for the presidency in a proactive manner, provided that they collect more than 50 RAS members' signatures for candidacy. It is not until the list of candidates is approved by the Russian government that the approved nominees may take part in the election. The newly elected RAS President is subject to approval by the Russian President.[3] Therefore, RAS presidential elections are now under rigorous surveillance and formal control by the Russian government.

The list of candidates was updated by September. RAS member Aleksandr Sergeev[4], Director of Institute of Applied Physics of the Russian Academy of Sciences (the city of Nizhniy Novgorod), was the favorite to win. In his election program Mr. Sergeev presented a conservative enough approach towards the RAS reform that was favored by the majority of RAS members. Eventually, the forecasts proved correct after Aleksandr Sergeev won the

[1] Volochkova N. Not enough leaders? Evaluation commission's final conclusions spoil the fun of scientists // Poisk, No. 52, December 29, 2017 http://www.poisknews.ru/theme/science-politic/31538/

[2] Aleksei Khokhlov: RAN engine's four-year wheel spin // RIA Novosti. July 29, 2017 https://ria.ru/science/20170729/1499294783.html

[3] Federal Act dated July 29, 2017 No. 219-FZ *On Amendments* to the Federal Act On the *Russian Academy* of *Sciences*, the *Reorganization* of the *State Academies* of S*ciences* and *Amendments* to *Certain Legislative Acts* of the *Russian Federation* http://www.garant.ru/products/ipo/prime/doc/71632828/

[4] Vaganov A. The government seem to have elected the President of the Russian Academy of Sciences // Nezavisimaya Gazeta-Nauka, September 3, 2017 http://www.ng.ru/science/2017-09-03/100_ran030917.html

election. The next day after the election the Russian president signed a decree appointing Mr. Sergeev as RAS president.

The newly elected RAS President believes that the first thing to do is to change the RAS status so that it ceases to be a state-funded institution. This must be done so that RAS will perform not only research and methodological functions but also organizational and methodological control of FASO institutions, including allocation of funds, as was the case prior to the reform.[1] The RAS President noted, however, that this process is a long-term process, and therefore a new status will not be granted in the offing.[2]

In addition, according to the newly elected president, FASO must be informally accountable to RAS by appointing scientists as including through introducing scientists into the FASO management as well as holding concurrently the position of FASO director and of RAS senior manager. The ideas of centralization have an effect on RAS regional branches too: the RAS President believes that RAS must bring them under scientific and organizational control and become their co-founder.

It's curious that Aleksandr Sergeev *shares almost the same views* as the previous RAS president, including views on how RAS must integrate itself into the process of addressing national issues. Again, focus is placed on major projects and on RAS engagement in the achievement of military-industrial complex tasks. According to the newly elected RAS President, it's important to, first, take part in major scientific projects, that's what RAS did in the Soviet era, and, second, conduct research to strengthen the national defense capabilities. In doing so, a basic and exploratory research program aimed at meeting the interests of the military-industrial complex needs to be adopted. Lastly, it's important to resume the program of integration with higher education institutions that was underway in the mid/late 1990s, performing largely the function of supplying manpower for RAS.

In the context of the above views and objectives it's not surprising that the new RAS Presidium has many members of the former RAS Presidium, with a few of them being compromised by scandals associated with, among other things, forged dissertations.[3] The stated views nevertheless meet the views of a majority of RAS members. Some of them even wrote an Open Letter addressed to the Russian President in support of the idea to make FASO accountable to the Russian Academy of Science, bring back academic institutions under the RAS control, and grant a special status to RAS.[4]

It's remarkable, however, that the newly elected RAS President has publicly acknowledged that RAS had lost people's respect. A critical goal, according to Aleksandr Sergeev, is to regain public and people's confidence and respect, which is, however, difficult to accomplish because good reputation is easier to lose than to achieve, let alone to regain. Therefore, reforms that go beyond partial returning to the previous framework will have to be introduced. Anyway, that's what the Russian President's stance is all about – the consolidation of the three academies is a good solution[5], and therefore the main course of the RAS reform is on the right track.

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[1] Russian science enters a death valley. Commersant publishes a speach of the newly elected RAS President // Commersant, September 26, 2017 https://www.kommersant.ru/doc/3422102

[2] Volochkova N. Digging deep. Russian Academy of Science digs into institutions' problems // Poisk, No. 49, December 8, 2017 http://www.poisknews.ru/theme/ran/30916/

[3] Orlova O. Academicians manage to gain government's respect but lose the game with themselves // Weekly journal. October 2, 2017 http://www.ej2015.ru/?a=note&id=31623 (was available on October 30, 2017)

[4] A open letter to President Putin // Kommersant, December 27, 2017 https://www.kommersant.ru/doc/3509262

[5] A meeting with members of the Russian Academy of Sciences. May 30, 2017 http://kremlin.ru/events/president/news/54635

6.3.4. Technological innovations promotion policy

The Digital Economy of the Russian Federation state program marks a new uptrend in the development of the country's innovation sector.[1] The program sets out basic cross-cutting digital technologies the government will promote as well as goals and objectives of developing research competences and technological capabilities. The program aims to develop startups[2], increase big companies engagement in innovative activities, intensive training of IT specialists and other professionals that are in demand in times of digitization. In particular, at least 10 globally competitive leading companies and at least 500 small and medium-sized enterprises specializing in the development of digital technologies and platforms and in the provision of digital services are expected to emerge by 2024.[3] In terms of ideology, the program is in line with the import substitution concept because it aims primarily to enhance research competences and technological capacity, sets out "*technological self-sufficiency* regarding every subject area of cross-cutting digital technologies on a global level, and national security."[4] There is a problem though: *McKinsey estimates* Russia's reliance on imports in certain market segments is getting critical: the country imports 80 to 100 percent of various types of IT equipment and about 75 percent of software.[5] The amount of venture capital funding of digital projects in Russia has been decreasing by approximately 5 percent a year.[6]

The Program was adopted amid stagnant technological innovations. A host of indicators describing country's inventive and innovative activities fell below an already low level of innovation activities that was observed over a long period of time (see *Fig. 7*).

First and foremost, according to Rospatent, in 2017, there was a decline in the patent activity of Russian research institutions and higher education institutions and therefore in the potential to set up startups on the basis of intellectual property.[7] The marketability of developments is low, with patented R&D products making up 10 percent, of which 2.2 percent have found practical application, which is due to (apart from companies' weak interest in innovations) a lack of clear-cut standards for the distribution of intellectual property rights, undeveloped court practice, shortage of patent lawyers.[8]

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[1] Endorsed by the Russian government through executive order No. 1632-p dated July 28, 2017 http://static.government.ru/media/files/9gFM4FHj4PsB79I5v7yLVuPgu4bvR7M0.pdf

[2] A meeting concerning the implementation of the Digital Economy state program. August 15, 2017 http://government.ru/news/28825/

[3] The Digital Economy of the Russian Federation state program», pp. 16-17. http://static.government.ru/media/files/9gFM4FHj4PsB79I5v7yLVuPgu4bvR7M0.pdf

[4] Ibid., p. 11.

[5] Digital Russia: A new reality. Aleksandr Aptecman, Vadim Kalabin, Vitaly Klintsov et al. Digital/ McKinsey. July 2017. P. 43. file:///D:/Libraries/Downloads/Digital-Russia-report.pdf

[6] Ibid., p. 49.

[7] Skorobogatiy P. Who is to invest in a perpetuum mobile // Expert, No. 45, 2017 http://expert.ru/expert/2017/45/kto-dast-deneg-na-perpetuum-mobile/

[8] Ibid.

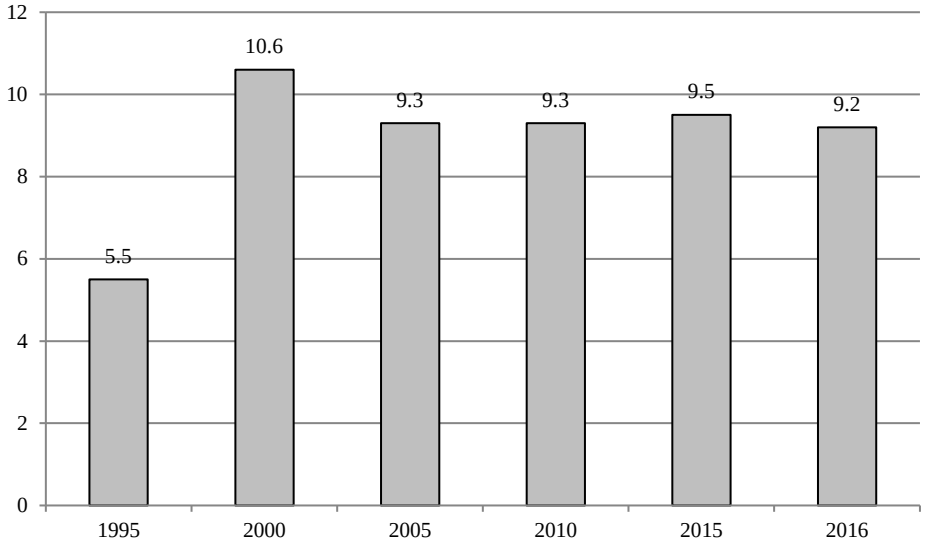

Fig. 7. Innovative enterprises in industry, as a percentage of total industrial enterprises

Source: Fridlyanova S. Industrial enterprises' innovative activities // Science, Technologies, Innovations. November 15, 2017 M.: National Research University Higher School of Economics, p. 1.

Second, hopes that student startups will encourage the development of small business (in particular, a series of programs of the Innovation Promotion Fund rely on that) have not been met. Russian Prime Minister Dmitry Medvedev noted that student entrepreneurship "has failed to meet at least 10 percent of what was expected."[1] Indeed, student entrepreneurship is still performing the training function, and it is therefore difficult to find investment for this type of business. However, it is not only student startups that are difficult to find investors for because, third, venture capital funding has been decreasing in the country due to, among other things, sanctions. According RBC's full-year report, the past three years saw transaction volumes in the Russian venture capital ecosystem decline 75 percent, total capital of venture capital funds operating in the Russian market drop 19 percent, venture capital transaction volumes lose 66 percent.[2] According to data from the OECD, venture capital investments Russia ranks 30rd on volume out of 33 countries covered by statistics. Russian statistics, however, cannot be used for dividing this type of investment into early and seed-stage investments and later-stage investment in business development[3], and it is therefore difficult to measure the innovation orientation of venture capital investments.

Venture capital is expected to be found in big state-owned companies, the target of a new policy that was introduced in June by the Russian President. The policy is so-called "coercion to innovations" by way of recommending such companies to set up corporate venture capital funds and deal with startups. Needless to say, big companies are in focus because most of the

[1] Sotnikova A. Dmitry Medvedev carps about student startups failure to meet "at least 10%" of expectations // RBC, May 25, 2017 https://www.rbc.ru/society/25/05/2017/5926ef489a7947524fe9cec5

[2] Data for 2014–2016. Source: New instruments formation. RBC 2016 full-year report . M.: RBC, August 2017 http://www.rvc.ru/upload/iblock/150/Report_RVC_2016.pdf

[3] According to data for 2016. Source: OECD (2017), OECD Science, Technology and Industry Scoreboard 2017: The digital transformation, OECD Publishing, Paris. P. 158.

R&D investment worldwide come from big and medium-sized companies that have long been in the market[1]; however, fresh small companies tend to offer new innovative ideas.

The recommendation to set up corporate venture capital funds is addressed mostly to biggest state-owned companies such as Rostech, the Federal Space Agency of the Russian Federation (Roscosmos), the United Aircraft Corporation (UAC), the United Shipbuilding Corporation (USBC), State Atomic Energy Corporation (Rosatom).[2] A few companies agreed late in November on pooling their efforts to set up venture capital funds: Roscosmos, RBC, VEB-Innovations established a venture capital fund; UAC joined a venture capital fund set up by the Skolkovo Foundation and RBC; USBC plans to establish a venture capital fund early in 2018.[3]

It's unlikely that corporate venture capital funds will swiftly solve the startups problem because Russia has not more than a few dozens of projects that can be appealing for investors, according to experts.[4] Rostelecom, Gazprom Neft, *RT-Business Development* LLC stand out among existing corporate funds. No successful project kick-offs has been seen yet. The new activity in this sector shows that centralized administrative resources continue to be in use despite low effectiveness of the coercion to innovations. It's not technological innovations that help big companies gain competitive advantages; in particular, state-owned companies gain advantage through having access to administrative resources, government subsidies and government defense contracts.[5]

The Digital Economy state program can be sort of a catalyst to get things going at least within a limited segment despite overall adversity facing the innovation ecosystem. In April 2017, The Institute of Innovation Management of the National Research University Higher School of Economics conducted a survey among 100 companies (mostly small companies). The survey shows that the program can be used as a mobilizing tool designed for more active transition to digital technologies. However, not all of them are aware of what digital transformation of economy is all about, and digitization is quite often viewed as a way of streamlining internal processes of doing business. Approximately 60 percent of the surveyed companies said digital technologies can be used to streamline the document flow, while only 28 percent companies mentioned big data processing, storage and analysis.[6] Therefore, the majority of companies said digital technologies had the strongest effect on stepping up internal processes, namely simplification, acceleration, labor and resource intensity reduction, whereas the weakest effect was on sales, acquisition of new consumers and appearance of brand new products, services and opportunities, with no effect at all on 34–41 percent of cases.[7] It's characteristic that a lack of special support policies was found to be one of the main constraints,

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[1] OECD (2017), OECD Science, Technology and Industry Scoreboard 2017: The digital transformation, OECD Publishing, Paris. P. 29.

[2] Vladimir Putin commissions biggest Russian companies to set up venture capital funds // RNS Information Agency, June 2, 2017 https://rns.online/economy/Putin-poruchil-krupneishim-kompaniyam-Rossii-sozdat-venchurnie-fondi-2017-06-02/

[3] Khlyuavko A. Roscosmos sets up a venture capital fund // Vedomisti, November 30, 2017 https://www.vedomosti.ru/technology/articles/2017/11/30/743634-roskosmos-venchurnii-fond

[4] Kerber S., Leader CJSC Managing Director. Mneniye // RNS Information Agency, November 10, 2017 https://m.rns.online/opinions/Kakuyu-vigodu-mozhet-prinesti-korporativnii-venchurnii-fond-2017-11-10/

[5] Sakovich M.. VC is judged by "exits": Why the Russian startups market keeps seeing small number of "exits"? // Forbes, March 10, 2017 http://www.forbes.ru/tehnologii/338751-vc-po-ekzitam-schitayut-pochemu-na-rossiyskom-rynke-startapov-po-prezhnemu-malo

[6] Global Economy: Global trends and Russian business practice / under the editorship of Medovnikov D.S. – M.: National Research University Higher School of Economics, 2017. PP. 49–50.

[7] Ibid., p. 56.

apart from the traditional shortage of funding. The Digital Economy state program may just as well facilitate the solution of the problem.

Another important aspect related to the program is human capital. Seventy percent of respondents pointed to a lack of high-quality labor force, including insufficient skills of personnel using digital technologies. The manpower issue, particularly IT specialists training, was paid a special attention while discussing the Digital Economy state program. The question of how many specialists the country needs to become a digital economy had different answers. According to the Agency for Strategic Initiatives (ASI), 120,000 highly qualified engineers and programmers are needed for a breakthrough, whereas managers of the Russian Ministry of Communications said about one million IT specialists.[1] The figures appear very approximate because of such a wide disagreement. Up to 2,000 IT specialists left the country over the past two years, according to Russoft, a nationwide association of leading companies specializing in software development. Although the number isn't big, we are talking about most qualified specialists.[2] Collectively, these data explain why the educational component is essential in the Digital Economy state program. The workforce issue is expected to be addressed through competence development centers that will be established as part of the implementation of the Digital Economy state program and through NTI.

An initiative aimed at promoting medium-sized private growth companies (national champions) was developed amid relatively negative trends in the innovation sector. The initiative is a pilot program encompassing 30 companies. Another 32 companies were selected on a competitive basis late in 2017.[3] The initiative exhibits the effectiveness of agencies' pooled efforts, the value of non-monetary policies as well as the potential of support tools synergy.

The key principle of the initiative is "manual" operation with companies in order to facilitate and double down their innovative activities. In 2017, The Ministry of Education and Science offered companies (national champions) to take part in identifying promising subject areas that will then be supported on a competitive basis through a federal special-purpose program – Research and development according to priority areas of the scientific and technological sector development in Russia for 2014–2020. The companies are eligible for competition, and government co-financing at initial R&D stages will cover up to 70 percent of the project value.[4] The Ministry's approach towards looking for and engaging industrial partners is now a pilot project, but it's likely that it will continue to develop because companies have great interest in this type of cooperation. Financial aid is also provided via the Industrial Development Fund in the form of easy-term loans and via the SMB Corporation in the form of sureties on concessional lending basis. There is another approach via the Russian Export Center that helps companies with registration of intellectual property rights abroad, compensation for certification costs as well as product shipment costs.[5]

National champions support tools include various forms of stimulating horizontal links with, above all, state-owned companies that regulate innovation development programs. Such links

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[1] A meeting at the Council for *Strategic Development and Priority Projects*. July 5, 2017 http://kremlin.ru/events/president/news/54983

[2] Digital Russia: A new reality. Aleksandr Aptecman, Vadim Kalabin, Vitaly Klintsov et al.. Digital/ McKinsey. July 2017. P. 60.

[3] Mekhanik A. A happy new champions! https://stimul.online/articles/sreda/s-novymi-natschempionami/

[4] Kondrakova T. Request for a signal. Ministry of Education and Science waiting for proposals from medium-sized business // Poisk, May 19, 2017 http://www.poisknews.ru/theme/science-politic/25315/

[5] Grigorjeva I. High-tech exports to see 3.5-fold increase by 2020 // Izvestia, August 22, 2017 https://iz.ru/632460/inna-grigoreva/mer-vysokotekhnologichnyi-eksport-vyrastet-v-35-raza

are expected to help state-owned companies implement more efficiently their plans and medium-sized companies sell their technologies and products. There are plans to encourage the establishment of consortiums that will embark on the development of globally competitive technologies. Such initiatives also can help big state-owned companies solve the problem of retarded innovation-driven development. According to managers of the Ministry of Economic Development of Russia, the implementation of innovation development programs state-owned companies has worsened, the number of innovation units of state-owned companies has been decreasing because "political momentum has been lost.»[1] Therefore, the political momentum may be regained through promotion of cooperation with medium-sized growth companies. The national champion status will ensure that products are competitive. Further, this approach also can help solve the import substitution problem.

At the same time, the "manual mode" is quite useful for medium-sized companies in the case of pilot project, whereas it is difficult enough to apply across the country. Another factor that may affect the forms of support in place is the temptation to make advantage of the industrial partner status for gaining a priority access to budget allocations. Where promising subject areas are determined by a limited pool of companies, it's highly likely that the companies will win ministries' tenders to be eligible for funding. Some companies do prefer "easy ways": companies' (national champions) 2017 road maps of growth showed that some of the supportive policies requested from the government aim to eliminate competition in the industry rather than facilitate the development of new technologies.[2]

Given all the existing potential problems, a concierge service program for medium-sized growth companies sets an interesting precedence of comprehensive use of various government support tools and makes it possible to ensure that they are well balanced.

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The last year saw the government continue to build out its presence in science and in the development and application of new technologies. The government outpaced the business sector in R&D spending, priorities of (mostly digital) development were set. New policies of "coercion to innovations" were introduced. The government strengthened its positions in the academic system.

Two aspects were characteristic for the scientific and technological policy. First, a series of documents, including statistical documents, were quickly developed and approved. New long-term documents emerged during the year. Second, the implementation of a number of initiatives faltered, such as performance measurement of scientific organizations, updates to the system of distribution of budget appropriations, creation of conditions to encourage venture capital funding, creation of a legal framework to govern intellectual property rights. A number of the last year's new policies resembled some of the previously implemented ideas and therefore looked like cyclical attempts to solve the same unmanageable problems. The Digital Economy state program has almost the same technological priorities as the NTI does, core universities started mimicking the approaches of leading higher education institutions, RAS' new plans were similar to early ideas of switching back to a number of prereform governance policies.

[1] Medovnikov D. Russia concentrated gets Innovative. https://stimul.online/articles/interview/innovatsionnaya-rossiya-sosredotachivaetsya-2/

[2] Saraev V. A nationwide experiment. https://stimul.online/articles/sreda/eksperiment-natsionalnogo-masshtaba/

Overall, the scientific and innovation policy tends to provide priority support to top-performers that are selected according to various criteria, be it universities, technology companies or selectively engaged foreign scientists. The approach is irrational amid limited capital resources, but it has side-effects. In the scientific and research sector this leads to stratification of the scientific community, which might turn out to be socially dangerous in the future. The scientific labor market remains exclusive, there is no system in place for staff exchange, engagement of specialists from the global market, as well as smooth-running mobility. The focus on specific types of companies in the innovation sector may lead to unreasonable benefits and distortion of competition. At the same time, the pilot project of custom-tailored support to companies (national champions) created an interesting precedence of comprehensive use of the available government support tools. The foregoing open a window of opportunity for forging horizontal links between various actors within the innovation system.