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The review “Russian Economy. Trends and Outlooks” has been published by the Gaidar Institute since 1991. This is the 41th issue. 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: global economic and political challenges and national responses, economic growth and economic crisis; the monetary and budget spheres; financial markets and institutions; the real sector; social sphere; institutional changes. The paper employs a huge mass of statistical data that forms the basis of original computation and numerous charts confirming the conclusions.

By contrast to the previous publications the present issue includes also a short analysis of the first three months of 2020 from the perspective of the COVID-19 pandemic impact on the Russian economy development.

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□ Gaidar Institute, 2020

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6.4. Science and innovations in Russia in 2019¹

The main topic related to science in the previous year was the National Project (NP) “Science” and federal projects implemented under its framework. Considering the speed of budget funds allocation, NP “Science” was one of the most dynamic one among projects of similar status. The National Project “Digital Economy” was on the other side of the spectrum, for which allocation of funds to performers has just started. An interlinking via identical monitoring indicators of NP “Science” and the Strategy for Scientific and Technological Development of the Russian Federation (SSTD) took place making the latter a “living” document.

At yearend, a more clear distribution of topics/issues that the Russian Academy of Sciences (RAS) and the Ministry of Science and Higher Education are focused on, was put in place. The main thing for RAS was the organization of their own activities, that is, clarification of competences, procedure for election of new academy members, organization of expertise of state assignments for all recipient scientific and educational institutions. In addition, RAS was developing a program dedicated to basic scientific research. The Ministry, in turn, was focused on the implementation of federal projects in the pattern of NP “Science”, where the major topic could be the establishment of the Research and Educational Centers (hereinafter - REC). Such a focusing is associated with the complexity of the initiative, the need to combine scientific and technological policies of the federal and regional scales.

No “breakthroughs” took place in the field of innovation technologies as evidenced by the dynamics of the Russia’s position in various rankings, results of the companies’ survey as well as indicators of the high-tech companies outflow from the country. At the same time, the Government introduced more measures striving to improve the situation, having initiated new target (development of artificial intelligence) and infrastructural projects (technological valleys).

6.4.1. Strategic guidelines

Main strategic guidelines for the sphere of science and technologies in 2019 and their prospects were announced in the Presidential Address to the Federal Assembly². Three priority groups, i.e. thematic, structural and human resources capacity, relate to development of science and technologies. The thematic priorities included genome technologies with new centers set up last year for their development, and the artificial intelligence followed up by the creation of the Development Strategy of the artificial intelligence. The new infrastructure was marked by mega-science installations and modern research vessels with activities in this direction carried out under the framework of NP “Science”, though relatively slow. At present, only the basic parameters of future megascience installations are being determined. There are plans to link

¹ This section was written by *Dezhina I.G.*, Doctor of Sciences (Economics), Leading researcher, Gaidar Institute, Head of Analytical Department, The Skolkovo Institute of Science and Technology

² Presidential Address to the Federal Assembly. 20.02.2019. URL: <http://kremlin.ru/events/president/news/59863>.

them with priority projects focused on mandatory use of these installations¹. The structural priorities also included research and educational centers designed to link regional priorities, science, education and business. The work in this direction was carried out in 2019 most actively.

The development of human resources in a broad sense, from school sections, technical professional schools, to highly qualified personnel, was also among the priorities, because the country needs specialists who are able to "create and use breakthrough technical solutions." Thus, the 2019 Address of the President determined the main trends of practical actions, implemented at different speeds during the year. The approval of the list of indicators for the implementation of the Strategy for scientific and technological development of the Russian Federation², was an important aspect and actually linked NP "Science" and the Strategy. These are the financial indicators of the amount of domestic costs on research and development from all sources (as a percentage of GDP) and separately, the amount and the share of extra-budgetary funds, the country's place in the rankings according to the number of articles in international databases, and by the share in the global pool of applications for patents. The proportion of researchers under the age of 39 is subject to monitoring, which raises the topic of attracting young people to science and reducing the outflow of employees to a new level.

The development of a science draft law has not been resolved during the year, however, it was under discussion more than five consecutive years. In summer, a new version of the science draft law and scientific and technical activity, developed by the Ministry of Science and Higher Education, was submitted for public consideration. The RAS took a time-out for a detailed consideration of the draft law, however, it failed to be submitted to the State Duma at the year end. The RAS authorities considered the project rough, containing too many generalities and provisions.

The key issues of the draft law relate to the government bylaws³. According to Alexey Khokhlov, the RAS Vice-President, the law on science should mostly offer favorable conditions for academic efforts in Russia, being in turn one of the goals of NP "Science". Therefore, the researchers' achievements should be assessed by their results, while the results mean the accomplishment of research, governing postgraduates and students, fund raising, writing articles, etc. Among remarkable suggestions by the RAS Vice-President are the requirement to put into law the right of the Russian scientists for "barrier-free cooperation" with their foreign colleagues on public topics researching. This is a reflection of the geopolitical challenges appeared in the recent years and impacted on the international scientific cooperation.

6.4.2. Plans to finance R & D from the budget

The year 2019 was marked by insufficiently active use of budget R & D funds, which resulted in the carry-over of unspent funds for 2020 in the budget plans for the next three years. Statistically, this gave the most significant increase for 2020 compared to 2019 (almost by

¹ The implementation of the Russian megascience installations project disclosed. 05.09.2019. URL: <https://lenta.ru/news/2019/09/05/megascieince/>.

² List of indicators related to implementation of Strategy of science/technological development of the Russian Federation with their dynamics to be subject to monitoring. Approved by Decree of the Russian Federation of 15.08.2019 № 1824-p. URL: <http://static.government.ru/media/files/L3np1utu1mzwMA58HluaADkvVxfkalUU.pdf>.

³ N.Volchkova. Science draft law was "zeroed" again. 26.07.2019 URL: <https://www.poisknews.ru/skript/donovanyaya-a-zachem-proekt-zakona-o-nauke-v-ocherednoj-raz-obnulen/>.

24 percent), and in the next two years the growth rate will be about 3-4 percent per year (see *Table 21*).

Table 21

Dynamics of civilian R&D budget appropriations

Indicator	2020	2021	2022
Federal budget expenses on civilian R&D, total RUB billion	505.61	518.87	540.65
Increase to previous year, percent	+23.9	+2.6	+4.2
Increase compared to draft law for 2018–2020, each year, percent	+14.4	+14.6	–

Source: Schedule 8 to the Explanatory Note attached to the Federal Draft Law "On the Federal Budget for 2020 and the 2021 and 2022 Planning Period", own calculations.

The main "umbrella" program benefiting from funds allocation for civilian R&D, as well as for other science needs, represents the state program "Scientific and technological development of the Russian Federation", approved in March 2019¹, with a budget for the current year in the amount of RUB 688.3 billion and plans for further appropriations growth: RUB 740.7 billion in 2020, RUB 795.9 billion in 2021 and RUB 870.7 billion in 2022. It is expected that the consolidation of the entire federal budget aimed at civilian research and development will begin in 2020 within the framework of this program, including the budget allocated so far through a number of state programs.

There are plans to increase budget appropriations for the implementation of NP "Science" under the National program "Scientific and Technological Development of the Russian Federation" (*See Table 22*).

Table 22

Parameters of Federal projects NP "Science" (RUB billion)

National project "Science"	2020	2021	2022
Total	47.4	69.8	96.1
Amendment compared to the Law № 459-FZ, percent	+10.2	+11.2	+8.6*
Including on federal projects:			
Federal project "Development of R&D production cooperation"	12.6	7.9	10.6
Federal project "Development of advanced infrastructure for R&D in the Russian Federation"	23.4	37.1	59.4
Federal project "Development of R&D human resources capacity"	11.3	24.7	26.1

* amendment to the project passport for 2022.

Source: Schedule 8 to the Explanatory Note attached to the Federal Draft Law "On the Federal Budget for 2020 and the 2021 and 2022 Planning Period", own calculations.

The support to basic research financed through the fundamental research program as well as two research foundations, i.e. the Russian Research Foundation (RRF) and the Russian Foundation for Basic Research (RFBR) will annually increase (*See Table 23*). Moreover, the foundations budgets will practically be equal by 2022 due to significant recapitalization of the Russian Research Foundation, as it failed to attract extra-budgetary funds almost on parity basis, as previously expected. The RRF and RFBR will cumulatively allocate about one third of the budget appropriations aimed at basic research, being a positive trend in general terms.

¹ RF Government Resolution of 29.03.2019. № 377 «On approval of the National program of the Russian federation "Scientific/technological development of the Russian Federation". URL: <http://fcpir.ru/upload/iblock/4d0/PP-GP.pdf>.

Budget appropriations for basic research

Type of expenditure	2020	2021	2022
Basic research (Capital Repairs Fund subsection), RUB billion	190.7	216.3	250.7
Share in total expenditures for civilian R&D, percent	37.7	41.7	46.4
Russian Foundation for Basic Research	22.9	23.9	24.7
Russian Research Foundation	9.3	21.8	22.4

Source: Schedule 11 and Schedule 11 to the Explanatory Note attached to the Federal Draft Law "On the Federal Budget for 2020 and the 2021 and 2022 Planning Period", own calculations.

In the meantime, it is evident that the Foundations could allocate larger resources. Thus, R&D appropriations for NRC "Kurchatov Institute" planned at RUB 24.9 billion by 2022, will exceed the whole RFBR budget. To put that in context, the Lomonosov MSU will receive 5–6 times less for R&D than "Kurchatov Institute".

A significant rise in appropriations in 2020 and the following reduction in budget funding by 4–7 percent per year is expected in the field of applied scientific research related to the main item of civilian expenditure (applied scientific research in national economy). Thus, hope remains that the extra-budgetary funding for applied research will be intensified.

On the whole, these expectations can be implemented in the coming five years. Thus, the history of R&D financing in the USA would remember that it took 30 years to make extra-budgetary appropriations equal to budget R&D funding in terms of volume¹.

6.4.3. Reorganization of research foundations

Despite the fact that budget plans for two state scientific foundations, RFBR and RRF, retain the logic of previous years, the Ministry of Science and Higher Education began developing plans last year to reorganize foundations by transforming their programs and redistributing functions. This work was carried out jointly with foundations management, however, without expert discussion and the RAS involvement. This approach to resolving issues resembles the actions of six years ago related to the RAS reform.

The Ministry did not strive for openness and collegial decision-making, and it should be noted that the Ministry of Science and Higher Education was on the last place in the ranking of Russian departments in terms of transparency, prepared by the Accounts Chamber². This has resulted in the Ministry delaying the creation of advisory bodies. A public Council was created only in October with its activity starting in November, and failed to consider the subject of foundations reorganization.

Moreover, in comparison with the previous Councils (it was a Scientific Council under the Ministry of Education and Science, and a Scientific Coordination Council under the Federal Agency for Scientific Organizations), there are very few RAS representatives in the new structure. As there are no public debates, the scientific community raised some concerns that the reform of the foundations could lead to negative consequences, including the liquidation of RFBR.

However, the most intriguing question is why the reorganization of scientific foundations should be held? It would seem that the functionality between them is clearly divided, duplication is minimal and concerns only the so-called "large" projects. Moreover, the

¹ U.S. Research and Development Funding and Performance: Fact Sheet. Congressional Research service. Updated January 24, 2020. P.2. URL: <https://fas.org/sgp/crs/misc/R44307.pdf>.

² The State transparency in Russia. Expert report. RF Accounting Chamber. 2019. C.45. URL: <https://www.infoculture.ru/wp-content/uploads/2019/06/Otkrytost-doklad.pdf>.

duplication is more likely an alternative rather than repeating the same thing in the absence of private research foundations in the Russia's environment. The presence of several foundations, even with overlapping agendas, is an important condition for stability of the scientific system in any developed country. Nevertheless, the official reason for the invented changes was the elimination of duplication.

The reform of foundations system is needed "to increase efficiency and expand grant support for domestic science", as well as ... to "avoid duplication¹."

The announced plans to transform the system of foundations can result in a reduction in the scope of grant support for domestic science, as the RFBR competition, the most massive and effective according to scientific results, aimed at support of pilot scientific projects (more than 8 thousand research teams participating in 63 regions of Russia) will be cancelled.

This competition is in fact a compensation for lacking funds aimed to conduct particular scientific activity at research institutions and universities, partially substituting a low-performing system of science organization with salaries and other objects of expenditure remaining low. The Ministry of Science and Higher Education specified a new functionality of the foundations: the RFBR will undertake the implementation of international and regional projects as well as develop scientific postgraduate studies; RRF will deal with the implementation of the Presidential Program of research projects and large interdisciplinary projects².

The planned differentiation of large scientific projects that will be funded by the RRF and international projects under umbrella of RFBR raises questions.

As a matter of fact, large projects should be international, therefore the separation of the "state-of-the-art science" supported by RRF, from the "international agenda" looks false and groundless. The planned separation of postgraduate school (RFBR) from the youth support programs (RRF) is no less strange.

The RAS and the scientific community represented by the Society of Scientific employees (SSE) made appeals to the government of the Russian Federation. In its letter, the Russian Academy of Sciences (RAS) insisted on a comprehensive discussion of the planned reorganization of scientific foundations and emphasized the importance to continue the RFBR competitions to support initiative projects³, while the SSE also justified the importance of this competition and its high demand and insisted to maintain it.

Therewith, the SSE appeal noted the inconsistency of the argument related to duplication of the RFBR and RRF functions, as well as the need for many scientific foundations in the country⁴.

Actually, the letter of the Ministry of Science and Higher Education of the Russian Federation, signed by Grigory Trubnikov, the First Deputy Minister⁵, was considered a reply

¹ Quoted from statement of A.Fursenko, the Assistant to the President of the Russian Federation, published by TASS. Source: Academic community discuss prospects of reorganization of scientific foundations. 05.09.2019. URL: <https://nauka.tass.ru/nauka/6847737>.

² N. Volchkova. Has the fate of RFBR been sealed? // Poisk, 20.11.2019. URL: <https://www.poisknews.ru/news/sudba-fondov-predreshena/>.

³ Academy appeals to the government // Scientific Russia. 11.09.2019. URL: <https://scientificrussia.ru/articles/akademiya-obrashchaetsya-v-pravitelstvo>.

⁴ An appeal of Russian scientists in defense of RFBR. Interregional Society of Researchers. 21.11.2019. URL: <http://onr-russia.ru/content/nauka-za-RFFI-press-release;> <https://trv-science.ru/2019/12/03/uchenye-protiv-reorganizacii-nauchnyx-fondov-v-rossii/comment-page-1/>.

⁵ Letter published on RAS website, news of 12.11.2019. URL: <http://www.ras.ru/tradeunion.aspx>.

to all applicants, containing arguments that the reorganization will be implemented and will be based on a step-by-step basis, agreed with the management of the two foundations, while panel discussions will take place in the course of transformation process. In other words, the decision was made without coordinating with main stakeholders and can not be challenged.

6.4.4. Plans and restrictions to attract young people to science

The “rejuvenation” of science due to an increase in the share of young researchers aged below 39 and became one of the main target indicators for the implementation of NP “Science” and the Strategy for Scientific and Technological Development. It should be noted that the share of young researchers in Russian science is already quite high and amounts to nearly 44 percent, however, the further involvement of young people is considered by the government as the platform for the sustainable development of science and the country's leadership in various rankings.

Meanwhile, there has been a tendency for three years in a row to reduce the proportion of young researchers under the age of 29, i.e. that cohort, which just characterizes the “influx of young people into science.” Over the past year, it fell by 1 percent, against just 2 percent over the period since 2010¹. There are many reasons for this phenomenon, i.e. from more challenging conditions for international cooperation to the growth of bureaucratization of science and pressure of bibliometrics. At the same time, scientific mobility as one of the instruments of international cooperation, attractive in particular for young people, will obviously significantly reduce in 2020 due to the unfolding pandemic.

Online forms of cooperation will succeed. The reduction of physical mobility can have an even more dramatic impact, that is, to decrease research productivity, however, it too early to assess such impact.

In 2019, the principal officially debated reason for the low influx of young people into science was the lack of systematic support measures for young researchers. It should be noted that the government implements quite a few measures to support young researchers, including special grants competitions, and the number of such incentives is growing. At the same time, the requirements for competitions differ, the definition of the concept “the young researcher” also differs depending on the incentive, while there is no data about the amount of money allocated to support young people and the effects of this measure.

The Accounts Chamber conducted an analysis of government support measures for young Russian researchers in 2016–2018 and noted this particular fact². This remark is fair and applies not only to youth programs, but also to most major government incentives: if cost indicators can still be calculated, then there are simply no estimates of effects, with rare exceptions. For example, according to the new version of the mega-grants program with the competition ended in November 2019, the number of young researchers should be half the number of the scientific teams without considering the subject and the tasks that have to be solved under megagrant.

Moreover, the program requires to annually increase the number of young researches at least by 2 percent³. However, this decision is not based on a platform that work will be more effective

¹ Calculations according to data: T. Ratay, I. Tarasenko. Academic staff: reduction trend is maintained //Science. Technologies. Innovations. Express-information. NRU HSE, 25.09.2019. p. 2. URL: https://issek.hse.ru/data/2019/09/25/1540060251/NTI_N_145_25092019.pdf.

² State support of young researchers is not systemic. 05.03.2019. URL: http://www.ach.gov.ru/press_center/news/36112?sphrase_id=11358263.

³ Results of the mega-grants competition summed up. 21.11.2019. URL: <http://www.p220.ru/home/news/item/1693-itogikonkurs2019>.

with this number of young people rather than when the boss determines the age parameters of the team.

That is why, it would be important to identify the incentives that have already proved their effectiveness, firstly among youth programs. Thus, for instance, what are the outcomes of the requirements determined by some grants competitions to mandatory include a particular number of young researchers among the performing team and to pay them at least the percentage of the total salary fund established by the rules, regardless of whether these young people really work well or only listed as grant recipients. However, another danger is evident: instead of analyzing success and failures, there is the centralization of incentives, the “fight against duplication”, and other approaches aimed at creating unique definitions and requirements formats¹. If the movement begins in this direction, it will suppress diversity, and the latter is critical for the adequate scientific activity.

The postgraduate education is partially related to the youth theme. Positive changes were observed in this area: the number of dissertation councils was reduced because a significant number of members of these councils did not meet the minimum requirements for publication activities over the past 5 years. In other words, they did not publish any scientific papers or number of their publications was either not sufficient or published not in the refereed journals. The dissertation council may continue working only if at least 90 percent of its members meet the requirements of the Higher Attestation Commission (HAC) in terms of publications². Thus, the remaining councils should not deal with poor quality theses. Actually, demands to postgraduates became tougher along with demands to members of the dissertation councils. This entailed a reduction in the proportion of candidates who defended their thesis on time. In the 2000s, the proportion of postgraduates who graduated from a university and defended their dissertation was around 31.5 percent, slightly varying depending on the subject, and currently, it has reduced more than half and constituted 12.7 percent. There was a similar reduction in respect of postgraduate education in research institutes, i.e. from 22.9 to 10.3 percent³. On the one hand, the observed trends should indicate an increase in the quality of education by reducing the number of ineffective dissertation councils and postgraduates.

On the other hand, the personnel “database” for attracting young people to science is declining, since the number of young candidates of science is decreasing annually. Thus, the task to attract young people to science remains non-trivial under declining influx, including those who have a Ph.D., and therefore more likely than a specialist without a degree, decide to commit to scientific activity.

6.4.5. Research and educational centers as a new priority

The topic of research and educational centers, being established under one of the federal projects of NP “Science”, was a centerpiece in mass media covering the development of science. The past year can be considered preparatory, since the platform and criteria for funding

¹ Ministry of Education and Science worked out measures aimed to improve the system of support of young researchers/TASS. 05.03.2019. URL: <https://nauka.tass.ru/nauka/6188550>.

² Ministry of Education and Science commented on the activity of over 320 dissertation councils/TASS. 19.08.2019. URL: <https://nauka.tass.ru/nauka/6775889>.

³ S. Martynova, A. Nefedova, I. Tarasenko. Development of highly qualified academic personnel: indicators of postgraduate education/Science. Technologies. Innovations. Express-information. 15.05.2019. URL: https://issek.hse.ru/data/2019/05/15/1507176995/NTI_N_128_15052019.pdf.

RECs were developed, the size of state subsidies determined, and approaches to the establishment of RECs developed (by and without competition, with and without budget financing).

There are plans to launch 15 RECs within three years (2019–2020), and the first 5 RECs were approved in 2019 without a competition. They were established in those regions where the Governors capacity and their interest to RECs were the highest.

Typically, the work on transformation of these centers has started in these regions long before all official criteria and rules of their selection were determined. RECs stacking” is a long process as the REC new model does not signify a university project compared to previous organization, rather, it is a large regional project involving a high number of stakeholders. They include universities of the region and beyond, research institutions, enterprises of a different size, regional administration. The fact that there is a basic university accommodating the REC without corporatizing, provides an analogy with the previous REC models..

The final working plans, membership and some other parameters of the first five RECs have not yet been approved by the government at the year end, however, the thematic focus of each of these centers and their specificity is generally understood.

The most developed concepts are the REC “Kuzbass” (Kemerovo region) and the West Siberian REC (uniting three regions: the Tyumen region, the Khanty-Mansi Autonomous Okrug and the Yamal -Nenets Autonomous Okrug).

In the Kemerovo region, it was easier to a certain extent to single out specialization and, therefore, to go through tasks and expected results in detail. This resulted in the project success. The incentive and the effort spent by the West Siberian REC on challenging coordination of interests of the three regions, made this REC special, while its activity was transparent and extensively highlighted in the media and social networks. Another three RECs are being establishes in Belgorod, Nizhny Novgorod regions and Perm Krai.

The initial concepts of the first five RECs show that every region clearly highlights its “smart specialization”, namely, the spheres, where scientific institutions and enterprises can work together, and their development is important for socio-economic prosperity of the region. Active position of the Governor provided for the success. It is more difficult to formulate specific tasks and target indicators. The tasks do not always evidently follow goals, while target indicators were very general as they were extracted from statistical reporting and from a number of target indicators of NP “Science”. Thus, with rare exception, indicators are not focused on identification of the development effects specific for this region. In this context, the project of the Perm REC stands positively apart presenting a list of possible socio-economic effects resulted from REC activity, such as the inflow of investments, new employment opportunities, living standards in the region.

The next five RECs will be chosen by competition to be apparently held in spring 2020, however, already in 2019 the following regions became known for their chances to win. Among them the Urals REC uniting Sverdlovsk, Chelyabinsk and Kurgan regions, RECs in Samara, Novosibirsk and Tomsk regions, REC “Eniseyskaya Sibir: Industry 4.0” in Krasnoyarsk Krai.

The elaboration of measures and criteria of the state support to RECs was going on throughout the year, but their final format has not been yet approved. The first one was the RF Resolution of the Government of April 30, 2019, № 537 “On measures of state support of the world-class scientific-educational centers based on integration of higher educational institutions and their cooperation with organizations acting in the real sector of the economy¹.” It states the

¹ URL: <https://www.garant.ru/products/ipo/prime/doc/72140532/>.

context of the program of the REC activity, the reporting indicators to be submitted as well as financial support provided in a format of subsidy and spent on fixed expenditures. Funds will be transmitted to the REC parent organization rather than to the regional budget. In terms of performance indicators, the REC program should indicate target indicators and indices, including those taken from NP “Science” (number of patents, number of articles, percentage of researchers under the age of 39 years, programs of additional professional education, etc.) Thus, initially the REC performance indicators are compared with the indicators related to the implementation of NP “Science”. This approach facilitates calculating results for officials, but makes it difficult to assess the real effects of the REC.

The financial models of the REC budget support have been constantly transformed. Initially, it was assumed that RECs approved on a non-competition basis, will receive government funding in 2020 after their real development success become visible¹, however, at the year end, the government decided to allocate them RUB 60 million each provided that these RECs will finally formulate and elaborate the programs of their development².

Another financial model related to REC development, the so-called “regional vector”, appeared, when the REC has been firstly proactively established at the regional level at its own expense, and then, if it develops successfully, claims federal support³. The Ural region first chose this path, but then decided to participate in the 2020 competition. It was replaced by the Samara region, but it quickly became clear that such a REC model would not “survive” without benefiting from special conditions provided by the government.

Thus, it is difficult for regional budgets to get involved in supporting universities due to the fact that predominantly they are federally governed⁴. Therewith, funds can be obtained from industrial partners, for example, the state corporations “Rostekh” and “Roscosmos” could become such partners for REC Samara. However, apparently this is not enough. Therefore, Alexander Fetisov, Deputy Chairman of the Government of the Samara Region, suggested introducing benefits and preferences for REC participants, such as tax incentives, customs duties for foreign manufacturers, preferential investment, short-term lending, etc⁵.

In addition to financial aspects, an issue was identified in the course of establishing RECs related to challenges in building the communication among the scientific community and business. It is a long-standing problem, but this time, representatives of regional administrations encountered it⁶. It is the disagreement of interest, and sometimes, inertia, self-centeredness of a number of stakeholders that became a stumbling block for those RECs that were not among the five elected but actively endeavored to develop their concepts.

¹ Conditions defined. World-class scientific-educational centers will not have any legal entity // Poisk, №20, 17.05.2019. p.2. URL: <https://www.poisknews.ru/skript/usloviya-ochercheny/>.

² Kotyukov: REC will receive grants support RUB 60 million each in the Russia’s regions //Russia’s future. National projects. 18.11.2019. URL: <https://futuresussia.gov.ru/nacionalnye-proekty/noc-v-regionah-rf-polucatan-grantovuu-podderzku-v-60-mln-rublej-kotukov>.

³ Ministry of Science and Education recommended the regions to finalize REC programs by June 27// Russia’s future. National projects. 24.06.2019. URL: <https://futuresussia.gov.ru/nacionalnye-proekty/585137>.

⁴ Y. *Vostretsova*. Intelligence for export. Urals regions will set up world-class RECs // Rossijskaya Gazeta 03.07.2019. URL: <https://rg.ru/2019/07/03/reg-urfo/tri-regiona-urala-sozdadut-nauchno-obrazovatelnyj-centromirovogo-urovnia.html>.

⁵ Alexander Fetisov spoke at the Federation Council suggesting RECs improvement //Information portal VolgaNews.ru 06.11.2019. URL: <https://volga.news/article/520515.html>.

⁶ M. *Starikova*. Officials failed to find criteria for scientific – educational centers //Kommersant .24.06.2019. URL: <https://www.kommersant.ru/doc/4011530>.

Finally, the determination of methods to assess the effectiveness of RECs has been and remains an issue, and last but not the least, there is still no answer to the question, whether RECs should cover the maximum possible number of various stakeholders or to make them more “compact”¹. It should be noted that building links between the scientific and business community is an issue for all countries, and it is studied not only by researchers, but also by such organizations the OECD.

In particular, the OECD, having studied the experience of 35 OECD member countries, identified 21 tools to accelerate the transfer of knowledge from science to industry². The following key trends were identified: (1) organizing intermediary organizations, including regional technology transfer centers; (2) joint knowledge production through inter-sectoral mobility inclusively, as well as engaging civil society institutions; and (3) digital transformation comprising establishment of an online community of experts, using such forms of collecting ideas and suggestions as crowdsourcing, as well as posting data on open platforms³.

So far, the study of the interactions between science and industry is carried out at the most general level in the context of the REC, although some RECs plan to develop digital approaches. For example, the Belgorod REC is going to create research and production platforms for the interaction between actors of the innovation system.

Thus, the deployment of an incentive having no clear rules and clearly articulated expectations gives dynamism to the whole process. In the future, it will be of interest to know which centers will more efficiently deploy their work, those created without a competition or others, established in accordance with all the rules on a competitive basis. The REC project is special because their establishment started almost a year before the basic rules, parameters and conditions of budget financing and the required REC elements were finally determined.

However, a direct connection was established from the very beginning between the Governor’s activity and the quality of the REC program. First of all, the REC represents a Governor’s initiative showing his capacity to work out an attractive project in the region. This, among other things, explains why the scientifically poor REC “Kuzbass” was included in the top five Centers selected in 2019 without competition. Thus, if success of the previous REC models was determined by the importance of the Rector position and the research team of the university at the stage of their development, now it is the position of the regional authorities that is critical.

In addition to REC, the NP “Science” suggests to establish centers of two other types, i.e. World – class research centers including mathematics and genome research, and STI (CC STI) Centers of competencies. Centers have their own specifics from the point of knowledge production (basic or applied research or developments) and, therefore, the extent of interaction with industry.

World-class research centers were selected according to competition in 2019, and as a follow up it was announced that 4 centers of mathematics and 3 genome research centers will receive funds. All centers are being established as consortium of research institutions, mostly in partnership with the universities. Both competitions were organized almost unnoticed and without consideration, as the scheme of a consortium research center has been already tested and it is rather simple compared to REC, while scientific community did not express any

¹ E. Mischenko. “Looking at the schedule without falling in love: “what is the progress against the first RECs // Indicator, 25.06.2019. URL: <https://indicator.ru/engineering-science/pervye-nots-bez-vlyublennosti.htm>.

² OECD (2019), University-Industry Collaboration: New Evidence and Policy Options, OECD Publishing, Paris. P.20. URL: <https://doi.org/10.1787/e9c1e648-en>.

³ Ibid, p. 21–22.

objections or surprise against the winners. In contrast with REC, support of the world-class research centers will be funded from the budget only. In 2019, funds allocated to centers of mathematics amounted to RUB 80 million per center and will double in 2020. Genome centers will receive more funds, about RUB 200 million each on the average, while it total it is expected to allocate RUB 3.7 billion to all centers for a period of 6 years (2019–2024)¹. Due to the spreading pandemic, the main focus in 2020 will probably be on establishment of new centers according to “Grand Challenge” problematics in the field of virology and epidemiology. The fight against new coronavirus is a new challenge. At the same time, this will mean the end of exclusive work on these topics².

On the other hand, the CC STI have been set up already in 2018, and in 2019, their activity has just started. The main challenge is to propose projects attractive for industry. Every center should attract significant extra-budgetary funds and, therefore, cooperation with enterprises is one of their principal functions.

6.4.6. Publishing activity and plans to transform Project 5-top 100

Publishing activity is one of the key parameters to assess implementation of the NP “Science” Strategy of scientific and technological development, performance of universities pretending for leadership and participating in the Project 5-top 100. Last year, public and government attention to bibliometric assessment remained very high. However, there were no changes proving any quantum shifts in scientific performance. Russia moved up from the 11th to 12th place over the past 15 years per number of publications indexed in the Scopus database, although, there were “gap years”, when the country was on the 15th or 16th place (2007–2014)³. According to the number of scientific publications, Russia belongs to the same group as such countries, such as Australia, Brazil, Iran and South Korea. Physics and Astronomy, engineering sciences, material engineering, chemistry and mathematics, were the subjects with the highest number of publications by the Russian scientists, traditional for the Soviet and Russian science, and they have not changed over the last 5 years. It proves conservatism and, consequently, lack of such programs and projects, which would change the balance of disciplines.

In terms of quality of scientific performance, partially determined by citation rate, Russia demonstrates results below world average in most disciplines. However, the citation rate of Russian publications slightly increased compared to 2012 and cited more frequently. A more detailed inter-disciplined analysis confirms the remaining “niche” featuring development of the Russian science, highlighting only hyper-focused areas with citation rate above world average. Unfortunately, Russia is a different record holder, as it is leading along with Ukraine at self-citation. If the world average self-citation median level constitutes 12 percent, it is worth 36

¹ Billions bill. The size of state support for world-class centers has been determined. // Poisk, №44-45, 08.11.2019, p.6.

² It turned out that only State scientific center of virology and biotechnology «Vektor» in technopolis Koltsovo, Novosibirsk region possesses required pipeline to develop testing and vaccines. That is why, the laboratory of the Antibubonic Center in Moscow is being rapidly reequipped. *Source*: Antibubonic Center will be reequipped to do laboratory testing // TASS, 15.03.2020. <https://tass.ru/moskva/7984949>. Moreover, university laboratories, i.e. MSU and Kazan Federal University, started parallel development of vaccines. *Source*: “It may appear by summer in the developed countries”. Who develops vaccine against coronavirus and when it can be expected // ZNAK, 18.03.2020 г. URL: https://www.znak.com/2020-03-18/kto_razrabatyvaet_vakcinu_ot_koronavirusa_i_kogda_ee_zhdat

³ E. Erokhina. Russian science in Scopus and WoS: quantity or quality // Indicator, 08.02.2019. URL: <https://indicator.ru/engineering-science/rossijskaya-nauka-v-scopus-i-wos-kolichestvo-ili-kachestvo.htm>.

percent in Russia¹. China and Japan, for comparison, are in line with the world average median level of self-citation, while scientists from the USA and Great Britain self-cite far less often. Thus, meanwhile, accelerating the publication race brings modest positive and tangible negative results.

In general, the issue of tolerance to various ethical violations associated with the publications and preparation of theses is escalating in Russian science, and it can have a long-term negative effect on the quality of scientific performance. According to NRU HSE monitoring data, only 54.3 percent of the university teachers support retraction of the academic degree for plagiarism². In other words, half of the Russian academic teaching staff considers plagiarism to be the norm not deserving punishment.

All the more remarkable was the initiative for retraction of scientific articles, launched at the end of the year. The RAS Commission for Combating Falsification of Scientific Research announced that over 850 articles from 263 Russian journals were retracted³, and more than 2.500 articles in total found in 541 Russian scientific publications subjected to retraction. Moreover, according to Dissertnet, the scale of the disaster in terms of articles containing false results, plagiarism or self-plagiarism is even higher, i.e. estimating at 150 thousand articles⁴.

Scientometrical success was the most significant among the universities of the 5-top 100 Project compared to the average Russian one (according to Scopus)⁵. Scientists from these universities more often publish articles in the journals of the first quartile, i.e. having the highest impact factor. It is noteworthy that higher productivity can be achieved inclusively due to international cooperation, for which these universities have more funds than former academic research institutes and other universities.

The share of international coauthored publications accounts for 35 percent at the universities included in the Project 5-top 100 against 25 percent an average of the Russian science. However, the recent evaluation of the universities under Project 5-top 100 showed that the scale of their international cooperation is stable, while Chinese universities demonstrate constant growth⁶. Universities participating in the Project could not surpass yet two leading Russia's universities, that is, the MSU and the St. Petersburg university, by indicators of scientific performance.

The Project 5-top 100 universities, and there are 21 of them currently, consistently break into three equal leading groups, actively developing and demonstrating modest success. Group membership has not changed since 2018. Perhaps, this “stability” is partially associated with tremendous difference in the universities funding: the strong become even stronger receiving annually around RUB 900 million each from the government in addition to their basic funding of state assignment and subsidies for other purposes; the “average” get twice less, around

¹ *Van Noorden R., Chawla D.S.* Hundreds of extreme self-citing scientists revealed in new database // *Nature* 572, 578-579 (2019), August 19, 2019. URL: <https://www.nature.com/articles/d41586-019-02479-7>.

² *V. Rudakov, Y. Roschina, L. Bitokova.* Changes of strategies, motivation and economic behavior of students and teachers of Russian universities. Information newsletter. Moscow: National Research University “Higher School of Economics”, 2019. (Economics of education monitoring; № 1 (133). p. 22.

³ *S. Belyaeva.* Chain retraction // *Poisk*, № 1-2, 17.01.2020. p. 3.

⁴ *Chawla D.S.* Russian journals retract more than 800 papers after ‘bombshell’ investigation // *Science*, January 8, 2020. URL: <https://www.sciencemag.org/news/2020/01/russian-journals-retract-more-800-papers-after-bombshell-investigation>.

⁵ *E. Erokhina.* Russian science in Scopus and WoS: quantity or quality // *Indicator*, 08.02.2019. URL: <https://indicator.ru/engineering-science/rossijskaya-nauka-v-scopus-i-wos-kolichestvo-ili-kachestvo.htm>.

⁶ Data presented by M. Fatkhullin., Director for cooperation with public authorities Elsevier S&T в Москве. Source: Session “Scientometrics” 2.0: digital resetting”. The Gaidar Forum, 15.01.2020.

RUB 450 million per year, while the laggards will hardly significantly improve their positions, receiving RUB 120–130 million per year. The universities will receive approximately the same amounts n year¹.

Formulating new goals and parameters of the Project 5-top 100 became an important change of the year mostly marked by expansion and diversification of participants and lowering the standards of the universities performance. The universities will strive to take top positions in the industrial or discipline rating rather than compete globally. Only “leading” universities under Project 5-top 100 (it is expected that there will be 10 of them)² will be focused on continuing growth in global ratings, however, the goals will be modest, i.e. to be in top 1000 at least for two years in row rather than in top 100 in any of the institutional ratings. There are plans to increase the number of the Project 5-top 100 participants up to 30 in 2020, having reviewed the composition of universities though announcement of a new competition. In this respect, the regional focus will be strengthened, as it is expected that universities representing at least 10 regions will participate in the project. Sectoral and regional universities will be focused on transformation in regional centers of excellence (the task is slightly similar to the REC idea). Thus, the new format of the Project 5-top 100 will be more closely associated with NP “Science”, the regional vector in scientific and technological policy will increase, however, the performance requirements will be lowered while maintaining the level of budget funding. Greater attention to regions is important for equalizing conditions and increasing competition within the country, however, simultaneous lowering of standards within the international scale indicates focusing on self-involvement and internal issues, despite manifesting the importance of leading global positions in a number of parameters enshrined in NP “Science”.

6.4.7. RAS as an expert institution

The RAS activity was noteworthy in three aspects: the expertise of scientific projects carried out on state assignment, formulation of a new basic research program and RAS elections, organized in a new way, in terms of greater transparency and information about candidates for positions of RAS academicians and corresponding members.

Expertise of scientific reports

Apparently, promoting the idea to assign RAS a status of the main national expert institution, RAS leaders meant an expertise of major government decisions, strategies, participation in foresights and other important types of activities that should be carried out by outstanding national scientists, rather than routine assessment of tens of thousands of reports on state assignments and other projects that were held at the budget expense. This task, that RAS eventually began to carry out, is both laborious and uninteresting.

Therewith, the information on the scale of this expertise differed from source to source. Thus, according to Alexey Khokhlov, RAS Vice-President, the annual expert load on the Academy amounts to 50–70 thousand reports³ on state assignments, while according to

¹ T. Vozovikova. Reaching the unreachable // Poisk, №44-45, 08.11.2019. p. 14.

² Number of the Project 5-top 100 participants will grow to 30 as from 2020. TASS, 19.11.2019. URL: <https://nauka.tass.ru/nauka/7150681>.

³ N. Demina. Scientists have to be liberalized // Troitsky variant-science, № 288, 24.09.2019. p. 4–5. URL: <https://trv-science.ru/2019/09/24/uchenyx-nado-raskrepostit/>.

Alexander Sergeev, it is up to 30 thousand¹. By the end of the year, when results of the first expertise of 2018 reports were discussed, it fell to 17 thousand expertise (this information also provided by RAS President)². If we take the last figure for the actual amount of work, it turns out that the estimated data on the amount of expert work were exaggerated by about 3 times. It is evident, though, that the main burden of conducting the expertise fell on the RAS professors rather than on academicians and corresponding members. 500 professors of the Russian Academy of Sciences conducted 6 thousand expertise³, and 2,000 academicians and corresponding members carried out the remaining 11 thousand. Thus, professors had an average of 12 expertise each and RAS members did the half. Professors are considered the “reserve” of the Russian Academy of Sciences, the source of its rejuvenation, and, apparently, this explains their higher expert load.

The expertise of the universities reports for 2018 has not been completed by April 2019⁴, causing negative reaction of the organizations falling within RAS assessment, as it delayed allocation of 2019 budget funds. Rectors of the universities, especially, the leading ones, publicly complained not only about RAS slow performance, but also about RAS being the institution conducting this expertise.

The most serious accusation was that the Academy was “biased” about expertise, showing favoritism in favor of projects carried out at former academic institutes, and accordingly underestimating universities. This attitude is partly explainable, because RAS representatives made direct or indirect statements about the weakness of university science compared to academic one. However, the accusation of bias towards the academic expertise turned out to be unfounded: according to the results of assessments, both for research institutes and universities, the proportion of rejected reports, according to the RAS Vice-president Alexey Khokhlov, amounted to about 7 percent⁵. This is a very modest figure, especially taking into account that the level of science in ordinary Russian universities is indeed quite weak. Thus, the expertise was carried out either formally or rather humanely.

Disproportionate funds expenditure by the former Ministry of Science and Higher Education on scientific and methodological support was a rather surprising result of the expertise, which was carried out by subordinate (not former academic) organizations. Actually, it was about solutions of tasks to provide services to the Ministry and not about implementation of scientific projects. About 25 percent of all funds allocated by the Ministry to scientific organizations and universities have been spent on appropriate services⁶. Thus, it occurred that it was not the Academy but the Ministry that ineffectively spends budget funds.

Despite all challenges related to conduct of the expertise, the RAS leaders aim to continue and improve the procedures, as, according to RAS President, it will be possible to “submit a

¹ A. *Emelyanov* RUS still has hopes//Rossijskaya gazeta, № 166, 30.07.2019. URL: <https://rg.ru/2019/07/30/akademik-strategicheskoe-prognozirovanie-mozhet-stat-vazhnejshoj-funkciej-ran.html>.

² RAS President criticized unwillingness of academicians to deal with expertise //TASS, 29.11.2019. URL: <https://nauka.tass.ru/nauka/7227353>.

³ Source data: *E. Mischenko*. “Nobody has brains except RAS”: sad paradoxes of the RAS Professors meeting // Indicator, 29.11.2019. URL: <https://indicator.ru/humanitarian-science/mozgov-ni-u-kogo-krome-ran-net.htm>.

⁴ About 2.7 thousand research works expect expertise in order to get funding // TASS, 27.03.2019. URL: <https://nauka.tass.ru/nauka/6264322>.

⁵ Interview with Alexey Khokhlov. Poisk, 07.06.2019. URL: <https://www.poisknews.ru/skript/strasti-po-ekspertize/>.

⁶ On projects expertise under State assignment by subordinate organization of the Ministry of science and education of Russia. 08.04.2019. URL: <http://www.ras.ru/news/shownews.aspx?id=c3fdfe2c-2e06-4369-9f6b-80afb64a3097>.

proposal to draft a law on RAS as of a State Academy”, if the expertise is conducted well¹. In this regard, there are plans to, first of all, more actively involve foreign scientists, members of RAS², in expertise process and to establish own information system, centralizing and facilitating the expertise of reports. It seems that RAS leaders do not wish to use the existing infrastructure, for example, Center of information technologies and systems of government bodies³. However, the project to set up such a system is under consideration, as the Academy does not have funds for its development⁴.

Program of long-term basic scientific research in the Russian Federation

In October, the RAS submitted draft program of basic scientific research (PBSR) covering all basic research in Russia funded by the federal budget. This is an “umbrella” program including projects and activities implemented also within NP “Science” as well as programs of government research foundations.

The most significant part of the program comprises the description of thematic trends of research, described according to the RAS traditional pattern of distribution by scientific disciplines. Taking into consideration the presented trends of research, it is not possible to link them with priority areas of development at the state level and assess their contribution to socio-economic development. The topics listed in the PBSR project most likely appeared as a result of summing up the areas in which research is being conducted at former academic institutes.

However, financial parameters of the program and the assessment indicators of its effectiveness are the most remarkable.

The main wish of the draft program is a twofold increase in the cost of basic research from the federal budget. However, this is not feasible, since it will result in a significant imbalance in the structure of budget financing of R&D. Budgetary allocations for basic research account for about 40 percent of civilian R&D.

If we make comparison with countries that have developed basic science, then there is about the same proportion of the costs aimed at basic research financed from budgetary funds. For example, in the United States 42.7 percent of the total federal budget expenditures go to R&D⁵, to support basic research, and currently a debate has been initiated claiming that this is too much⁶.

Meeting the request to double expenditures would mean directing all the R&D appropriations exclusively to support basic research. This is not only unrealistic, but also extremely dangerous, since the “applied” component of R&D in Russia has been so far poorly developed and resulted in a low level of R&D commercialization, and therefore a small contribution of science to the economic development of the country.

¹ Meeting of RAS Presidium 21.05.2019. Scientific Russia. URL: <https://scientificrussia.ru/articles/zasedanie-prezidiuma-ran-21-05-2019-pryamaya-translyatsiya>.

² E. Mischenko. “Now you have these functions, let us implement them” // Indicator, 26.06.2019. URL: <https://indicator.ru/humanitarian-science/ran-funktsii-vlast.htm>.

³ Center of information technologies and systems of government bodies.

⁴ A. Emelyanov. RAS still has hopes PAH // Rossijskaya gazeta, № 166, 30.07.2019. URL: <https://rg.ru/2019/07/30/akademik-strategicheskoe-prognozirovanie-mozhet-stat-vazhnejšej-funkciej-ran.html>.

⁵ Federal R&D. In: The State of U.S. Science and Engineering 2020. Science and Engineering Indicators. NSB, January 2020. Figure 20. URL: <https://nces.nsf.gov/pubs/nsb20201/u-s-r-d-performance-and-funding#federal-r-d>.

⁶ Sarewitz D. Necessary but not Sufficient? // Issues in Science and Technology. Winter 2020. Vol. 36. No. 2. P. 17–18.

At the same time, it is proposed to increase funding of the RAS as a budget institution by 3 times in comparison with the current level (up to RUB 13 billion by 2026). According to draft federal budget, the appropriations for the Academy will amount to RUB 4.4 in 2020, which is quite sufficient, given the fact that the RAS does not have subordinate institutions and spends the allocated funds to ensure its own work, as well as to pay fees to international organizations on behalf of the Russian Federation. The draft program does not explain the purposes for such a substantial increase in funding. Finally, it is proposed to evaluate the effectiveness of the program by 6 indicators with some of them corresponding to those used in NP “Science”:

- 1) number of researchers under the age of 39;
- 2) cost of basic research in GDP;
- 3) Russia's place in the share of articles in priority areas;
- 4) number of scientific specialized areas where Russia is among top ten;
- 5) number of major international programs implemented in the Russian Federation;
- 6) number of PhD and doctoral theses.

Among the listed indicators, the index of effectiveness can be attributed only to the indicator of leadership in a number of scientific areas. This is really relevant, since a “niche” science has been essentially formed in Russia, and quality research in highly- specialized areas are not available in every discipline. The remaining listed indicators are either resource (researchers, funding, dissertations), or process indicators (number of international programs, percentage of articles).

The program will probably be updated, however, the presented project is notable for the ongoing tradition and style of preparing academic documents, comprising indispensable long descriptions of thematic areas and poorly reasoned requests for increased budget funding.

RAS elections

RAS elections held in November, were called “unprecedentedly transparent”. Actually, they were more transparent, as the information about scientific performance of candidates to the position of RAS academicians and corresponding members (including bibliometric data) was publicly available. The President of the Russian Federation said that this time there were no candidates having no outstanding merits in science¹. Meanwhile, the ample public discussion took place precisely in connection with the inadequate or non-existing scientific merits of a number of candidates. Data on such personalities were presented in a report prepared jointly by the Dissernet and the RAS Commission on Combatting the Falsification of Scientific Research. According to the report, the works of 56 candidates for position of RAS academician and corresponding member showed signs of plagiarism and pseudoscientific allegations². The report caused a mixed reaction at the RAS, the RAS departments considered it, and as a result, 22 candidates from this list were nevertheless recommended for election.

The age of academicians and corresponding members was unexpectedly debated in connection with the RAS elections. The impetus to the discussion was sent by the President of Russia, who noted that at the last elections the newly elected members were younger³. In fact, the average age of academicians and corresponding members was quite respectable, 75 and 68

¹ Meeting with Alexander Sergeev, the RAS President. 12.11.2019. URL: <http://kremlin.ru/events/president/news/62016>.

² URL: <http://kpfran.ru/2019/09/23/doklad-komissii-kandidaty-v-chleny-korrespondenty-i-akademiki-ran/>.

³ Meeting Alexander Sergeev, President of the Russian Academy of Science. 12.11.2019. URL: <http://kremlin.ru/events/president/news/62016>.

years respectively. The age of candidates was lower, 67 and 59 years respectively¹. Thus, “rejuvenation” does take place in RUS but at a low pace. Probably, it would be possible to move in this direction faster, if the reserve is involved, i.e. RUS professors (they should be not older 50 when this title was awarded), and start moving away from the practice to elect to the Academy primarily those who occupy high administrative positions in research organizations and universities. However, the age issue is not that important as such, but it matters in connection with the functions that the Academy should perform. For members of the Honorary Club, age is not important, however, it matters for experts of strategic and innovative solutions.

6.4.8. Conflicting signals: appeals for internationalization vs growth of autarchy

It is impossible to achieve leadership positions under the autarchy of science, and, therefore, the goals of NP “Science” and the Strategy of scientific and technological development (SSTD) alone imply internationalization and international cooperation. The calls for the internationalization of science signify a kind of meme, since the programs to promote Russian universities and to strengthen and develop their research activities has already started. However, despite an almost 15-year history, there is still no clearly articulated vision of the government on the specific goals, which require internationalization in the field of Russian science.

Wording related to internationalization, its importance for promotion in a variety of ratings are definitely present in various government documents, but its essence, while the rating position cannot be an essence, has been poorly disclosed. However, it is not forbidden for each institution and university to independently decide how to develop internationalization. Agencies are also differently involved in this process. For example, there are about 12 percent of foreign scientists among the RRF, however, it is not known how many of them are actually involved in the expertise². On the other hand, RFBR makes no provisions for the international expertise of Russian scientific projects.

However, an external context setting the scope of red lines exists and dominates more and more. Current laws of the Russian Federation “On Foreign Agents” (No. 121-FZ dated July 20, 2012) and on unwanted foreign organizations (No. 129-FZ dated May 23, 2015) served as an example of typical external impact, resulted in the winding-up of a number of representative offices of foreign funds and the termination of international scientific cooperation programs.

The attitude towards non-commercial organization (NCO) receiving funds from abroad and rendering their assistance to science has not changed in 2019. This support was called “destructive”, and sphere of education (including universities receiving most of these funds³) was highlighted in this context. Moreover, the NCO reporting became even tougher: they have to report not only on available sources of funding from abroad, but also whether the organizations that provided donations, have foreign sources of funding. Among international programs, that surprisingly fell out of favor, was the prestigious British Chevening program,

¹ Ibid.

² Russian Research Foundation. Information on the Foundation activity in 2018. p.18. URL: http://rscf.ru/fondfiles/other/rsf_in2018.pdf.

³ Putin was Only told about “undermining” foreign funding of Russian universities. 11.03.2019. URL: <https://www.rosbalt.ru/russia/2019/03/11/1768675.html>.

because opinion leaders having “liberal values”¹ are virtually trained using education of postgraduates. Similar rhetoric was also typical with regard to Fulbright's most prestigious American science programs².

However, the most sensational event in this series were “recommendations” of the Ministry of Science and Higher Education of the Russian Federation on interaction with international organizations and reception of foreign citizens in organizations subordinate to the Ministry. Formally, they were put into effect in February 2019, however, public attention burst only in August, and the scandal developed intensively and even resulted in official letters sent by various societies, including international (scientific societies of Great Britain and Germany)³. Such a widespread response to the ministerial “recommendations” was associated with their style, written in the spirit of the Soviet instructions, dating back to the times, when any communication with foreigners was suspicious and condemned. In particular, the Ministry instructed to hold meetings between Russian and foreign scientists only after obtaining special permission from the leadership and then prepare a report to be sent to the Ministry of Science and Higher Education.

If meetings take place at institutes or universities, they should be held in specially designed and specially equipped rooms, foreigners should not use technical means allowing to process information, including mobile phones⁴, and at least two Russian scientists should be present at the meeting. According to the official interpretation of the ministry representatives, the drafted document is only a recommendation and aimed solely at accounting rather than control.

However, these “recommendations” contributed to aggravation of international scientific cooperation and negatively impacted on the Russia’s image. It is noteworthy that a number of universities accepted “recommendations” as a guide for action. And that made sense, as despite the criticism and all sorts of appeals and letters, the “recommendations” have not been officially abrogated as at the yearend. The counter reaction was launched in the USA, the key scientific partner of Russian scientists, along with Germany, France and Great Britain⁵. The US Department of Energy followed by the National Science Foundation and National Institutes of Health started to track and restrict cooperation of their researchers with colleagues from China, Russia, Iran and Peoples Democratic Republic of Korea. Getting funds for research purposes from these countries became a sensitive subject for the USA. Therewith, the Department of Energy pursues the toughest policy prohibiting laboratory employees to participate in the

¹ *E. Sizov*. British Foreign Office uses pseudoscientific program Chevening to train enemies of Russia. 23.11.2019. URL: <https://slovodel.com/540633-britanskii-mid-ispolzuet-psevdonauchnuyu-programmu-chevening-dlya-podgotovki-vragov-rossii>.

² *M. Tsepelev*. The USA use educational programs to transfer Russia into a new colony 28.10.2019. URL: <https://riafan.ru/1223106-ssha-ispolzuyut-obrazovatelnye-programmy-dlya-prevrasheniya-rossii-v-novuyu-koloniyu>.

³ *N. Vedeneeva*. Foreign scientists wrote a letter to Mr. Kotyukov, Minister of Science and Higher Education// Siberian science news 21.10.2019. URL: <http://www.sib-science.info/ru/news/inostranye-uchenye-napisali-pismo-glave-minobrnauki-20102019>.

⁴ Ministry of Science and Higher Education decided to track meetings of Russian researchers with foreigners. 14.08.2019. URL: <https://www.rbc.ru/society/14/08/2019/5d53e60d9a79471f5c462313>.

⁵ Share of joint works of Russian and American researchers is the highest and constitutes 8.7 percent in the total amount of articles by the Russian authors, 8.1 percent with German colleagues, 5.1 percent with French and 4.7 percent with British colleagues. *Source*: Russian science by numbers /*V.V. Vlasova, L.M. Gokhberg, E.L. Dyachenko et al.* National Research University “Higher School of Economics”. – M.: NRU HSE, 2018. p. 13. URL: <https://issek.hse.ru/mirror/pubs/share/215179745>.

Russian programs and travel to profile events on invitations from Russia¹. Some universities may also suffer from interaction with Russia: for example, the US Department of Education demanded that the Massachusetts Institute of Technology (MIT) provide information about all contacts with Russia and the funding received, in particular from the Skolkovo Foundation. Indeed, MIT received substantial funds (about \$ 350 million)² for assistance in establishing Skoltech – the Skolkovo Institute of Science and Technology. Despite the fact that these are “just checks,” they help American universities to exercise greater caution when interacting with Russia.

It is not surprising that internationalization in science, even in formal terms, is poorly developed with this combination of external factors. Thus, the indicators of university reporting based on monitoring results prove that, for example, in 15 of the 21 universities participating in the 5-top 100 project, the share of foreign professors did not exceed 5 percent, and in the remaining 6 universities there were more than 6. 5 percent. This is just a little, and the indicators of internationalization will drop significantly after recalculating the proportions including the “researchers” (they are statistically accounted separately from the scientific and pedagogical employees).

It has to be taken into consideration that it is rather difficult to interpret the presented data, as one indicator comprises those who arrived for 3–4 months as well as others performing a long term, at least one-year contracts. These foreigners are totally different, they differ by depth of immersion in Russian science and, apparently, by different effects from their work. It is also important to note that the invitation of foreign specialists to work in research institutes and universities is still exclusive and is not part of the routine hiring policy. For example, the mega-grant program, assuming work of foreign researchers in Russia for 4 months a year (3 months from 2019), indicates that even having special and generous funding, we are talking only about short-term visits of foreign researchers to Russia, and the hiring contractual multiyear process adopted by the developed countries is not discussed as a possible mass procedure.

The evaluation of projects results involving foreign partners becomes relevant. An independent study held in the end of 2019, aimed to assess results of research benefiting from mega-grants issued between 2010–2017, based on exemplary laboratories of a physical and biological profile, showed that only about 20 percent managed to publish more articles than efficient Russian laboratories. At the same time, in about a quarter of laboratories, productivity was lower than that of the average effective Russian scientific group in the field of natural sciences³. After mega-grant expiry, only about one third of laboratories continued cooperation with the guest leader, while active teams received new funding aimed at mutual cooperation after mega-grant expiry⁴. There was a critical observation made in respect of mega-grants that were largely won by teams that were quite successful in obtaining financing, but this did not provide an equally high level of results. It is true that there are arguments being debated abroad that it is wrong to estimate academic results by volumes of attracted funding, since such an

¹ *E. Molokanov*. Laboratories under lock and key // Kommersant, 18.03.2019. URL: <https://www.kommersant.ru/doc/3910236>.

² *G. Taltaev*. US authorities demanded reports on contacts with Russia and China from universities //RBC, 20.11.2019. URL: <https://www.rbc.ru/politics/20/11/2019/5dd575af9a7947234bf2dd98>.

³ *G. Tsirlina, M. Feygelman., E. Malinkina*. In the wake of mega grants-1 //Troitsky variant-Science, 2019, № 294, 24.12.2019. p. 2. URL: <https://trv-science.ru/2019/12/24/po-sledam-megagrantov-1/>.

⁴ *G. Tsirlina, M. Feygelman., E. Malinkina*. In the wake of mega grants-2 //Troitsky variant-Science, 2020, № 295, 14.01.2020 г. С. 4. URL: <https://trv-science.ru/2020/01/14/po-sledam-megagrantov-2/>.

indicator is toxic, and researchers spend more time writing applications and projects¹, which distracts from actual researching.

There is also an internal problem of internationalization: if the academic teaching staff lacks knowledge of foreign languages, has no publications in foreign journals and not presenting at the international conferences, this is a sign of autarchy rather than the impact of external constraints. The NRU HSE monitoring of the economics of education conducted in 2019, showed that only around 10 percent of the universities teaching staff has a good command of a foreign language (according to self-assessment) and nearly 15 percent are well enough. This is a very small part of the scientific and educational community². However, despite the significant increase in the number of those who began to publish scientific articles, only 13.5 percent have publications abroad, and very few, 4.5, speak at international conferences³. By all means, financial factors restrict participation in international conferences, but they cannot solely justify such a low representation of Russian scientists at international scientific events.

The pandemic will inevitably reduce the intensity of international relations due to the transition to online modes. In turn, this can become a catalyst for changing the formats of international conferences, with a tendency to move from multi-thousand symposia and forums to more local thematic conferences.

The events dating back to the beginning of 2020 also show that countries began to isolate from each other and work on their own instead of joining scientific efforts striving to find solutions to fight against coronavirus.

This turned out to be especially typical for the USA and EU countries. The consequences of this policy can have long-term effects in terms of declining trust and challenges to get cooperative ties back on track.

The net effect is that the balance of incentives (financial and administrative) and barriers is not yet in favor of expanding international cooperation.

6.4.9. Innovation activity

The technological innovation pattern has not changed significantly compared to the previous year, however, according to a number of parameters it has more likely deteriorated. Thus, Russia retained its 46th place (out of 129 countries) in the Global Innovation Index, but the balance of “resources-results” has shifted in favor of resources. According to the indicator of resources invested in the development of innovations, the country moved up from 43rd to 41st place, and in terms of innovation activity results fell from 56th to 59th place. Thus, with an increase in the volume of resources invested in the development of innovations, the output in the form of concrete results decreases.

The institutes remain the weakest points of Russian innovation system, i.e. legislative platform, political stability, performance regulator, rule of law and infrastructure including compliance with ecological standards⁴.

¹ A call for funders to ban institutions that use grant capture targets. 20 July 2019. URL: <http://deevybee.blogspot.com/2019/07/a-call-for-funders-to-ban-institutions.html>.

² V. Rudakov, Y. Roschina, L. Bitokova. Change of strategies, motivations and economic behavior of students and teaches of the Russian universities. Information bulletin. – Moscow: National Research University “Higher School of Economics”, 2019. (Monitoring of the economics of education; № 1 (133)). p. 11.

³ Ibid, p. 16.

⁴ V.V. Vlasova, V.A. Rud. Global Innovation index-2019 // Science. Technologies. Innovations. Express-information. NRU HSE, 24.07.2019. URL: https://issek.hse.ru/data/2019/07/24/1481487665/NTI_N_137_24072019.pdf.

Public funds kept replacing private ones. If public venture capital investments grew by 60 percent compared to the previous year, private ones almost halved (with their initially substantially smaller size)¹. Among the state investors, the most active were the Russian Direct Investment Fund (RDI) and the Russian Venture Company (RVC). The fall of foreign investment in venture projects was the most dramatic decreasing by 7 times over one year (from RUB 12.6 billion in 2018 to RUB 1.8 billion in 2019).

Not surprisingly, enterprises, especially major ones, kept aiming at budgetary innovation, i.e. development of technological innovations at the expense of state funds. A survey conducted by NRU HSE among the leaders of 545 enterprises in high-tech industries showed that targeted subsidies in the framework of state and federal targeted programs were the most popular among companies of all sizes. The second most important measures related to non-financial support, such as information and state advisory support.

Herewith, large and medium-sized companies expressed their interest towards non-financial support more often than small businesses, although most of these tools have been developed with the aim to support the sector of small innovative entrepreneurship. Finally, the third priority measure is again the state funding distributed only through state development institutions². It is noteworthy that among large companies there was the largest share of those that used instruments of state support: 72 percent versus 45 percent (medium-sized companies) and 42 percent (small businesses). Another research “Startup barometer 2019” partially explains this result. Reportedly, 39 percent of startups are disappointed about the instruments of state support, including through development institutions, as according to their arguments, they do not get any tangible benefit³.

Moreover, the number of instruments suggested by state development institutions is growing. Thus, last year, RBC announced new initiatives aimed at enterprises participating in the implementation of the National technological initiative. For these purposes, various “support packages” are suggested depending on the type and the focus of enterprises. Among them there is a program focused on support, to be provided to high export capacity companies. Its participants will benefit from grants and subsidized interest rate on loans as well as non-financial assistance. Another program focuses on major enterprises creating spin off, and they will be stimulated by a subsidized interest rate on loans and a number of non-financial measures. At the same time, the RBC management underlined that the main accent will be in favor of supporting those enterprises that are not only export-oriented but also capable to win considerable proportions at global markets⁴.

As has been demonstrated globally, focusing on export-oriented high-tech business aimed at economic development has been justified. However, companies of this particular category mostly depend on imports in Russia: for example, dependence on imported parts and elements is typical for 82 percent of enterprises, machinery and equipment for 70 percent, foreign

¹ Who invested in startups in 2019 and how much // Inc. 18.12.2019. URL: <https://incussia.ru/understand/vc-2019/>.

² V.V. Vlasova, T.E. Kuznetsova, V.A. Rud. Demand for instruments of state innovation policy from high – tech industry enterprises // Science. Technologies. Innovations. Express-information. NRU HSE 04.07.2019 . URL: https://issek.hse.ru/data/2019/07/04/1477949063/NTI_N_134_04072019.pdf.

³ P. Smertina. Nobody will help startup. // Vedomosti, 05.2019. p. 15.

⁴ RBC will provide business with up to RUB 500 million to support developing NTI projects // TASS, 28.05.2019. URL: <https://nauka.tass.ru/nauka/6478839>.

technological solutions for 68 percent¹. Respectively, debates on the benefit and harm of import dependence and import phase-out are not abating. Dependence on imports helps to improve quality and competitiveness of enterprises. Imports phase-out results in losing competitiveness because, as a rule, it is a challenge to make a substituted product of the same or better quality. An oft-repeated counter-argument is that dependence on imports threatens the national security, raises vulnerability, especially for defensive applications. However, the issue is more in the discussion zone, since it is extremely difficult to change the situation substantially.

Moreover, along with the introduction of new programs for enterprises participating in the National Technological Initiative (NTI), the Government of the Russian Federation issued the Decree restricting to transfer technologies developed with public funds to foreign legal entities and Russian legal entities with the share of foreign participation in the authorized capital amounting to over 50 percent². In case of violation of this requirement, all public funds must be returned to the budget, and, in addition, violators pay a fine.

On the one hand, this restriction is explainable, it was imposed in order to prevent leakage of new technologies, as such situations already happened in the course of the NTI projects implementation. On the other hand, the concept of technology transfer to foreign countries is very vague and, due to the interpretation ambiguity, it can represent a certain ban on close cooperation with international partners. This becomes an incentive to transform companies under jurisdiction of other countries.

A massive outflow of IT companies from the country started already in 2019 beyond those companies under the National Technological Initiative. Thus, the Conundrum³ was casted as British company, the Parallels merged with the Canadian corporation Corel, and the Luxoft moved under control of the American IT corporation DXC Technology. However, the Russian IT market players noted that acquisitions were anyway better than a massive immigration of programmers.

The Huawei also had plans to take over a number of Russian enterprises and launched a more active cooperation with Russia in the previous year in R&D, especially when the USA have introduced anti-Russian sanctions. Meanwhile, the pandemic can contribute to creation of new Russian high-tech services dealing with development of online-services including for distance work, holding meetings and conferences. Deterioration in the quality of communication, including video, with a high number of users was a large technical issue⁴.

The government implemented selective measures under state policy aimed at Russia's technological development. Two major projects have a special place among them: the introduction of the National strategy of the artificial intelligence development until 2030 and launching of technological valleys after adoption of the respective Governmental Decree having been prepared in 2019 with varying intensity.

¹ A. *Fedyunina*, Y. *Averianova*. To buy and then sell // *Expert*, № 39, 2019. p. 19. URL: <https://expert.ru/expert/2019/39/kupit-chtobyi-prodat/>.

² Decree by the Government of the Russian Federation of August 31, 2019. № 1125 “On amendments to paragraph 5 of the Rules on provision of federal budget subsidies to implement projects aimed at fulfilment of plans of actions (“road maps”) of the National Technological Initiative”. URL: <http://publication.pravo.gov.ru/Document/View/0001201909030002>.

³ The company introduces programming solutions preventing break down of sophisticated equipment at large international enterprises.

⁴ A. *Cochran*. Making a Plan When Planning Is Impossible // *The Scholarly Kitchen*, 11.03.2020. <https://scholarlykitchen.sspnet.org/2020/03/11/making-a-plan-when-planning-is-impossible/?fbclid=IwAR3ITeD5dP996CwXIAw1P2xICmeAiZh2rGNKg7wWgxts-oM3ACSZFgBQrYA>

There were initial plans to develop technologies of artificial intelligence (AI) as one of the priority trends of the National Project “Digital economy”, however, in 2019 the AI has actually turned into a separately addressed topic. In this case, Russia is not an exception, as strategies of the artificial intelligence development have been adopted in various countries since 2013–2014. Currently, this topic is fashionable and hype, but at the same time it is one of the strong competencies of domestic scientists and technologists. Generally, there is a limited number of areas, where Russian exports exceed imports, and the most dynamic one is the IT industry. Exports have exceeded domestic sales in this area over several years in a row¹. The artificial intelligence, information security, mobile applications, VR/AR, workflow solutions have been recognized as the most successful trends.

In the context of the science development, the AI Development Strategy indicates priority areas described specifically and precisely (for example, autonomous self-education, autonomous decomposition of complex tasks, algorithmic simulation of biological decision-making systems, etc.). At the same time, support measures are listed in the most general form and basically repeat those already existing in the country (stimulation of attracting investments, implementation of interdisciplinary projects, conducting patent research, etc.).

The only innovation is the “priority long-term support for scientific research in the field of artificial intelligence”², raising the subject of AI in the rank of financial rather than simply strategic priority. There are good reasons for this, as Russia's scientific success in this field is modest compared to the country's share in scientific articles on this subject worth about 1 percent. The world AI leaders in researching of artificial intelligence are China and the United States. A similar situation is still observed in the technological field: in Russia there are only 17 enterprises operating in the field of AI, while in the USA there are more than 2 thousand with more than 1 thousand in China³.

There are plans to use indicators to evaluate the AI scientific achievements not only related to number of publications as well as their citation, the number of registered results of intellectual activity and developed technological practical solutions. Thus, the Strategy for the development of AI in terms of basic and applied research is a more elaborated and innovative document than the Strategy for the scientific and technological development of Russia. It is not excluded that this is the result of the active business involvement in its development.

Finally, a new infrastructural project, that is, the creation of technological valleys, started last year. The Decree by the Government of the Russian Federation on establishment of the MSU innovation- technological center “Vorobievsky Gory”⁴ was signed in March kicking start to initiate technological valleys projects. Basically, these valleys are analogues of the “Skolkovo” innovation center models. They also represent various tax and customs privileges, introduce rules and standards regulating certain activities, i.e. city-planning, medical, educational. The MUS valley has a rather comprehensive business profile and will be focused

¹ A. Grammatichikov. Soft under pressure/Expert, № 41, 07.10.2019. p. 9. URL: <https://expert.ru/expert/2019/41/soft-pod-davleniem/>.

² National strategy of the artificial intelligence development till 2030. Approved by the Executive Order of the President of the Russian Federation of October 10, 2019. № 490. URL: <https://www.garant.ru/products/ipo/prime/doc/72738946/>.

³ N. Ulyanov. How to stop living as someone else//Expert, № 24, 10.06.2019. URL: <https://expert.ru/expert/2019/24/kak-perestat-zhit-chuzhim-umom/>.

⁴ Decree of the Government of the Russian Federation on establishment of scientific-technological center MSU “Vorobyevsky gory” of 28.03.2019. № 332. URL: <http://static.government.ru/media/files/6HVZbMfi2ZpV4C42K4W19MYeQBLDUPJD.pdf>.

mainly on basic scientific research and design engineering. However, more targeted valleys can be launched, and their first precedent was the “Composite valley” in Tula region, oriented to create technologies for composite materials and pilot productions¹. In December 2019, the Prime-Minister has approved the foundation of another valley, that is, the Scientific-technological center “Mendeleev valley” with the main focus on agritechology and chemical technologies².

On the other hand, “Skolkovo” innovation center became extra-territorial in 2019, meaning that the requirement to register the company (legal entity) on the center premises will be lifted. Thus, any Russian companies involved in research and commercialization of their results will receive an access towards services and facilities. Another amendment is renouncing thematic constraints. Previously, companies had to specialize in one of the six highlighted trends, while now research should meet the priorities of the Strategy of scientific/technological development of the Russian³, which has a very broad language. This means that “Skolkovo” becomes the increasingly self-developing commercial center added by new territorially specialized models, borrowing a number of facilities offered by “Skolkovo”. Essentially, this trend of development should make the infrastructure of technological companies more comfortable due to its diversification.

* * *

The previous year showed relatively high government activity with regard to implementation of the May RF Presidential Executive Orders (2018) particularly concerning the development of science, and the activity of the Ministry of Science and Higher Education expressly focused on the implementation of NP “Science”. Inside NP “Science”, the greatest attention was paid to the development of Scientific and educational centers as a complex project for combining policies and federal and regional measures. The REC topic is interesting from two points of view. The first is that the REC means another reincarnation of scientific-educational, academic-research and other centers of that kind that have been launched over the past 20 years. The new project is much larger in terms of the diversity of participants and is more focused on the contribution of scientific research to the economic development of Russia.

The second view is that the bid for the first time was made for regional administrations as mediators of interaction between the scientific-educational and real sectors of the economy. If implemented successfully, this project can become a catalyst for the deployment of various regional scientific-technological policies, being currently rather weak. The first five RECs set up in 2019 were special because their selection was made in the “manual mode”, without competition. Such an approach can be justified in case those, who take decision on selection, clearly understand what they want to get in the end.

The outbreak of the coronavirus pandemic may affect the choice of topics for those centers that will be founded in 2020. In addition, the transition from monopolistic activities on specific

¹ A. *Mekhanik*. Long will projects // Stimuli. Journal on innovations. 26.08.2019. URL: <https://stimul.online/articles/interview/proekty-dlinnoy-voli/>.

² Decision taken on establishment of innovation-technological center “Mendeleev valley”. 26.12.2019. URL: <http://government.ru/docs/38685/>.

³ E. *Erokhina*. Towards the interior of Russia and vastitude of opportunities: how “Skolkovo” will now operate // Indicator, 26.07.2019. URL: <https://indicator.ru/engineering-science/skolkovo-novyj-zakon.htm>.

topics in virology and epidemiology to the deployment of a parallel search for solutions to combat the “global challenge” has already started. To organize effective work, it is needed to partially resuscitate the Soviet science management skills, which would allow to mobilize substantial resources for solving the urgent scientific problem in a short time.

However, this solution is applicable only for emergency.

In the normal course of events, effective science develops in favorable environment rather than under mobilization model of support. So far, the issues related to the development of the environment evidently stall, and last year, there has actually been a rollback to the prohibitive style of regulation. The reorganization of scientific funds exhibited the backstage style of management. There was no wide discussion of the planned transformations and, most importantly, no justified arguments, why such a reorganization was needed in principle.

The situation in the field of technological innovations is more clear, i.e. there is a focused success, major unresolved problems associated with the development of new environment that would favor creation of new technologies. Despite highly specialized measures, it can be said that government policy becomes more systemic, attempting to tackle various aspects of developing this environment. As an example, there are infrastructural projects added by mechanisms already in place. At the same time, the dynamics of changes in technological environment shows instability with more efforts aimed at coordination of political measures rather than only at development of new signature projects.