The Russian Federation

INTRODUCTION

Russian science is well known for its achievements in basic and pilot research, in solving important academic and technical problems on both national and international scales. Russian scholars have traditionally based their academic projects on original research of a high intellectual standard.

In the past decade, Russian science has faced serious challenges created by the transformation of the Russian economy following the collapse of the Union of Soviet Socialist Republics (USSR) in 1991. Funding for scientific and technical activities was abruptly and severely reduced. Military funding plummeted.

Despite this adverse environment, Russian science has adjusted to the new socio-economic realities, demonstrating viability and resourcefulness. Science and academic life in the country as a whole has become more open and democratic; international cooperation in the fields of science and technology (S&T) has soared; regulation of academic activity based on ideology has disappeared and administrative regulations have been eased. Sources of funding for academic scientific and technical projects have become more diversified.

Funding is now based on a competitive, merit-based approach with a focus on advanced scientific schools,[1] high-priority fields and research targets, high-calibre scholars and innovative academic and educational centres. Important measures have been introduced in order to integrate institutions of higher learning and centres of basic scientific research, and to attract young people to academia using, along with other incentives, additional financial support for graduate and postgraduate students and scholars.

Besides the chronic problem of insufficient state financing, Russian science faced other serious problems at the end of the twentieth century. These included little demand for S&T-based projects from industry, 'brain drain' to other countries, a low public opinion of the academic professions and rapid ageing of the scholarly community.

In the period between 1990 and 2002, the number of people involved in research and other academic activities decreased by 55.2%. In absolute figures, this means that Russian science lost 1 072 500 skilled people. On a ranking of countries by the proportion of those employed in academic fields, the Russian Federation now rates ninth in the world, after Finland and Iceland.

The number of academics in their most productive years has decreased dramatically. The average age of a professor or lecturer in a Russian tertiary institution is now approximately 60 years, whereas it used to be just 40–45. The highly prestigious image accorded to the academic profession at all levels – a higher status even than in other countries of the world – is no longer true for Russia.

CHANGES IN EDUCATION

It can be argued that the enormous number of newly created universities and other institutions of higher learning represents a loss for Russian science and academia. In general, this growth in institutions has not been accompanied by a higher level of education or scientific activities. In the last few years, 3 200 non-state institutions of higher learning and their branches have begun to operate in the Russian Federation along with new branches of existing state universities. As a result, a disparity has emerged between the real demand in society for a professional, highly qualified workforce and the number of university graduates. The number of students has rocketed in just a few years to 410 students per 10 000 population. The imbalance between supply and demand in higher education and the unpredicted and unpredictable rise of university graduates, often with low-quality education, are detrimental trends.

The situation regarding academic degrees earned through dissertation and thesis preparation has also changed. The number of graduates has risen significantly but

1. 'Scientific schools' were first created under the former Soviet system and still exist today . A 'scientific school' is a group of research scientists working under the leadership of a well-known figure in their field, who has also usually supervised their Candidate of Science degree (the equivalent of a PhD) and higher Doctor of Science degree.

without producing a higher number of completed dissertation theses. More importantly, this development has been accompanied by lower-quality dissertations, reflecting a lower level of basic research. The choice of subject has also changed: in 1991, 71% of the dissertations presented were in hard sciences and 29% in the humanities and social sciences; in 2001, the percentage of PhD dissertations in the humanities and social sciences had risen to 46% compared with 54% in hard sciences. The situation with the second academic degree (Doctor of State) is similar: in 2003, more than 50% of all second academic degree dissertations were in the humanities and social sciences. According to data for the first three months of 2004, two-thirds of the dissertations in the humanities and social sciences were in management and law. In general, in these disciplines, the dissertations have little or no scientific value but are useful to those in the political and business spheres in confirming their status.

OVERSEAS DRIFT

Between 1989 and 2000, more than 20 000 academics previously employed as researchers and research assistants emigrated from Russia. Another 30 000 specialists now work abroad on a contractual basis. A significant part of the latter group does not plan to return to Russia, where academic salaries are far below what can be earned abroad. The Russian scholars who live and work abroad are, in the majority of cases, specialists in the most advanced and science-intensive high-technology fields – mathematics, information technology, physics, biophysics, virusology, genetics, biochemistry – which to a great extent currently determine social and technological progress in society.

Science is, of course, international by its very essence. There have been many instances in history when Russian scholars working in international laboratories or in cooperation with international academic centres have achieved great results and made significant contributions to the development of science, thus enriching and strengthening Russian scientific schools. The first name that springs to mind in this context is Academician Kapitsa (1894–1984), a Nobel laureate for physics: the equipment he brought back with him from Cambridge, along with cutting-edge research topics, determined the development of physics and the creation of science academies in Russia.

A good example of modern cooperation is the work of Russian scholars at CERN – the European Organization for Nuclear Research. At the CERN experimental grounds, about 7 000 specialists representing 500 scientific organizations from 80 countries carry out research and conduct experiments. About 10% of these scientists are Russian. Russian specialists working at CERN feel they are representatives of Russian scientific traditions, conducting science and pursuing the interests of Russian academies. Only a small percentage of Russian scientists have left the country as a result of this cooperation – an example which shows that, when organized in the right way, the work of Russian specialists abroad can be mutually beneficial.

One way to develop the human resources necessary for academic and scientific research in Russia is to maintain relations and enhance cooperation with the Russian academic diaspora. It is especially important to maintain contact with the countries of the Commonwealth of Independent States (CIS), founded after the disintegration of the Soviet Union, by providing opportunities for talented young people from the CIS to receive higher education in Russian universities.

Several positive steps taken by the state have tended to lower the number of people leaving the academies or leaving Russia to pursue their academic careers abroad. The most important initiatives have been the development of foundations for the support of science in the mid-1990s and federal programmes supporting academic research. The latter include President of the Russian Federation postdoctoral grants to support young Russian scholars and their academic advisers (300 per year); President of the Russian Federation grants to support young Doctors of State (100 per year); President of the Russian Federation grants to support young scholars from the leading Russian academies and to support the academies themselves (more than 700 groups of researchers per year); a Russian Foundation for Basic Research programme for young scholars, graduate students and undergraduate students

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

(MAs) (2 000 grants of US$ 1 000 each per year); the Federal Programme for Integration of Science and Higher Education for 2002–06; the Foundation for Support of Entrepreneurship in Science and Technics programme; and Ministry of Education and Science of the Russian Federation grants to young scholars (91 million roubles per year, equivalent to US$ 3.2 million).

THE CURRENT SITUATION

Almost 4 000 organizations represent science and research in today's Russia. Among them are more than 400 universities (in all, Russia has over 1 000 institutions of higher learning), 1 200 state research institutions and 450 institutions of the Russian Academy of Sciences. The country's professors and lecturers number 291 800, and researchers and specialists total about 400 000. There are more than 32 000 Doctors of State, over 135 000 PhD holders and around 136 000 graduate students in PhD programmes. It is worth noting that, for more than 300 Russian cities and towns, higher education, science and academia together constitute the main employer and the main intellectual resource and potential for socio-economic development.

In 2002, gross domestic expenditure on research and development (GERD) amounted to around 135 billion roubles. Of this, 58% came from the federal budget, almost 33% from corporate organizations and 0.4% from higher education and non-profit funds. International sources contributed 8% of total research funding. In recent years, a series of memoranda of cooperation have been signed with 53 Subjects (i.e. public and private bodies) of the Russian Federation. The amount of funding for research and other scientific work coming from regional budgets now amounts to 3 billion roubles per year.

Not only has Russian science managed to keep its human resources and its academies but it has also managed to educate and promote modern-style research managers. Organizational forms are being changed. One part of academia is shifting closer to industry; another is becoming more involved in higher education. There is a significant growth of interest in hard S&T disciplines among young people. The Russian Academy of Sciences – the unique S&T centre of the country – has managed to remain intact. A future direction for the institutes within the Russian Academy of Sciences is to integrate them with institutions of higher education in order to create research universities. Such universities would be well-organized, effectively managed academic institutions featuring both quality education and advanced research. The main Russian university – Moscow State University, named after M.V. Lomonosov – is an example of such a classic research university, meeting international standards on almost all criteria.

Issues of state policy in the area of basic and applied science, as well as concerning those involved in training human resources for academic research, have increasingly been the focus of attention of the Russian higher authorities. The meeting of the Council on Science and High Technology under the President of the Russian Federation which took place on 9 February 2004 centred on potential in science. The agenda included a detailed analysis of the situation regarding human resources for S&T in Russia to allow the council to define the main problems and offer specific measures to retain and develop academic potential.

The education system is the starting point for achieving this goal. Russia has a time-proven system of educational institutions organized by educational stages: high schools, higher learning institutions and on-the-job personnel training. There exists a long-standing tradition of selecting talented youth through various intellectual competitions, academic projects involving young people and special boarding schools for gifted high-school students. This work has to be continued and enhanced so that the ever-growing social stratification of Russian society will not impede talented youth – especially those from smaller towns and rural regions – from receiving a good education.

Russian science still has a low rate of innovation. Thus, the development of innovative infrastructure for science, technology and education becomes very important. Such infrastructure should include small enterprises with low start-up financing and high-technology transfer centres based on integrated university and Academy of Sciences research partnerships. It should also include research and development (R&D) parks, 'zones of innovation' surrounding the scientific centres that could obtain the status of free economic zones.

On 24 February 2004, a special joint meeting of the Security Council and the presidium of the State Council of the Russian Federation discussed issues related to developing a national innovation system. Enhancing innovative activities and creating infrastructural and economic conditions for faster implementation of scientific achievements in various sectors of the economy is a high priority for today's Russia. The most important element will be overcoming prejudice in Russian regions, leading to the active support of science as one of the main instruments of innovation.

The modern infrastructure of the innovative R&D centres at the institutions of higher education includes about 1 000 regional centres covering various disciplines and fields (academic and educational centres, observatories, botanic gardens and biological stations, university museums and so on). At the same time, a new system of consulting and engineering companies and ventures oriented exclusively towards the high-tech sphere is being formed.

The infrastructure to encourage innovative science currently comprises 76 research and development parks, 15 education and technology innovation centres based at the universities, 11 centres for technology transfer, 16 regional training centres for innovative management, 12 regional analytical information centres, ten regional innovation centres, 12 regional centres for assistance in development of R&D entrepreneurship and a foundation for assistance in development of innovation in higher education.

FUTURE CHANGES

Russia has begun creating an environment conducive to new types of R&D activities. Gradually, innovative structures capable of both creating new knowledge and working it into commercially attractive projects have emerged. Commercially successful businesses are financing R&D programmes by participating in huge investment projects. Simultaneously, some of the organizations involved in high-technology production are being integrated in the global technology arena.

State policy is also being oriented towards improving the status of science and education, promoting high-technology companies and the export of high-tech products. Such a policy is transforming Russian science to create the basis for a dramatically different model of economic growth.

Russia's main task will be to create a system enabling the development of new knowledge, supported by an inflow of professional personnel, and to find ways to use and implement the results of research into new technology. The main national universities and national R&D centres surrounded by special zones for innovative economic activities should become the basis of this system. These will be the places for joint efforts embracing specialist education and training, high-priority research, implementation in industry and new commercial applications.

This, in turn, will create the conditions for revitalizing and supporting human resources to boost national science and the high-tech industry. Only then will Russia move from the current situation where academic personnel or potentially new research ideas are being exported to one where research results are embodied in high-tech exports. Only then will Russia truly take its place among the developed nations of the world.

VICTOR SADOVNICHY

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

CONTEMPORARY HISTORY OF THE APPLIED SCIENCES

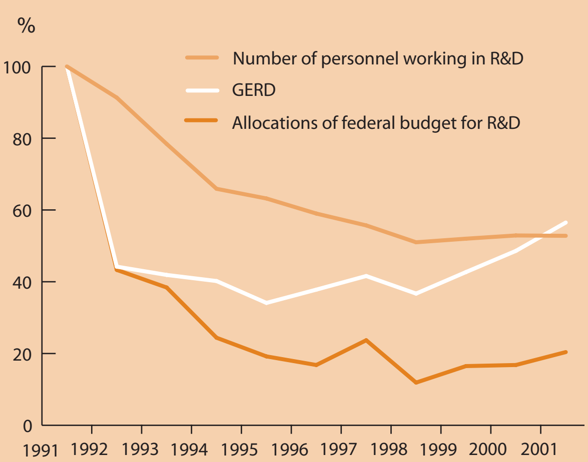
The current state of applied scientific research in the Russian Federation and the way it has developed reflect the deep changes in the country's political and economic structure from 1917 to 1991. Along with its political and economic transformation, Russia has, since 1991, witnessed the overturn of its well-established system of basic and applied R&D. The economic and institutional reform of Russian science from 1991 to 2003 may be described as a three-stage process.

During the first stage (January 1992 to August 1998), the majority of national funding sources were rapidly privatized, prices of goods and services were liberalized and the market economy began to emerge. This resulted in a considerable decline in industrial output and in the value of gross national product (GNP), as well as cutbacks in national budget expenditure. Science funding was reduced accordingly. The subsequent attempt to introduce institutional reforms of science failed because of the difficult economic conditions and social uncertainty.

The second stage began with a significant economic downturn in August 1998, which put a stay on almost all the institutional reforms of Russian science and economics. After 1998, economic recovery began, with some growth in production and an acceleration in industrial technological modernization.

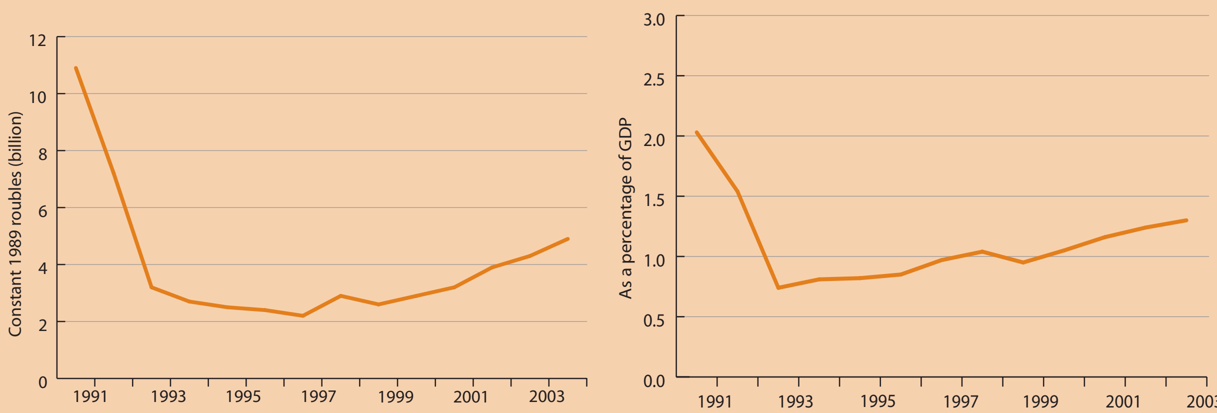
The third stage began with a period of economic growth between 2000 and 2001 which enabled a number of

Figure 1
S&T CAPABILITY IN THE RUSSIAN FEDERATION, 1991–2001 (1991=100)



Source: Kouznetsova, T.U. and Dobretsova, N.I. (eds) (2003) *Scientific Potential and Technical Level of Production: Russia in Figures.* (In Russian)

Figure 2
GERD IN THE RUSSIAN FEDERATION, 1990–2003



Source: K Kouznetsova, T.U. and Dobretsova, N.I. (eds) (2003) *Scientific Potential and Technical Level of Production: Russia in Figures.* (In Russian) enterprises to proceed more actively with technological innovation. Actual reform of basic funding first came about at this stage. During 2003–04, the country has been going through yet another government reorganization, with the system of state science management likewise being reorganized.

REORGANIZATION AND INSTABILITY

A general problem during this latest stage has been the considerable organizational instability in state control over applied R&D. For example, in 1991, the USSR State Committee for Science and Technology was transformed into the State Committee for Science and Engineering. At the beginning of 1992, the Ministry of Science, Higher School and Technical Policy of the Russian Federation was created. As early as February 1993, the Ministry was reorganized into the Ministry of Science and Technology Policy, with control over higher education delegated to a separate government body. In 1996, the Ministry of Science and Technology Policy was transformed into the State Committee of the Russian Federation on Science and Engineering, which in 1997 was reorganized into the Ministry of Science and Engineering of the Russian Federation. In 2000, this ministry was transformed into the Ministry of Industry, Science and Engineering. In 2003–04, within administrative reforms, a new Ministry of Education and Science was created with responsibility for scientific research and education.

Each reorganization of a ministry or a state committee entails considerable changes to its function, inner structure and administration, especially as concerns major executives in charge of structural units of an institution. Changes in the central figures in science administration have been even more frequent than that in other areas. Thus, in 1998 alone, three different ministers supervised scientific research in the Russian Federation.

To further complicate matters, in analysing and interpreting the official statistics that describe changes to applied R&D in the Russian Federation, the imperfections caused by the structural shortcomings of national statistics in Russia in general have to be taken into account. At the end of the 1990s, with the conversion to international standards of statistical observation, certain problems arose that have still not been resolved. According to expert opinion, the available information on the state and development of Russian S&T does not meet the needs of researchers encountering problems in their work, nor can that information serve as an adequate basis for the necessary assessment prior to administrative decisions. Users of statistical data find some difficult to apply and interpret, whereas others appear problematic or contradictory. Specialists of the Russian Scientific Research Institute of Economics, Politics and Law, in the S&T sphere of the Ministry of Industry, Science and Technologies of the Russian Federation focused on this problem in 2003.

It has also been stated that the information available is too simplistic and does not take into account the changes and reforms the country is going through; some important figures are lacking. In fact, the range of science-related national statistics is much narrower than the scope of science outlined in the Federal Law on Science of 1996. The selection and allocation of institutions undertaking R&D within a certain activity segment conforms to international standards but in reality does not reflect the structural peculiarities of Russian science.

All the above hinders objective analysis of this already complicated state of affairs. Nevertheless, there is enough reliable information on the main events and trends in S&T and applied research in the Russian Federation between 1991 and 2003 to make a general evaluation.

A BRIEF APPRAISAL OF RUSSIA'S S&T POTENTIAL IN 1991

The nature of the Russian Federation's historical background has to a great extent determined the development of applied research in the period 1991–2004. The way general science was managed over this period was hugely influenced by the twilight years of the USSR. National spending on science development amounted to 3.8% of national budget expenditure in 1988, 1.99% in 1990 and 1.85% in 1991. Those figures closely corresponded to state funding of scientific research in the leading economically advanced countries. However, the structure of S&T in the USSR from 1917 to 1991, and the way it developed, differed fundamentally from the situation in the USA and other Western countries.

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

First, all the institutions engaged in basic and applied research during that period belonged to the state and functioned within the system of government administration, budget funding and a planned national economy. Russian S&T was only able to advance within the limits and rules set by a government that was essentially not accountable to the population for its actions. It is generally acknowledged that the country's leaders considered it a great achievement of the totalitarian state that the government was able to organize R&D in every sphere of basic and applied science – its 'full-scale attack'. Indeed, any country with a market economy and a political system answerable to citizens would not be able to afford such a concentration of resources aimed at solving major S&T problems at the price of a reduction in consumption and tough living conditions for the population. The communist government apparatus, with its forceful (i.e. not economically or scientifically founded) decisions, did not require sanction from its citizens, whose interests were thus effectively disregarded. The system's opponents were not only politically repressed but also physically eliminated by the state security bodies. The USSR's leaders were able to create enormous S&T potential, supported and provided by organized basic and applied research in the main areas of S&T – all in a very short time.

Second, all organizations involved in basic and applied R&D were divided into three self-sufficient sectors: academic, higher education and industrial establishments. Academic institutions were structurally part of the USSR Academy of Sciences and industrial academies of the country. Scientific sections of the higher learning establishments were responsible to the ministerial departments to which each establishment structurally belonged. Industrial scientific research, project development laboratories, engineering and other similar organizations were brought under ministries and other departments in control of various branches of the national economy.

The nation's leaders intended the functions of the three sectors to be different. Academic scientific institutions were to conduct basic research in natural and social sciences (although in reality applied research also played a considerable role in their activities). Higher education science was first and foremost in charge of the educational process; it had inadequate links to industry, was systematically underfunded and did not possess the necessary equipment or experimental and production base. The component parts of higher learning establishments – laboratories, groups of scientists, etc. – were not stand-alone scientific organizations. They conducted basic and applied research on a limited scale.

By contrast, industrial scientific institutions conducted applied scientific research and were also responsible for the application of basic research results. These institutions played the main role in new technological projects as well as providing engineering support for sample production using new techniques. The industrial scientific sector of the USSR included powerful departmental systems of R&D institutes, project design and technology organizations, pilot plants and so on. The sector used to employ 75% of the country's specialists in the field of scientific R&D. Institutions of the industrial scientific sector implemented 80% of the country's scientific research (including almost 25% of basic research), 75% of applied research and about 90% of R&D. Thus, the leading position in the S&T activities of the USSR was occupied by industrial science.

Thirdly, the distribution of scientific institutions in the USSR between certain ministries and departments did not adequately reflect their status and the character of their activities. Applied R&D was also divided into the defence (militaro-technical) and civil sectors. Applied R&D in the area of defence was given top priority. The share of defence constituted more than 60% (80% according to some estimates) of all S&T work in terms of value. Institutions conducting research in defence, whatever department they came under, were strictly classified. They had at their disposal the most qualified and talented staff and the best logistics and maintenance; they spent the major part of Soviet science general funding and commissioned basic research that opened up new perspectives in R&D. Defence employees also received higher salaries and thus were more motivated than those employed in the civil sector of applied science.

All these factors meant that basic and applied research in the militaro-technical field was very efficient. The high level of R&D and scientific support for military engineering placed the USSR in a leading position in the world in many branches of S&T. Soviet industry mass-produced the world's best small arms and artillery. Atomic submarines were built with features as yet unsurpassed. The world's best rockets, nuclear ammunition, means of air defence and military space systems were created. All these types of armaments exemplified the latest achievements of S&T in almost every sphere of S&T progress. Many of them exceeded the best achievements of Western countries. It was for the needs of the defence industry that highly efficient programmable precision machines and many other items of advanced equipment were designed and produced.

Major militaro-technical solutions required new industries to be created when necessary. For example, atomic shipbuilding and aerospace engineering called into existence a large-scale industry to produce titanic alloys and products made from these, which demanded new resources as well as the creation of a new technological cycle from metallurgy to titanic construction welding, etc.

On the other hand, from the end of the 1980s to the beginning of the 1990s, the economic situation in the country became quite paradoxical. The achievements in engineering and technology resulting from basic and applied research conducted in the USSR were not usually taken up by industrial organizations, so they were excluded from the process of the real economic development of the country and the growth of its S&T capability. This was clearly apparent in the civil sectors of the national economy but enterprises in the militaro-industrial complex (MICA) were also often reluctant to adapt to new technologies and equipment. The problem of industry and the economy not responding to S&T progress was never properly resolved throughout the history of the USSR.

The communist government blamed the apparent lack of progress on the inaction of scientists, who were said to be uninterested in practical applications and accused of lack of effort in adapting new scientific achievements for industry. There were frequent statements by party leaders that scientific groups and organizations were only 'thinkers'.

In reality, the root of the problem lay in the little attention paid by some economic leaders to the laws of economic development. Cheap labour, almost-free resources (energy, materials and component items were not acquired at economically justified prices but rather distributed on request among plants and institutions out of available funds), along with complex pricing that did not encourage enterprises to increase labour productivity or the quality of production – all these became serious obstacles to raising the S&T level of production, even though the results of R&D were potentially available and free for industry to use. From 1975 to 1985, the economic efficiency of R&D (measured as the ratio of improvements in knowledge-intensive production to R&D costs) was decreasing on average by 3% per annum. By 1991, it had become urgent to reform the R&D sphere in order to increase efficiency.

Another less obvious but nevertheless fundamental contradiction of the Soviet state was failing motivation among scientific research workers. Apart from economic reasons, lack of elementary civil liberties, ideological suppression of forms of culture undesirable to the government, increasing bureaucratization of science and the absence of creative freedom all had a discouraging effect. The dogmatic ideological directive on the hegemony of the working class in the country's political life did not help to solve the deep contradiction between the actual political and economic status of the country's scientists, on the one hand, and their growing role in creating new knowledge-intensive production on the other. Having accomplished the historical task of catching up on industrialization (albeit at a terrible price), there was no successful transition from an industrial to a post-industrial phase within the repressive political system.

REFORM OF S&T RESEARCH 1992–98

After the collapse of the Soviet Union, the great majority of organizations involved in basic and applied research that had been the central core of the country's S&T potential

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

remained within the Russian Federation's borders. Russia retained 70% of the employees of the Soviet economic branch called Science and Scientific Management. From that branch, 445 000 researchers and 80% of its basic funding became 'the Soviet heritage' of the Russian Federation. Some 77% of the general volume of R&D was now performed in post-Soviet Russia, which also held more than 68% of the specialists and more than 90% of the scientific institutions of the Academy of Sciences of the USSR.

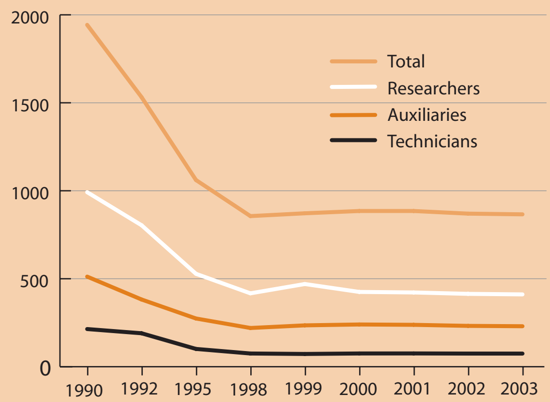
One of the main principles of the Russian government's state policy regarding science (SPGS) in 1991–98 was a recommendation by the Organisation of Economic Co-operation and Development (OECD) for the 'excessive' scientific potential inherited from the USSR to be reduced. That task was expected to be settled in the process of institutional reforms, which were given priority in the early 1990s. The opinion of some experts was that economic growth came only third or fourth on the list of priorities for the development of Russia at that time (Uzyakov, 2000).

In 1992, many Russian scientific research and project-development organizations were privatized and a number of them, in accordance with their owners' wishes, changed to more profitable activities. Some scientific organizations either stopped doing R&D or limited their applied research and took up other activities. A significant motivation in the privatization of the basic state funding used in R&D in Russia was its value. In 1989, the value of this funding, including that for experimental activities, came to 5.1% of the USSR's funding for manufacturing industry, or 25.3 billion roubles (in 1990 prices). This trend did not stop until after the government adopted the Regulations on Privatization of S&T Objects in June 1994, which fixed the rules for selling organizations S&T on a competitive commercial or investment basis.

Nevertheless, contrary to Russian economic reformers' expectations, the transition of R&D funding and organizations to private ownership did not increase efficiency but actually had the opposite effect. After scientific organizations and knowledge-intensive industrial enterprises were privatized, interest in the market-stimulated results of short- and medium-term applied research started growing rapidly. At the same time, investment in long-term basic and applied research with no immediate commercial value declined considerably. Demand for inventions by industrial enterprises fell by more than 85% in five years. In the period 1992–94, the innovation activity of enterprises dropped to two-thirds that of the USSR. The reason was no longer the 'insusceptibility of enterprises to ST progress' typical of the Soviet economy but the enterprises' impoverished circumstances and the lack of means to pay for R&D in a climate where demand for knowledge-intensive production was falling rapidly.

From 1992 to 1996, internal running costs and capital expenditure on R&D fell by three-quarters. During those years, there was a growing tendency to reduce funds allocation from the expenditure part of the federal budget under the heading 'Basic Research and Contribution to S&T Progress', which forced a number of scientific institutions and enterprises to find the money to pay employees' wages by cutting back staff, renting out premises, dismantling and selling expensive equipment and materials, and so on. Rises in the prices of

Figure 3
PERSONNEL WORKING IN R&D IN THE RUSSIAN FEDERATION, 1990–2003
In thousands



Source: Kouznetsova and Dobretsova (2003) *Scientific Potential and Technical Level of Production: Russia in Figures*. (In Russian)

THE RUSSIAN FEDERATION

goods and services and a restraint on wages became commonplace, leading to a decrease in the number of those involved in scientific R&D.

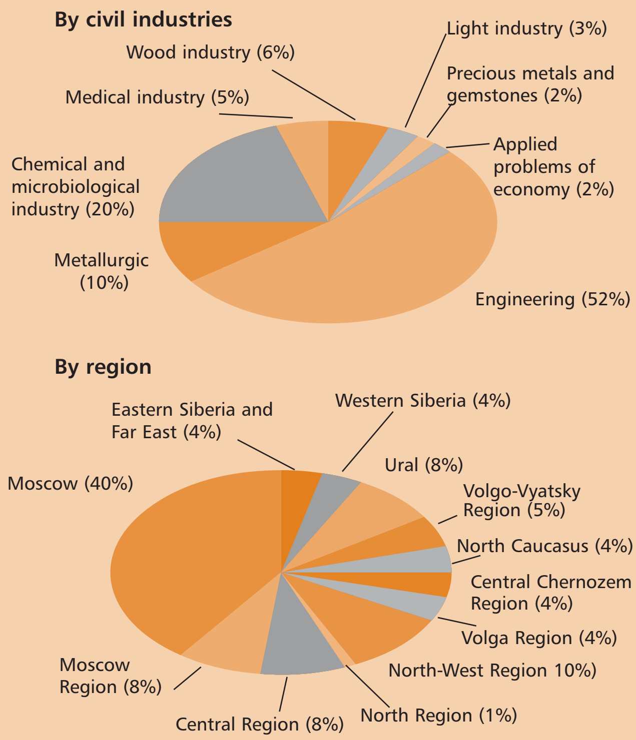
In 1996, the Federal Law on Science and Technology was passed, followed by several governmental decrees that were meant to become the legal foundation for the future reorganization of S&T research and innovation, aimed at improving the competitiveness of production.

To try to preserve the country's S&T base, science and industry executives looked for ways of making applied research and innovation better suited to the market economy. By the end of the 1980s, technoparks – associations of scientific, project and industrial organizations with well-developed information and experimental divisions and highly qualified personnel – had already been introduced. Technoparks proved to be a useful development in the new socio-economic context, as they integrated science, education and production while stimulating more intensive innovation. By 1997, about 60 technoparks had been founded in the Russian Federation.

In 1993, the President of the Russian Federation introduced the status of state scientific centre (SSC) to distinguish a number of advanced scientific institutions and enterprises with unique experimental equipment and highly qualified personnel who had achieved international recognition for their scientific research (Decree No. 939). As a rule, these SSCs, which incorporated over 40% of the country's S&T resources, were founded in large industrial institutes and enterprises functioning successfully under the new economic conditions. From 1994 to 1997, 56 scientific organizations were given SSC

Figure 4
ORGANIZATIONS IMPLEMENTING R&D IN THE RUSSIAN FEDERATION, 1998
By industrial sector and region

Industry	Number of organizations
Mechanical engineering	98
Chemical technologies and chemical industry	71
Electrical engineering	44
Metallurgy	31
General and complex problems of technical and applied sciences and branches of the economy	31
Automatics and telemechanics, computation	29
Medicine and health services	25
Wood and woodworking industry	24
Instrumentation	23
Electronics and radio engineering	20
Mining	18
Light industry	16
Biotechnology	12
Agriculture and forestry	11
Water economy	10
Energetics	9
Atomics	7
Communication	6
Construction and architecture	6
Transport	5



Sources: *Russian Statistics Yearbook* (1998); *Industrial Research in Figures* (1999). (In Russian)

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

Table 1
CONTRIBUTION TO GDP OF VARIOUS SECTORS IN THE RUSSIAN FEDERATION, 1998
As a percentage of 1990

	%
Gross domestic product (GDP)	54
Volume of industrial production	45
Metallurgic industry	53
Food industry	49
Light industry	12
Chemistry and petrochemistry	42
Mechanical engineering, wood and woodworking industry, construction materials industry	35
Fuel industry	66
Electric power production	76
Manufacturing industry	40
Extractive industry	70
Consumption of services paid for by population	25
Passenger turnover at public transport	60
Services production	81
Commodities production	45

Source: Kouznetsova and Dobretsova (2003) *Scientific Potential and Technical Level of Production*. (In Russian)

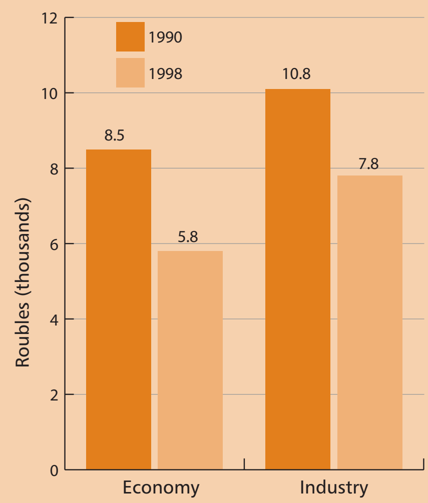
status, reflecting to some extent the priority given in the Russian Federation to different branches of S&T. Among others, the enterprises were in the fields of:

- chemistry and new materials (7)
- aerospace engineering (4)
- shipbuilding, navigation and hydrophysics (6)
- medical science and biology (4)
- oceanology, meteorology, water supply and engineering geohydrology (3)
- computer science and instrumentation (5)
- mechanical engineering (4)
- optical electronics, laser systems, robotics, special chemistry (5)
- agro-industrial complex (4)
- mining metallurgic complex (4)
- construction (1)

The progress being made on innovation encouraged the formation of innovation-technological centres (there were eight in 1997) and especially financial-industrial groups (FIGs). A FIG is an association of legal entities that enters into a contract providing for full or partial consolidation of material and non-material assets for the purpose of technological or economic integration, to implement investment and other projects and programmes, in order to achieve greater competitiveness and further development of markets for goods and services. Creating joint infrastructure in information, banking, insurance, consulting and auditing, supply and sale, transport and personnel results in greater productivity and new jobs. Interregional and transnational FIGs are powerful bodies capable of investing considerable amounts in personnel training, information infrastructure and marketing.

When joining an FIG, an enterprise acquires access to additional investment due to the funding available within FIG financial and loan offices, as well as resources attracted on the security of these offices. Experience has shown that cooperation and differentiation of labour within an FIG allows more efficient use of industrial potential, application of knowledge-intensive and resource-saving highly

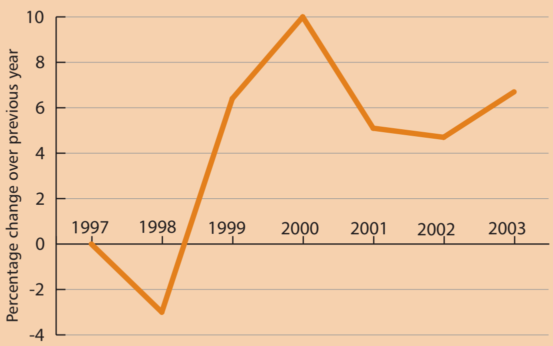
Figure 5
GDP PER HEAD OF WORKING POPULATION IN THE RUSSIAN FEDERATION, 1990 AND 1998



Source: *Russian Statistics Yearbook* 1990–99. (In Russian)

THE RUSSIAN FEDERATION

Figure 6
GDP IN THE RUSSIAN FEDERATION, 1997–2003
Percentage change over previous year



Source: Calculated using data from *Russian Statistics Yearbook* 1990–2004. (In Russian)

productive technologies and the growth of productivity, while maintaining the level of personnel. In 1997, there were 72 FIGs listed in the Russian Federation register.

In October 1997, the Russian government approved the Regulations on State Accreditation of Scientific Organizations, which set common standards for scientific institutions and for licensing their activities irrespective of the form of ownership. In 1998, the Russian Ministry of Economic Affairs was responsible for overseeing applied R&D in 250 state and 374 non-governmental scientific organizations functioning within the structure of civil industrial complexes.

Measures taken from 1996 to 1998 were unable to prevent further deep disruption to the technology-transfer mechanism and to the dissemination of forward-looking ideas and developments from the state-funded sphere of basic scientific research to the sphere of R&D and knowledge-intensive production, most of which had taken on new forms of ownership. According to official figures, production fell considerably between 1991 and 1998. The great damage caused to S&T in Russia is hard to estimate and has to the present day still not been repaired.

The economic downturn of August 1998 interrupted implementation of the institutional and economic reforms planned by the legislative and executive bodies. Applied R&D in Russia was stranded in a growing systemic crisis; the institutional reorganization of science would end up being one of the casualties of the economic crisis. A new chapter in the modern history of Russia had begun with the country's economy, as well as its scientific organizations sustaining economic and technical progress, having to adapt to new, even harder conditions to ensure their survival and development.

DEVELOPMENT OF APPLIED SCIENCE, 1999–2003

After seven years of institutional reforms that proceeded regardless of the adverse economic conditions, some indications of recovery began to appear. In 1999, the value of gross domestic product (GDP) halted its decline for the first time since the collapse of the Soviet Union. In 2002, the volume of GDP was 25.8% above the level of 1998.

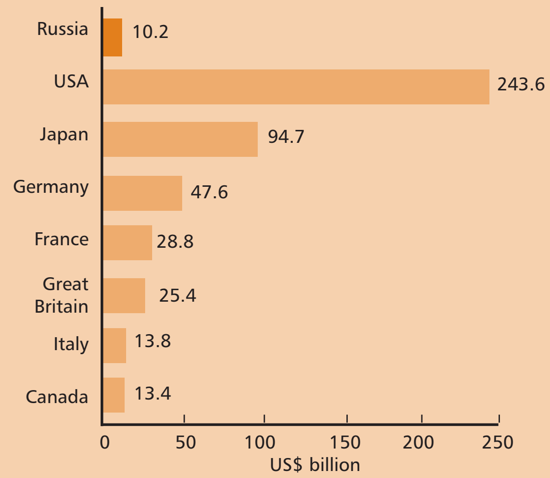
The number of enterprises actively investing grew by 60% over the same period. By 2001, investment in fixed capital stock had grown by 34% over 1998 levels, with 36% going into new equipment. Foreign investment in 2001 amounted to US$ 703 million, a 357% increase over 1997 levels. The number of newly 'technologized' facilities also increased. The unemployment rate in May 2003 was 37% below May 1999 levels. That resulted in a growth in labour efficiency of 19% in 2001 as against 1999 for the economy as a whole and in growth of 18% in industry.

There is still a long way to go to restore the position lost in 1991 but the country's economy and scientific institutions have been given additional opportunities to adjust to the market. A stronger federal budget has allowed a rise in GERD. In 2001, the Russian Federation still came eighth in terms of GERD among the Group of Eight (G8) countries (Figure 7).

It is generally agreed that human resources are a crucial factor in realizing a country's S&T potential, as well as for its development prospects. The number of those employed in the branch of science and scientific management declined by more than half in 2001 compared with 1990 and represented 1.8% of the total number employed in the Russian economy. Moreover, whereas the number in employment declined by 14% between 1990 and 2001, and by 38% in industry, the number of people employed in

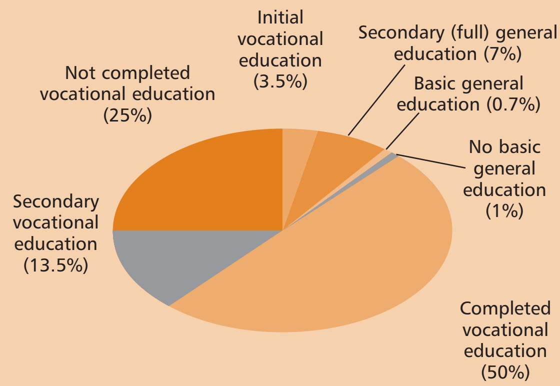
UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

Figure 7
GERD IN G8 COUNTRIES, 2001



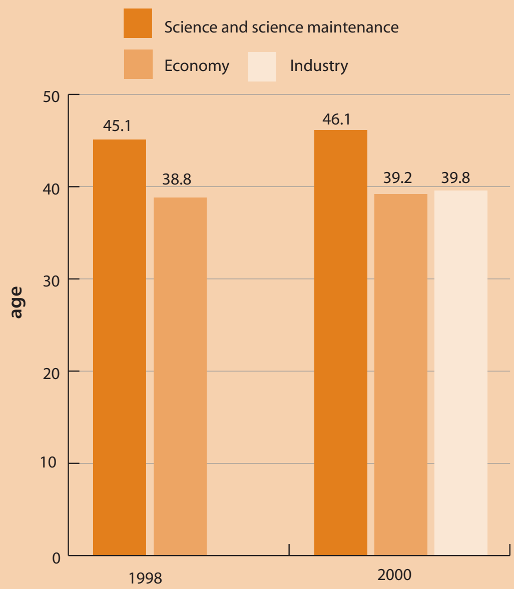
Source: Beketov (2003) *Science in Russia and in the World*. (In Russian)

Figure 9
PERSONNEL IN SCIENCE AND SCIENCE MANAGEMENT IN THE RUSSIAN FEDERATION, 2000
According to educational level (%)



Source: Kouznetsova and Dobretsova (2003) *Scientific Potential and Technical Level of Production, Russian Statistics Yearbook* 2001. (In Russian)

Figure 8
AVERAGE AGE OF PERSONNEL IN SCIENCE AND INDUSTRY IN THE RUSSIAN FEDERATION, 1998 AND 2000



Source: *Russian Statistics Yearbook*. (In Russian)

science declined by 58% over the same period. This was caused both by the ageing of science personnel (Figure 8) and the drift away of the young, coupled with more qualified and creatively active scientists taking up permanent residence abroad.

These trends, which have continued unchecked to the present day, are removing Russia's most precious resource for the country's transition from industrially extensive production to the steady development of knowledge-intensive production. A country's S&T capability stems from a number of long-term factors, such as the activity of several generations of specialists, secondary and higher education and the level of postgraduate training, and is slow to change.

Over the past few years, the Russian Federation system of general, secondary and higher professional education has been going through a process of major reform to adapt it better to the conditions of the market economy and allow it to meet international educational standards. Statistics on the current state of professional training for S&T and engineering personnel (Table 3) illustrate the situation.

Table 2
PERSONNEL IN SCIENCE AND SCIENCE MANAGEMENT IN THE RUSSIAN FEDERATION, 1990, 1995 AND 2001

	1990		1995		2001	
	Men	Women	Men	Women	Men	Women
Number (thousands)	1 332	1 472	827	861	597	590
As % number employed in 1990	100	100	62	58	45	40

Source: Kouznetsova and Dobretsova (2003) *Scientific Potential and Technical Level of Production.* (In Russian)

There are also some interesting figures on trends in training for highly qualified personnel like postgraduate students and candidates[2] (Table 5).

PATENTS AND LICENSING AGREEMENTS

One of the main indicators of technological development is a country's patent and licensing activity. A measure of invention activity is the number of patent applications per 10 000 population; Russia's performance for this indicator in 2000 was 2.6 times higher than that of the Republic of Korea, 4.7 times higher than that of Germany and 5.7 times higher than that of the USA. However, when calculations are made of the ratio of the number of patent applications made abroad to the number of domestic applications, then the figure for the Russian Federation is substantially lower than those of the leading countries in world innovation activity. Thus, the high creative potential of Russian scientists, engineers and inventors is underdeveloped because of Russia's lack of integration in the world patenting process.

In view of the favourable economic development of the last four years, the President of the Russian Federation has set the strategic goal of doubling GDP in the next eight to ten years while keeping inflation down. However, as economic analysis shows, an increase in GDP of more than 7% a year is not possible if only based on continuing high prices for oil; it will necessitate further development of resource industries and a growth in exports of their products. (Some experts believe the present high oil prices are providing a 6–7% increment to GDP in the Russian Federation.)

Worldwide, significant growth in GDP has been based on expanding exports of competitive knowledge-intensive products. In the 27 countries of the OECD, the GERD/GDP ratio grew between 1992 and 2002 in a trend driven by the private sector. Over these ten years, funding of R&D by

Table 3
TRENDS IN HIGHER EDUCATION IN THE RUSSIAN FEDERATION, 1995 AND 2001*

	Total		State higher-education institutions		Non-state higher-education institutions	
	1995	2001	1995	2001	1995	2001
Number of educational establishments	762	1 008	569	621	193	387
Number of students (thousands)	2 790.7	5 426.9	2 655.2	4 797.4	135.5	629.5

* At the start of the academic year

Source: *Russia in Figures* 1995–2003. (In Russian)

2. The Candidate of Science degree in the Russian higher education system is the second university degree obtained after the initial five-year diploma. It is followed by a Doctor of Science degree. The PhD falls between the Candidate of Science and Doctor of Science degrees.

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

Table 4
ENROLMENT IN TECHNICAL AND TECHNOLOGICAL SPECIALTIES IN THE RUSSIAN FEDERATION, 1990–2001
In thousands

	1990	1995	1996	1997	1998	1999	2000	2001
Geology and prospecting	0 .9	1.9	1.7	1.5	1.4	1.5	1.7	1.8
Mineral exploitation	4.1	3.2	2.9	2.9	3.5	3.7	4.0	4.9
Energetics and power mechanical engineering	8.8	7.0	6.6	6.8	6.5	7.2	8.3	9.2
Metallurgy	3.9	2.9	2.9	2.8	2.4	2.6	2.8	3.0
Mechanical engineering and material processing	14.0	12.2	11.5	10.4	10.2	10.4	11.1	11.7
Aviation and rocket space-engineering	4.0	4.1	3.4	3.3	2.9	2.8	2.9	3.2
Surface transportation means	7.4	5.3	4.9	5.2	4.7	5.2	6.1	6.6
Technological machines and equipment	10.0	8.8	9.2	8.8	8.4	8.9	9.4	10.2
Electrical engineering	2.8	4.9	4.8	4.5	4.1	4.3	5.0	5.8
Instrumentation	3.9	3.5	3.3	3.0	2.9	2.8	3.2	3.2
Electronics, radiotechnics and communication	14.2	13.1	11.9	10.9	9.0	8.8	9.9	10.8
Automatics and control	10.8	9.8	9.3	8.4	8.2	8.5	9.3	9.8
Computer science and computation	7.1	9.4	8.8	8.7	8.2	8.7	9.3	9.9
Transport exploitation	4.5	4.3	4.9	5.2	5.5	6.2	6.8	7.0
Chemical technology	7.2	4.9	4.6	4.1	4.0	4.3	4.5	4.8
Food technology	8.5	3.9	4.0	4.2	4.4	4.9	5.3	5.8
Commodities technology	8.9	4.5	4.5	4.1	4.1	4.0	4.0	4.3
Construction and architecture	22.6	17.7	18.2	17.5	17.3	18.7	20.2	22.3
Agriculture and fishery	29.7	20.6	21.8	21.6	21.2	22.8	24.8	26.1
Other	6.5	9.1	8.6	8.5	0.3	9.4	12.2	15.3

Source: Kouznetsova, T.U. and Dobretsova, N.I. (eds) (2003) *Scientific Potential and Technical Level of Production: Russia in Figures.* (In Russian)

Table 5
TRAINING OF HIGHLY QUALIFIED S&T PERSONNEL, 1995–2003

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Postgraduate students									
Total in all establishments (at end-year)	62 317	74 944	88 243	98 355	107 031	117 714	128 420	136 242	140 741
In scientific organizations	11 488	12 700	14 508	15 771	15 420	17 502	17 784	18 323	18 959
In higher-education establishments	50 829	62 244	73 735	82 584	91 611	100 212	110 636	117 918	121 762
Postgraduate students by scientific specialty (out of 20)									
Physics and mathematics	5 888	6 599	7 025	7 237	7 360	7 522	7 552	–	7 640
Chemical	1 964	2 263	2 495	2 754	2 951	2 987	3 104	–	3 241
Technical	17 424	21 428	25 407	27 160	28 385	29 058	30 974	–	33 370
Candidates									
Total (at end-year)	2 190	2 554	3 182	3 684	3 993	4 213	4 462	4 546	4 567

Source: *Russian Statistics Yearbook* 1996–2003; *Russia in Figures* 2004. (In Russian) business increased by 50% compared with a rise of only 8% for government funding. The private sector's share of GERD climbed from 57.5% in 1990 to 63.9% in 2002 even as governing funding declined from 39.6% to 28.9%. The contribution of knowledge-intensive industries to GDP rose by a factor of 2.04 to 2.24% on average.

By comparison, only a quarter (27.2%) of entities performing R&D in Russia were privately owned in 2001. Taken together, business and non-profit organizations represented a share of 9.8% of GERD the same year, an increase of just 2.2% over 1995. The federal share of GERD dropped over the same period by 4.3%. These trends are symptomatic of the business sector's lack of interest in investing in long-term scientific R&D. Thus, doubling GDP through knowledge-intensive industries appears impossible without a considerable rise in private investment in this area.

There were some contradictory trends in the development of S&T in the Russian Federation in 1999–2003. Economic growth during those years indicated that the country was recovering from the long recession. Nevertheless, the main qualitative indicators of the country's economic development remained subdued. Continuing economic and institutional reforms have not been reinforced by a fundamental revision of the state S&T policy in a long-term perspective, there have been no essential alterations to the way in which R&D is organized and no solutions have been found for the economic and institutional problems that surfaced between 1992 and 1998 in the process of reorganizing S&T. This allows us to draw the conclusion that the prolonged systemic crisis of basic and applied science in Russia has not yet been overcome.

APPLIED SCIENCE IN RUSSIA: PROBLEMS AND PROSPECTS

The conceptual document, *The Foundation of the Russian Federation Policy in the Field of Science and Technology Development for the Period to 2010 and Further Prospects*,[3]

Table 6
PATENTING AND LICENSING IN THE RUSSIAN FEDERATION, 1995–2001

Indicators of patenting activity	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Resident patent applications per 10 000 population	1.12	1.22	1.03	1.13	1.37	1.61	1.72
Ratio of patent applications made abroad to domestic applications (conveyance)	0.50	0.80	1.16	1.45	–	–	–
Registration of agreements on licence trade and cession of rights on patents							
Total	1 095	1 313	1 521	1 616	1 578	2 114	2 022
By field of technology:							
Construction, construction materials	104	97	111	117	74	89	115
Mechanical engineering, machine-tool construction, materials production	102	260	181	383	197	345	311
Chemistry, petrochemistry	150	171	219	220	223	203	27
Metallurgy	55	63	84	82	95	85	63
Electronics	87	98	125	87	104	78	103
Light industry, food industry	166	179	204	218	271	323	269
Energy, electrical engineering	55	62	71	82	69	150	117
Medicine	230	215	196	171	224	264	131
Oil and gas industry	49	41	97	44	103	224	131
Other	97	127	233	212	218	353	355

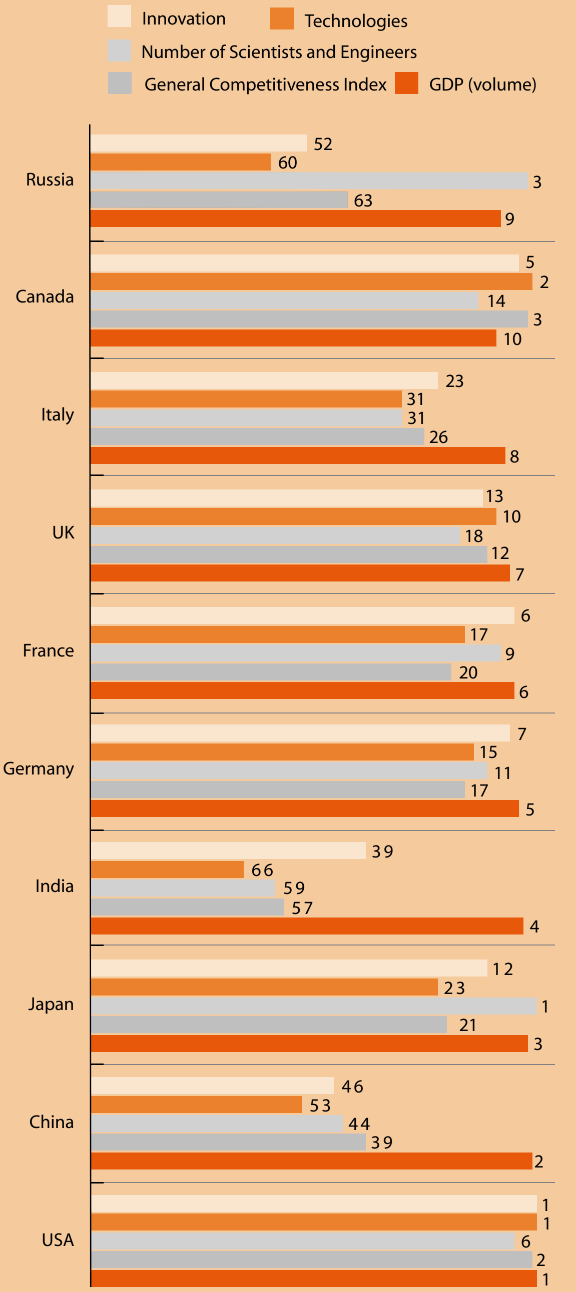
Source: *Russian Statistics Yearbook* 1996–2002; Russian Statistics Collection. (In Russian)

3. This was adopted in March 2002 by a joint meeting of the Security Council, the State Council Presidium and the Council by the President of the Russian Federation on Science and High Technologies and approved by presidential decree the same month.

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

Figure 10
WORLD RATING* OF RUSSIAN FEDERATION IN ECONOMIC DEVELOPMENT AND INNOVATION, 2002

Other countries are given for comparison



* A score of 1 indicates the top country in the world

Source: Beketov, N.V. (2003) *Science in Russia and in the World*. (In Russian)

market, the growth of production in one area does not sufficiently stimulate a rise in the other.

URGENT REFORMS NEEDED

This has resulted in a growing dependence on export-oriented production and world market conditions that is disruptive for the unity of the Russian economy. Hence, the urgent question of the day is whether the Russian Federation can bring about decisive acceleration of reform of the way in which Russian science is organized. Among the top-priority tasks are:

- to create the economic and institutional conditions needed for rapid development of innovation and investment activity in the sphere of science and knowledge-intensive industrial production, with the active participation of the private sector;
- to eliminate once and for all the differentiation of production technology into civil and defence, export and domestic;
- to improve the social and economic status of scientists and scientific groups;
- to complete a reorganization of the system of academic, higher learning and industrial institutions, as well as of the general and professional, secondary and higher-education systems;
- to develop significantly various forms of funding for scientists and groups actively involved in R&D (in particular to facilitate powerful private charitable foundations supporting S&T development);
- to introduce as soon as possible a law on intellectual property relevant to the market economy;
- to substantiate an organizational model of scientific R&D suited to the post-industrial reality and to redefine accordingly the principles and priorities of state S&T policy.

Solutions may be around the corner thanks to a high-level administrative reform being introduced at the time of writing this chapter in 2004. In 2003–04, the Ministry of Education and Science was established to reintegrate science and education management. The structure of the ministry includes the Federal Office on Intellectual

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005

Property, Patents and Trademarks; the Federal Office of Education and Science Supervision; the Federal Agency on Science; and the Federal Agency on Education.

Within the new government structure, other ministries are also closely linked to applied research and the organization of R&D, as well as to innovation (including scientific research, product development and the application of technology), among them: the Ministry of Economic Development and Trade, the Ministry of Industry and Energy, the Ministry of Transport and the Ministry of Defence, with departments such as the Federal Office in Technical-Military Cooperation, the Federal Office on Defence Contracts and the Federal Office on Technical and Export Control of the Russian Federation.

It is too early to draw conclusions about the efficiency of the new system of state regulation of S&T activity and science and engineering management in Russia, or to evaluate future prospects. Nevertheless, some favourable trends can already be seen: for example, the federal budget for 2004 projects further growth of some indicators of S&T development over 2001, 2002 and 2003. The allocation for science development amounts to 1.74% of general federal budget expenditure. Civil R&D will be allocated 14.9% more than in 2003. Grants will be given to scientific organizations for instrumental base development, unique stand maintenance, development of complex use centres and for the acquisition and maintenance of scientific equipment. Measures taken to redress the consequences of the USSR's differentiation between the S&T and industrial-technological spheres, as well as between the civil and defence sectors, are promising and already appear to be working. The alignment of all manufactured goods on universal, worldwide technical standards will be beneficial and reduce overhead costs.

A current issue for Russia is the development of scientific contacts with the European Union in the area of basic and applied research, which would facilitate the country's integration in the process of globalization. Russian scientists and engineers are already participating in some large-scale international S&T projects. Despite the fact that the Russian economy is still lagging behind those of developed countries, Russia is now entering the world innovation market. All these developments will expedite the recovery of S&T in Russia and help Russia's unique scientific community to advance in a number of directions with the prospects of being a player in global technological progress in the future.

BORIS KOZLOV

REFERENCES AND FURTHER READING

Reform of the system of government administration of the Russian Federation. http://www.hsl.ru /temp/2002/preskonf/009.ttm. (In Russian)

Avdulov, A.N. and Kulkin, A.M. (2003) *State Support Systems of S&T Activities in Russia and the USA*. INION, Moscow.(In Russian)

Beketov, N.V. (2003) Science in Russia and in the World. *Eäé*, 11. (In Russian)

Breev, B.D. (2003) Trends in Unemployment in Russia. In: *RHSF Calendar*, ISS. 4. (In Russian)

Economics and Life (1997) ISS. 45.

Gokhberg, Leonid (1998) The Commonwealth of Independent States. In: *World Science Report.* UNESCO Publishing, Paris.

Growth Competitiveness Index. http://www.weforum.org\pdf\gci\ExecSumm_Final.

Kouznetsova, T.U. and Dobretsova, N.I. (eds) (2003) *Scientific Potential and Technical Level of Production: Russia in Figures*. RUDN Publishers, Moscow. (In Russian)

Ministry of Economy and Development of the Russian Federation. http://www.gov.ru/main/ministry/isp-vlast47.html.(In Russian)

Ministry of Science and Technology of the Russian Federation (1997) Information materials. Moscow. (In Russian)

Science and High Technologies in Russia on the Threshold of the Third Millennium (2001) Nauka, Moscow. (In Russian)

Russian Statistics Collection 2001 (2002). Moscow. (In Russian)

Russian Statistics Yearbook 1990–2004. (In Russian)

UNESCO (1998) *World Science Report 1998*. UNESCO Publishing, Paris.

Uzyakov, M.N. (2000) *Transformation of Russian Economy and Possibilities for Economical Growth*. Moscow. (In Russian)

Vodopyanova, E.V. (2002) *Europe and Russia on the Map of World Science.* MPPA BIMPA, Moscow.(In Russian)

Warshawsky, A.E. (2001) Social and Economic Problems of Russian Science: long-term aspects of development. In: *Science and High Technologies in Russia on the Threshold of the Third Millennium*. Nauka, Moscow. (In Russian)

Victor Sadovnichy has been Rector of Moscow State University since 1992. He holds a PhD in physics and mathematics (1974) and is a specialist in informatics and applied mathematics. Among other research projects over the past 30 years, his study of the dynamic simulation of movement control of a spaceship resulted in a world first, the creation of a simulated zero-gravity state under ground conditions. He is also known for being the author of spectral theory, in 1967.

Professor Sadovnichy was appointed Head of the Mathematical Analysis Department of the Faculty of Mechanics and Mathematics at Moscow State University in 1982. In 1994, he was elected President of the principals of almost 700 Russian universities and other tertiary establishments and, the same year, President of the Eurasian Association of Universities. He has been a full member of the Russian Academy of Sciences since 1997. He is also a member of the Standing Committee of European University Rectors and a number of other international institutions.

He was awarded the M.V. Lomonosov Prize in 1973, which rewards outstanding achievements in the natural sciences and humanities. He was also the recipient of the State Prize of the Union of Soviet Socialist Republics in 1989.

Boris Igorevich Kozlov is Professor at the Russian Academy of Sciences. He has been Head of Department at the Academy's Archives since 1993 and is a Fellow of the Russian Academy of Astronautics.

After graduating from the Institute of Military Engineering in 1967, Professor Kozlov took up a position as Head of Laboratory at the Scientific Research Institute of Metrology, before going on to become Deputy-Chief Engineer. In 1976, he was appointed Scientific Researcher at the Institute of the History of Natural and Technical Sciences then later Chief Editor of the Institute's journal, *History of Natural and Technical Sciences*, and Acting Director, a post he occupied until 1993.

Professor Kozlov's research spans a wide spectrum of fields, from the general theory of complex systems to social history and the philosophy of science and engineering, scientific theory and noospherology (a prototype of sustainable development theory). He is the author of two inventions and 150 scientific publications.

UNESCO Science Report 2005 - ISBN 92-3-103967-9 - © UNESCO 2005