*Major trends in recent years are the stronger orientation of R&D towards the needs of industry, a quite substantial focus on non-oriented research and the still insufficient share of government funding assigned to social and environmental issues.*

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# 11 · Russian Federation

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## INTRODUCTION

According to the strategic document adopted by the Russian government in 2008, *Long-Term Social and Economic Development to 2020: A Policy Framework (LTDP-2020)*, Russia had completed its transition to a market economy and the transformation of its social and political systems by the turn of the century (Government of Russian Federation, 2008).

Since 2005, economic trends in Russia have clearly fallen into two distinct periods. During the first period (2005–2007), the economy grew and quality of life gradually improved, thanks largely to high oil prices and an initially weak currency, combined with rising domestic demand, consumption and investment.

The country then experienced a severe economic downturn in the last quarter of 2008, caused by a global financial crisis and subsequent economic recession (Table 1). In an effort to combat the repercussions of this recession, the Russian government, like governments elsewhere, developed an extensive national recovery package, *The Anti-crisis Plan for the Russian Federation* (Government of Russian Federation, 2009). This package is expected to help cushion the social cost of the recession, maintain a robust financial system and support some key industrial sectors, such as motor vehicle and aircraft manufacture, metallurgy and pharmaceuticals. This will require substantial public funds; the recovery package cumulated at about US$ 88.4 billion for 2008–2010 and represented approximately 9% of Russian GDP for 2009. Experts believe, however, that the recovery package may aggravate the risk of immoderate government intervention in the economy and slow down certain institutional reforms, particularly those intended to bring about a radical modernization of the economy and reform the country's science, technology and innovation (STI) system (INSOR, 2009).

The current economic recession is making it even more difficult for Russia to respond to pressing long-term global challenges, such as demographic trends, health issues, climate change and both energy and food security. These challenges are exacerbating domestic weaknesses and hampering the growth of the Russian economy. According to the *LTDP-2020*, the gravest among these weaknesses include:

- Russia's dependence on raw materials, with economic growth and a better quality of life being ensured chiefly by export earnings from oil, gas and other raw materials;
- persistent structural imbalances in the economy and a technological gap with leading industrial nations;
- the monopolization of most local markets, which suppresses incentives to improve productivity and competitiveness;
- persistent barriers to entrepreneurship and inadequate protection of ownership rights, including intellectual property rights;

**Table 1:** Major socio-economic indicators in Russia, 2005–2009

*Percentage change over previous years*

| | 2005 | 2006 | 2007 | 2000–2007* | 2008 | 2009 |
|---|---|---|---|---|---|---|
| GDP | 106.4 | 107.4 | 107.6 | 107.0 | 105.6 | 92.1 |
| Consumer price index | 110.9 | 109.0 | 112.0 | 113.6 | 114.1 | 111.7 |
| Industrial production index | 104.0 | 104.4 | 106.0 | 105.8 | 102.1 | 95.7 |
| Capital investment | 110.9 | 113.7 | 120.0 | 112.5 | 109.1 | 83.0 |
| Real income of population | 112.4 | 113.3 | 110.3 | 111.6 | 102.7 | 101.9 |
| Real average monthly wages | 112.6 | 113.3 | 115.8 | 115.0 | 109.7 | 108.5 |
| Retail trade turnover | 112.8 | 113.9 | 115.0 | 111.6 | 113.0 | 94.5 |
| Turnover of services purchased by population | 106.3 | 107.6 | 107.2 | 105.7 | 112.8 | 95.7 |
| Exports 133.1 | | 124.7 | 116.5 | 122.1 | 140.2 | 60.9 |
| Imports 128.8 | | 131.3 | 136.8 | 124.6 | 134.9 | 63.6 |

*Annual average growth rate

*Source:* Government of Russian Federation (2008) *Long-Term Social and Economic Development to 2020: A Policy Framework;* MED (2009) *Monitoring of Economic Development in the Russian Federation;* Rosstat (2009) *The Socio-Economic Position of Russia: 2009,* p. 7.

Constructed in 1959, the Pushchino Radio Astronomy Observatory in Russia has four fully steerable radio telescopes, a wide-band radio telescope and a nomenclature Large Phased Array.

*Photo: © Dmitry Mordvintsev/ iStockphoto*

- a lack of appropriate incentives and conditions for fostering a 'pragmatic coalition' between business, the government and the public;
- a low level of confidence in state authorities, combined with the insufficient effectiveness of public governance;
- glaring economic and social differences between regions; and
- a number of social issues, such as the significant inequality in income distribution and in the development of social infrastructure.

All this makes Russia's position extremely vulnerable and unsustainable in the long term and prevents a rapid transition to post-crisis recovery and growth. The President of the Russian Federation, Dmitry Medvedev, conceded this fact, in essence, when he decided to set up and head the Commission for the Modernization and Technological Development of Russia's Economy in May 2009.

More recently, in his State of the Nation address to both houses of Parliament on 12 November 2009, he said that 'We must start modernising and technologically upgrading the entire production sphere. This is an issue of our country's survival in today's world.' The President spoke of the decision to develop new medicinal and space technologies and telecommunications, as well as to 'radically increase energy efficiency.' One target he cited was for 50% of medicines commercialized in Russia to be Russian-made by 2020. The President added that government support would henceforth target those companies with explicit plans to raise efficiency and implement high-tech projects (President of the Russian Federation, 2009).

## R&D INPUT

### Trends in R&D expenditure

Gross domestic expenditure on research and development (GERD) in Russia almost doubled at constant prices during 1998–2008 (Figure 1). This is one of the highest growth rates for R&D investment worldwide. However, current GERD in Russia has still not climbed back to 1991 levels (it stands at 76.4%), nor even to half the level of 1990, the last year of existence of the Union of Soviet Socialist Republics (USSR).

Federal budget allocations for civil R&D grew 1.3-fold between 2005 and 2008 at constant prices, about 40% of which was allocated to supporting basic research. Also on the rise has been financial support for R&D through public procurement procedures – such as within the framework of federal targeted R&D programmes – as well as contributions to public science foundations, grants to outstanding research scholars and international co-operation in science and technology (S&T).

As a consequence, the salaries of research staff have also gone up. These are now 8.5% higher than the average for the economy as a whole and 13.5% higher than salaries in the manufacturing sector. The amount of R&D spent on each researcher in Russia (PPP US$ 40 100) nevertheless remains much lower than in other leading countries such as Germany (PPP US$ 238 000), the USA (PPP US$ 233 000) or the Republic of Korea (PPP US$173 000). Levels of expenditure in Russia are still insufficient to upgrade radically the quality of research equipment to compensate for years of neglect, even though this is a crucial factor in ensuring excellence in R&D (Box 1).

### **Box 1:** Russia's inadequate facilities for research

For many years, Russia has neither upgraded on a grand scale nor replaced or acquired machinery, equipment and other facilities for research when the need has made itself felt. As a consequence, vital resources for research have now deteriorated or are in short supply.

One-quarter (25%) of the machinery and equipment used for R&D in Russia is more than 10 years old and 12.3% more than 20 years old. The degree of wear and tear has been calculated at 55.2%. Overall, the share of scientific equipment in the aggregate value of machinery and equipment in the Russian R&D sector is 35.5%.

Installations specifically designed for R&D are available at less than 7% of R&D organizations and less than 20% of them have their own experimental base; for the former USSR, this figure was 34%.

*Source:* HSE (2008*a*)

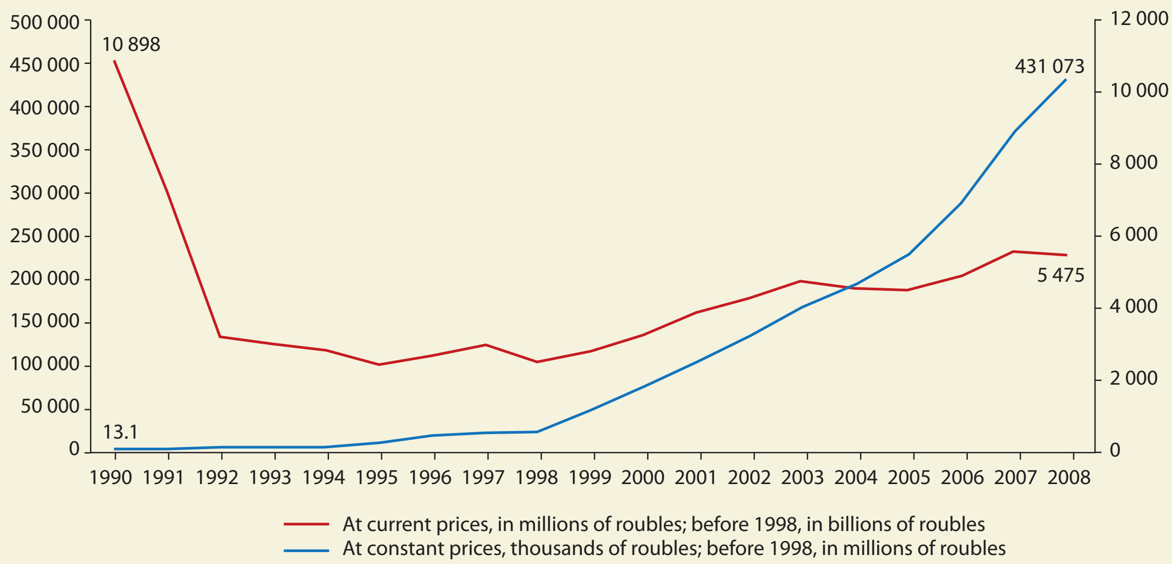
This said, in absolute terms, Russia has managed to conserve its place among the world's top ten spenders since 2000. During 2005–2008, GERD in Russia increased from PPP US$18.1 billion to PPP US$24.5 billion. This still places Russia far behind the USA (fifteen times higher), Japan (six times higher), China (four times higher), Germany (three times higher) and France (twice as high). For the purposes of comparison, Russia trailed only the USA, Japan, Germany and France in 1991 after the collapse of the Soviet Union. As for Russia's GERD/GDP ratio of 1.03% (2008), this is lower than in 2007 (1.12%) and a far cry from its level of 1.43% in 1991. Russia ranks 31st for this indicator in OECD and UNESCO publications (*Gokhberg, 2007, pp. 10–11)*.

Over the past few years, there has been little improvement in the structure of R&D funding and performance, or in the socio-economic objectives of GERD. Demand for R&D in Russia still comes mostly from the government, which remains the key source of R&D funding at around 65% of GERD. The continuing large share of the state budget dedicated to R&D is a necessity to a certain extent, reflecting the weakness of all other sources of funding. The business sector provides just 29% of GERD, a share that has even fallen slightly since 2005 (30%).

However, the roles of the government and business sectors are reversed when it comes to performing R&D. Here, it is the business sector (including both private and publicly owned companies) which performs nearly two-thirds of R&D and the government sector just 30%. Higher education institutions contribute the remaining 7%. Our analysis suggests that, unless it is accompanied by strong government incentives for private investment in R&D, growing public funding for R&D may increasingly substitute company financing rather than complementing it.

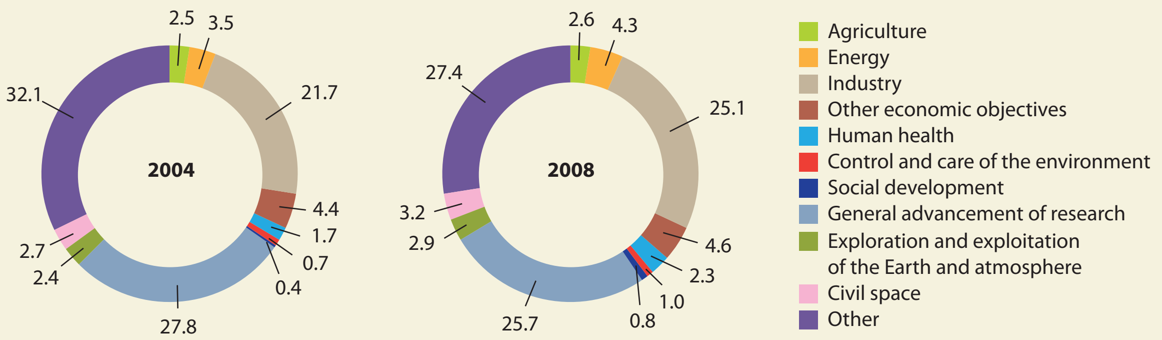
Figure 2 shows government funding of R&D by socio-economic objective. Major trends in this regard in recent years are the stronger orientation of R&D towards the needs of industry, a quite substantial focus on non-oriented research (at a stable quarter of GERD) and the still insufficient share of government funding assigned to social and environmental issues, even though these areas are no less important than others for socio-economic progress in Russia. Energy-related research, as well as that aimed at exploration and exploitation of the Earth and atmosphere and civil space applications, has recently gained a slightly greater stake in the overall financing of R&D.

**Figure 1:** GERD in Russia, 1990–2008




*Source:* HSE (2010) *Science and Technology. Innovation. Information Society;* HSE (2009b) *Science Indicators: 2009*

**Figure 2:** Government expenditure on R&D in Russia by socio-economic objective, 2004 and 2008 (%)




*Source:* HSE (2010) *Science and Technology. Innovation. Information Society;* HSE (2009b) *Science Indicators: 2009*

## TRENDS IN HUMAN RESOURCES

### An ageing research population

In 2008, there were 761 300 people engaged in R&D in Russia, including researchers, technicians and support staff. This represented 1.3% of the Russian labour force, or 0.6% of the total population. After several years of decline, this number has now more or less stabilized. The same is true for researchers, who totalled 375 800, or 49% of R&D personnel, in 2008. In terms of the absolute numbers of R&D staff, Russia is among the world leaders, coming only after the USA, Japan and China. However, the dynamics and structure of R&D personnel in Russia reveal an unhealthy imbalance. Unlike in many other countries, researchers in Russia account for less than half of R&D personnel. The remainder are mostly support and auxiliary staff (43%), rather than technicians serving the scientific process (8%). As a result, Russia ranks 10$^{th}$ globally in terms of the number of people engaged in R&D per 10 000 employees but 19$^{th}$ in terms of researchers. To compound matters, more than 70% of researchers in Russia hold no advanced scientific degree.

Between 2002 and 2008, the age structure of researchers was marked by absolute growth in the two polar groups, namely scientists under 30 years of age (up by nearly 18%) and those aged 70 years and above (up by a factor of two). Simultaneously, the ranks thinned of such creative age groups as 40–49 year-olds (down by nearly 58%) and 50–59 years (down by 13%). The bottom line is that about 40% of Russian researchers have overstepped the official retirement age of 55 years for women and 60 years for men. In 2008, researchers were 49 years old on average, compared to an average age of 40 years for those working in the national economy as a whole.

### A new type of university

The network of institutions of higher education is growing steadily in Russia. By 2009, they numbered 1 134 across the country. Of these, 660 are state-owned or municipal institutions, the remainder being privately owned.

Existing legislation defines three types of higher education institution: universities with multi-profile research activity (53% of the total), academies with mono-profile research activity (25%), and institutes that conduct no research at all (22%). In addition, a fourth type was introduced in 2008–2009, the federal university. This is a large-scale institution usually resulting from the merger of smaller local universities to become a key educational centre for macroregions. So far, the government has decided to inaugurate seven such universities in Russia: in the city of Rostov-on-Don in the south of the country, in the Siberian city of Krasnoyarsk, in Arkhangelsk (the European North), in Kazan (Volga Region), in Ekaterinburg (Urals), in Yakutsk (East Siberia) and in Vladivostok (Far East); other candidate institutions are under consideration.

**Box 2:** Higher education popular in Russia

According to the 2002 population census, 19.0 million people aged over 15 years hold university degrees in Russia. This represents about 16.0% of the overall population in this age group, compared to 11.3% in 1989. Among those aged 20–29 years, the share is nearly the same: 16.1%.

Regular surveys of household attitudes to education show that the majority (77%) of respondents with children aged between 4 and 22 years consider higher education to be important for their children's future; 56% of households say they would be willing to invest in higher education. University degrees are valued for the crucial role they play in obtaining well-paid positions (72% of respondents), becoming highly demanded professionals (45%), achieving success and enjoying rewarding careers (41%), and securing interesting and creative jobs (22%).

*Source:* Petrenko *et al.* (2007) ); HSE (2009*a*)



The status of a given higher education institution in terms of its allocation to one of these four categories depends on the nature of the education and research offered, as well as the comprehensiveness of educational programmes. In the present chapter, we shall use the generic term of 'university' to cover the various types of higher education institutions, in the interests of simplicity.

In 2008, 4.5% of university students were enrolled in natural sciences and 18.6% in engineering. Medicine and agriculture attracted 2.8% and 3.2% of student enrollment respectively. Socio-economic and managerial disciplines and the humanities have enjoyed sustainable demand ever since a shortage in educational supply in this sphere was revealed in the 1990s when market-oriented reforms were launched. Within a few years, the situation had righted itself to the point where concern was voiced at the excessive numbers of lawyers, economists, managers, accountants and the like being produced by universities. Today, the proportion of graduates in these fields remains unchanged: in 2008, 32.5% students in the public university sector obtained degrees in economics and management, 16.3% in humanities and 9.2% in education. Private universities are even more reluctant than the public sector to alter their policies and continue to turn out large numbers of students specializing in the humanities (32.6%) and in economics and management (58.4%).

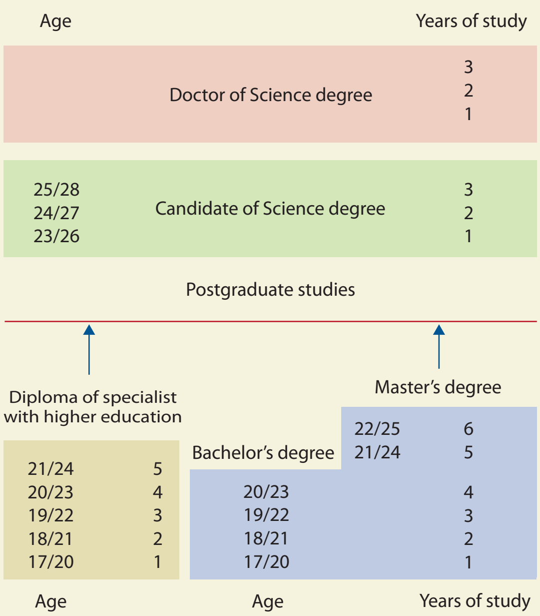
In 2008, the university enrollment rate in Russia was 529 persons per 10 000 population, up from 495 in 2005 (Box 2). Over the same period, the number of graduates per 10 000 employees shrank from 198 to 172. Despite the dynamic growth of private universities (by nearly one-third during the 2000s), over 80% of all students – both undergraduates and graduates – still pass through public universities. In view of this large proportion and the after-effects of the global economic recession, it would be difficult to say what the future prospects will be for private universities in Russia, especially considering the broad criticism they have attracted for the quality of training they offer. With stronger competition, those universities that are unable to ensure quality education will be ousted from the market. Another essential factor is the growth of student bursaries: in 2008, nearly 59% of entrants admitted to public universities were in possession of a bursary. This trend is also having an impact on the way private institutions of higher education function, since they mainly serve local markets and usually have no substantial impact on inter-regional student mobility.

## Modernizing the higher education system

The Russian higher education system has undergone significant modernization in recent years. In addition to the traditional five-year specialist training programme, bachelor's and master's programmes have been introduced (Figure 3). Since Russia only joined the Bologna Convention in 2003 (*see page* 150), over 90% of graduates with five years of study behind them still receive 'specialist with higher education' diplomas; just over 1% obtain a master's degree after six years of study and 7% a bachelor's degree after four years of study.

The qualifications of lecturers have improved visibly. By early 2009, the number of Doctors of Science in public universities had climbed to 42 100, or 12.3% of all faculty staff, a proportion that includes those working part-time. More than half of lecturers held a Candidate of Science degree, equivalent to a PhD. In 2003, the proportions were a little lower: 11.3% and 46.8% respectively.

**Figure 3:** Higher education system in Russia for scientific disciplines, 2009




*Source:* HSE (2009a) *Education in the Russian Federation*

The training of professionals with top scientific qualifications includes postgraduate programmes that confer a Candidate of Science degree (equivalent to a PhD) and doctoral courses leading to the highest scientific degree in Russia, the Doctor of Science. In 2008, postgraduate S&T programmes were offered by 1 529 organizations, 718 of which were universities and the remainder research institutes. Some 39% of these organizations – 388 universities and 205 research institutes – also ran doctoral courses.

Women made up just under half (43–45%) of the 147 700 postgraduate and 4 200 doctoral students in S&T fields in 2008. Most of the postgraduates (88%) and doctoral students (92%) specializing in scientific disciplines are on the university payroll. This means that the training of highly qualified scientists in Russia, like elsewhere, is increasingly becoming a core mission of universities and a top priority for them. Among disciplines for postgraduate training, it is engineering, economics, law, medicine and pedagogy which take the lead. Engineering and economics also tend to attract the most doctoral students, although their next preferences go to pedagogy, philology, physics and mathematics.

The dynamics of postgraduate training in Russia have generally stabilized in recent years. However, this also means that success rates have not improved: the percentage of students who completed their thesis within the prescribed period dropped from 30% to 26% in 2000–2008 (and even from 23% to 15% in research institutes). The average age of researchers upgrading their qualifications has risen to 41 years for doctoral students and 26 years for postgraduate students.

The national system for training scientific personnel and providing certification still suffers from inefficiency and inflexibility. The key concerns are:

- the declining quality standards for theses;
- the poor output of postgraduate and doctoral courses, with most graduates failing to deliver their completed theses on time;
- protracted and excessive formalization of certification procedures that are sometimes accompanied by biased attitudes and lack of objective peer review;
- the insufficient transparency of activities undertaken by dissertation boards at some universities and research institutes.

These issues become even more alarming in light of the shift announced by policy-makers towards an economy where the capacity to innovate is crucial. In this context, there is a need for efficient mechanisms to renew the stock of highly qualified personnel and, in particular, to ensure their high-quality training, promotion and rotation. This also calls for conditions conducive to consolidating human resources in S&T, education and high-tech industries. One policy currently being considered is the instigation of a separate advanced degree system for practitioners, such as businessmen, civil servants and lawyers, to ensure adequate recognition of their professional achievements in a form other than advanced scientific qualifications.

## MAJOR TRENDS AND KEY PROBLEMS IN R&D

### Greater support required for university research

Russia's higher education sector possesses significant S&T potential and long-standing research traditions. However, universities still play a minor role in new knowledge production: in 2008, they contributed just 6.7% of GERD, a figure that has remained fairly stable for the past two decades. Other key indicators also reflect a low engagement of university staff in R&D (Figure 4). Only one out of three universities performs R&D, compared with half (52%) in 1995. As for the private universities which emerged in the 1990s, they hardly perform any research at all. University R&D laboratories have not yet become a magnet for scientists. As a result, the population of full-time researchers at universities remains relatively small but stable in most cases: 28 900, or about 7.7 % of the country's research pool.

In addition to insufficient, albeit growing government support for university research, the higher education sector faces serious problems that are to a large extent dependent on available funding mechanisms. Public universities are budget entities with legally limited rights. They receive regular funding within the framework of educational programmes primarily but only a handful are able to compete with research institutes for tender-based R&D projects.

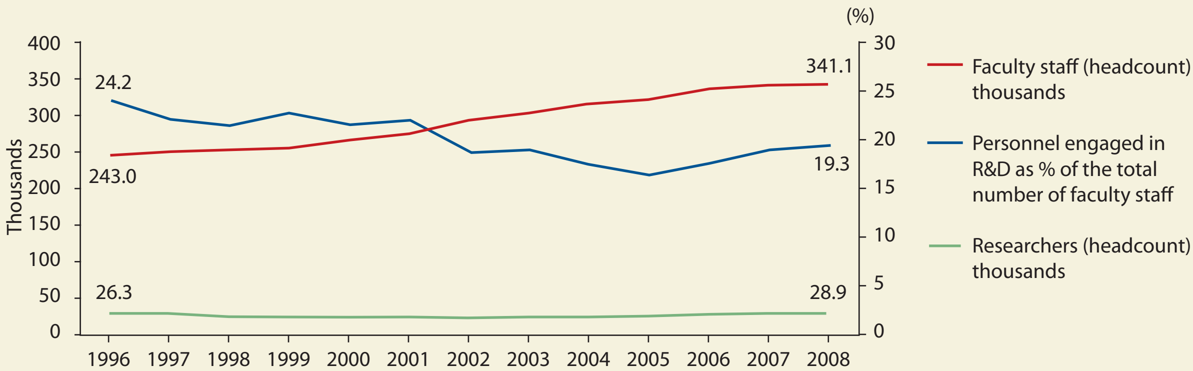
Boosting support for university research has become one of the most important strategic orientations of STI and education policies in Russia. For instance, the National Priority Project for Education (2006–2007) envisaged competitive grants for universities implementing innovative education programmes. It provided each of these centres of excellence with additional funding of approximately US$ 30 million in the form of two-year institutional grants. These grants served to promote human resource development, high-quality R&D and educational projects, and the acquisition of research equipment. There were 57 beneficiaries in 2006–2007. The main challenge today will be to ensure the sustainability of this project (Gokhberg *et al*., 2009*a*).

The National Priority Project for Education is not the only government initiative to have provided centres of excellence with support. In 2008, two Moscow-based universities, the University of Engineering and Physics and the University of Steel and Alloys, obtained the coveted label of national research university, a status that should channel subsequent incentives for R&D and educational activities their way. In 2009–2010, a follow-up programme selected another 27 national research universities in different areas of S&T.

Over the period 2009–2013, the federal programme Science and Education Personnel for an Innovative Russia (launched in 2008) is offering various incentives to attract young talent and highly skilled professionals to universities and R&D institutions. These incentives come in the form of contest-based funding for advanced research projects at science and education centres; and grants for gifted young scientists, teachers and postgraduate students, as well as for Russian scientists and teachers returning from abroad. All of these initiatives will be implemented regardless of any current financial obstacles.

In order to bring research institutes and universities closer together and remove existing legal and administrative barriers, a federal law on *Changes to Selected Laws of the Russian Federation concerning the Integration of Education and Science* was adopted in 2007. It provides a legal basis for different models of integrating scientific research with university training, such as setting up laboratories of public research institutes on university grounds and establishing specialized university departments at leading research institutes.

**Figure 4:** Staffing levels at Russian public universities, 1996–2008




*Source:* HSE (2010) *Science and Technology. Innovation. Information Society;* HSE (2009*a*) *Education in the Russian Federation;* HSE (2009*b*) *Science Indicators: 2009*

### Conflicting trends in R&D

The R&D sector in Russia is still developing along conflicting lines and remains subject to conflicting trends. On the one hand, many positive changes can be observed, which are particularly important since they mark a break with a longlasting 'big crisis' period for Russian S&T. Despite all the difficulties in the past two decades born of the collapse of the USSR and the so-called shock-therapy transition to a market economy, Russia has been able to maintain its strong position in basic research and in certain priority fields of applied R&D (examples being physics, nuclear research, space, biotechnology, organic chemistry and Earth sciences) to ensure an unbroken flow of technology to industry. At the same time, the national S&T sector continues to stagnate. It has three special characteristics which still follow – to a certain extent – the Soviet model:

- The S&T sector is relatively large in relation to its productivity, centrally directed and government financed (Kuznetsova, 1992; Gokhberg *et al*., 1997). These features are ill-suited to a market economy;

- There is a striking imbalance between the country's performance in STI, on the one hand, and the growing quantity of financial resources devoted to R&D, on the other. Moreover, the lion's share of these resources mostly circulates beyond the realm of the industrial and university sectors in public research institutions. Market reforms of the national innovation system are much slower and more superficial than those in other sectors of the economy and remain incomplete. Accordingly, while only 3–4% of businesses in the Russian economy are still publicly owned, the figure for R&D-performing units is over 70% *(*Rosstat, 2008, pp. 349; HSE, 2009*b,* pp. *36–37).*

- Structural indicators demonstrate that the institutional model of Russian S&T remains obsolete and erects multiple barriers between R&D, industry and education; this is impairing the quality of the supply of S&T in Russia and weakening Russia's position in the global S&T arena. It will obviously be extremely difficult for Russia to pursue its economic development and sustain its competitive position if this model is not radically amended. However, the S&T sector will not be able to deal with the problems it faces in its development, nor implement the necessary reforms effectively, as long as it remains under the yoke of government.

### Changing the organizational structure of the R&D network

Institutions executing R&D in Russia have been sensitive to demand. In 2000–2005, their number decreased by nearly 13%, whereas in 2005–2007, their number increased by 11%. It is hardly surprising that the latest financial crisis has sent numbers plunging again: the network shrank by 7% in 2007–2008, from 3 957 units to 3 666.

However, the structure of the R&D network remains much the same, given that the institutional features of Russia's R&D sector have changed little. As before, it is mostly dominated by research institutes, industrial design bureaux and technological organizations that are legally independent of universities and industrial enterprises (Figure 5). This tradition does not correspond to institutional arrangements characteristic of mature market economies, where national R&D sectors are typically led by industrial companies and universities. On the contrary, the latter still play a minor role in Russian R&D: according to official statistics, there were only 239 industrial enterprises and 503 universities engaged regularly in R&D in 2008 *(HSE, 2010).*

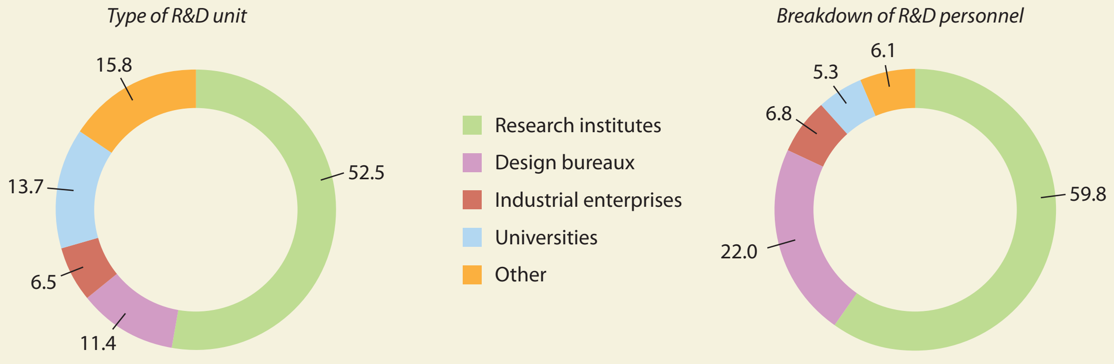
## R&D OUTPUT

### Trends in publications and patents

Deficiencies in Russia's S&T sector are reflected in R&D output and the impact of research applications on the economy and society. In 2008, Russian scientists published 27 300 articles in the journals indexed in the Web of Science, corresponding to 2.48% of the world total (HSE, 2010). For this indicator, Russia ranks 14$^{th}$ worldwide. This is a drop from 7$^{th}$ place in 1995 and an even greater fall from the 3$^{rd}$ place occupied by the former USSR in 1980.

While patenting activity in Russia is relatively intensive, with about 42 000 patent applications annually, placing Russia 6$^{th}$ worldwide, the share of registered licensing contracts in the country is low: 5–6% of annually registered patents. This can largely be explained by insufficient industrial demand for innovation but also by the poor competitiveness of Russian technologies, especially those destined for civilian applications. The supply of technology is unsubstantial in Russia and biased towards mostly unpatented R&D results. Annual technology exports from Russia amount to just US$ 0.8 billion; this compares with US$ 2.5 billion for Hungary, US$ 3.8 billion for Finland and US$ 85.9 billion for the USA.

**Figure 5:** R&D units in Russia by type and breakdown of personnel, 2008 (%)




*Source:* HSE (2010) *Science and Technology. Innovation. Information Society*

If we take another indicator, Russia's innovation activity expressed as a percentage of the industrial enterprises engaged in technological innovation has remained at 9–10% since 2000. The economies of the European Union (EU) perform much better for this indicator, ranging from a low of 20% in Hungary to a high of 63% in Germany. At the same time, the substantial 1.6-fold increase in expenditure on technological innovation in Russian industry between 2000 and 2008 holds some promise for domestic goods being more competitive in the future.

## NEW STI POLICIES

### Towards greater competitiveness and economic growth

The objectives of Russian STI policies since 2005 have been largely determined by socio-economic and political factors. As we have seen in Figure 1, the government was able to pump considerable additional resources into the S&T sector, thanks to high oil and gas prices up until the start of the global recession in the third quarter of 2008. However, Russia needs to deal with a whole set of complex challenges simultaneously, including those connected with the generation of new ideas, their commercialization and transformation into efficient technologies and, lastly, the production of competitive goods and services**.** STI policies face the dual challenge of having to stimulate both the demand and supply side of innovation markets.

In recent years, the Russian government has introduced a new cycle of strategic documents and implementation programmes, laying down the foundations and major objectives of STI policies for the medium term and long term. A most essential document, *The Strategy for S&T and Innovation in the Russian Federation until 2015* (2006), establishes crucial new approaches to promoting allied activities, as well as a system of programmes and other policy instruments that are interrelated in terms of tasks, timelines, resources and target indicators.

Another key document is the federal target-oriented programme *Research and Development in Priority Areas for S&T Development in Russia for 2007–2012* (2006). It aims to ensure accelerated development of the key segments of the national innovation system that have immediate links to priority S&T areas.

More generally, concern over how to address new global and national challenges underpins the president's report *On the Strategy for Russia's Development to 2020* (2008) and the aforementioned *LTDP-2020* with the same horizon of 2020. The report's emphasis on the need to shift towards an innovation-based scenario, dictated by the current state of the national economy, is of utmost importance. It also suggests that lessons could be learned from the experience of other nations that have succeeded in retaining or improving their global position by relying on effective institutions and instruments of innovative growth. Both documents also fix long-term objectives for S&T and socio-economic development in Russia consistent with global trends and national specificities and capabilities.

Despite their inevitable adjustment in 2009 due to the global recession, the measures outlined in *LTDP-2020* will, in the long run, make it possible to tackle the principal systemic problems facing the national S&T sector, namely an inefficient utilization of resources allocated to R&D, combined with weak industrial demand for innovation. In particular, *LTDP-2020* outlines four broad policy objectives for strengthening STI:

- promoting industrial demand for new technology and innovation;
- increasing the quality and scale of national R&D output;
- developing human capital capable of meeting the challenges and requirements of an innovative economy; and
- establishing an effective system for fixing and attaining R&D objectives and for setting and implementing long-term R&D priorities.

## SETTING NEW PRIORITIES FOR R&D

Russia has an established system for identifying and implementing R&D priorities so that resources can be distributed effectively to a limited number of fields in compliance with national development objectives, internal and external challenges and limitations. The current list of S&T priorities was approved by the President of the Russian Federation on 25 May 2006. It includes eight priority areas and 34 critical technologies. This list is intended to help Russia address global issues, ensure national competitiveness and promote innovation in key areas. It is also expected to evolve over time in both size and scope (Table 2). This list was used to design the federal target-oriented programme *Research and Development in Priority Areas for S&T Development in Russia for 2007–2012*. This was in turn followed by a government resolution *Approving the Rules for Setting Up, Adjusting and Implementing S&T Priority Areas and the List of Critical Technologies of the Russian Federation* (2009).

### A persistant priority: ICTs

A national S&T foresight exercise to 2025 was carried out in Russia in 2007–2008 to develop a better approach to identifying promising S&T areas and assessing their technological potential for improving the competitiveness of domestic industry. Figure 6 shows the results for the field of ICTs obtained from a Delphi survey[1] conducted within the framework of the same foresight exercise. These estimates are used in strategic documents on socio-economic development and to define government policies for STI. A new round of the foresight exercise up to 2030 was initiated by the Ministry for Education and Science in 2009.

### An emerging priority: nanotechnology

Since the *Strategy for Nanoindustry Development* was published at the President's initiative in 2007, great importance has also been attached in Russia to the development and wider use of nanotechnology (President of the Russian Federation, 2007). Owing to the economic crisis Russia experienced in the first half of the 1990s in its transition to a market economy, the country joined the global nanotechnology race a little late. As a consequence, its domestic 'nanomarket' is still in the early stages. Nonetheless, the country has managed to preserve its scientific potential in this domain, along with its world-class expertise and unique scientific facilities, which include synchrotron and neutron sources and atomic force microscopy. Russia figures among the global leaders in a number of specific areas of nanotechnology, including the development of new construction materials, catalysts and catalytic membranes; the production of biochips for rapid analysis and diagnostics of dangerous infections and diseases; light-emitting diodes and advanced light sources; and new technological and diagnostic equipment using these advanced technologies. Figure 7 shows how the level of Russian nanotechnology R&D in certain areas compares with state-of-the-art nanotechnology worldwide.

In order to mobilize organizational, material, financial and intellectual resources in this priority area, earmarked government programmes are being implemented. The list includes:

- the Programme for Nanoindustry Development in Russia to 2015;
- the federal target-oriented programmes for the Development of Nanoindustry Infrastructure in Russia for 2008–2010 and for Research and Development in Priority Areas for S&T Development in Russia for 2007–2012. The latter includes the priority area 'industry of nanosystems and materials'; and
- specialized publicly funded programmes in nanotechnology conducted by state science academies and science foundations.

1. The Delphi method uses a series of surveys to gather feedback from experts on possible developments in particular areas in order to establish a collective vision of the future.

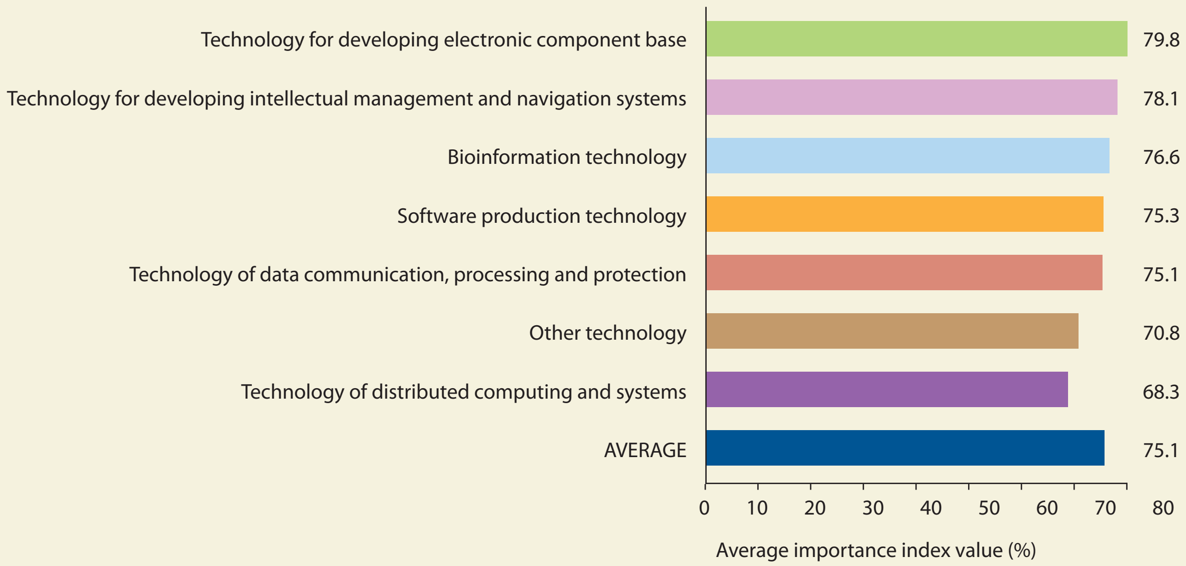
**Table 2:** Evolution of priority areas for R&D in Russia, 1996, 2002 and 2006

| **1996**<br>*Basic research* | **2002** | **2006*** |
|---|---|---|
| Information technologies and electronics | Information and telecommunication technologies and electronics | Information and telecommunication systems (18.1%) |
| New materials and chemical technologies | New materials and chemical technologies | Industry of nanosystems and materials (9.2%) |
| Transportation | New transportation technologies | Transportation, aviation and space systems (44.6%) |
| Manufacturing technologies | Manufacturing technologies | |
| Living systems technologies | Living systems technologies | Living systems (5.9%) |
| Ecology and rational utilization of nature | Ecology and rational utilization | Rational use of natural resources (8.7%) |
| Fuel and power engineering | Energy-saving technologies | Power engineering and energy saving (5.1%) |
| | Space and aviation technologies | |
| | Armaments, military and special equipment | Arms, defense and special technologies |
| | | Safety from terrorism, counterterrorism activities |

* In brackets is the percentage of GERD allocated to priority areas of civil-purpose S&T that is funded from the federal budget.

*Source:* Sokolov, A. (2006) *Identification of National S&T Priority Areas with Respect to the Promotion of Innovation and Economic Growth: the Case of Russia,* pp. 100–101; HSE (2010) *Science and Technology. Innovation. Information Society*

**Figure 6:** Ranking of ICT areas by importance for Russia, 2008 (%)




*Source:* HSE (2008*b*) *Russian S&T Delphi: 2025*

It is expected that, by 2015, all the necessary conditions will be in place for large-scale manufacturing of new nanotechnology-related products in Russia and for Russian nanotech companies to enter global markets.

In 2008–2009, the Higher School of Economics' Institute for Statistical Studies and Economics of Knowledge in Moscow developed a new statistical methodology for collecting data regularly on sales of nanotechnology-related products in Russia. This project was carried out jointly with the Russian Corporation for Nanotechnology (Rosnano) and the Federal Statistical Service (Rosstat). Sales of nanotechnology-related products in 2009 have been estimated at around 120 billion roubles (approximately US$4 billion), a figure that could grow to seven or eight times this amount by 2015.

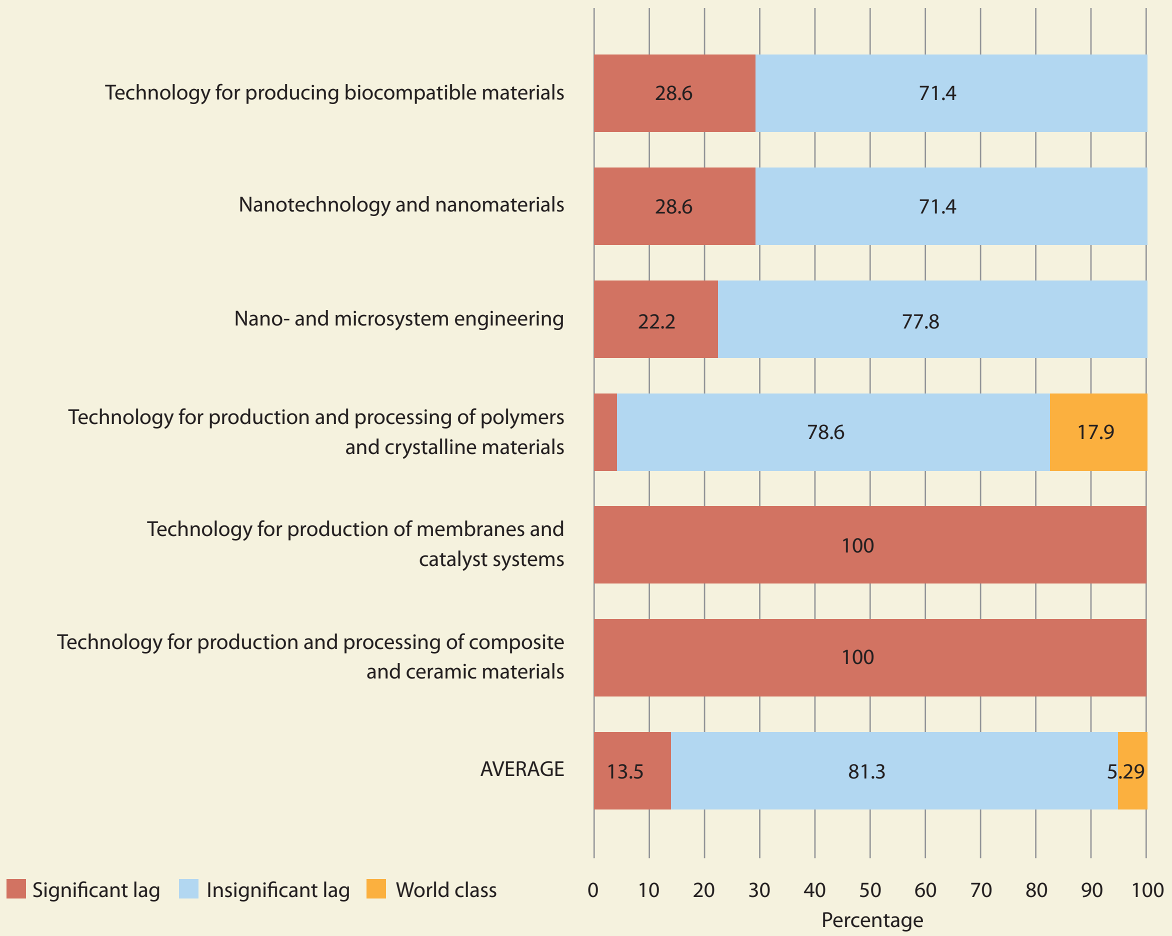
## RESTRUCTURING THE R&D SECTOR

### A new status for R&D institutions

The traditional dominance of the state-owned, state budget-funded institutions that was characteristic of the Soviet R&D model remains one of the key features of the Russian S&T sector (Gokhberg *et al.,* 1997). During the transition to a market economy, various types of commercial and non-profit R&D organizations were allowed to develop but government R&D organizations underwent little change. Nearly 43% of R&D institutes in Russia are still fully government-funded.

Just as national legislation imposes strict limitations on public universities, so too does it on R&D institutes.

**Figure 7:** Level of Russian R&D in nanosystems and materials, 2008 (%)




*Source:* HSE (2008b) *Russian S&T Delphi: 2025*

In many instances, this legislation contradicts academic freedom and economic reality. Government R&D institutes claim significant budgetary allocations but are not expected to provide any guarantees as to the efficient use of their budget. As a result, there is no immediate link between performance and funding. This is particularly true of state science academies (Box 3).

A new, more flexible legal model for state-owned institutions has been provided by the federal Law on Autonomous Institutions (2006). The new structures will be funded through lump-sum subsidies rather than through fixed budgetary institutional grants broken down by specific cost items, as is the case at present. This new approach is expected to provide better and more flexible opportunities for the development of research institutions and should increase their accountability when it comes to research results. Although they will remain government-owned entities, the new institutions will enjoy a certain autonomy in attracting – and spending – funds from non-governmental sources, including loans and investments.

Another important domain of organizational change in the Russian R&D landscape is the plan to establish several large-scale national research centres in order to ensure high-tech sectors obtain cutting-edge technology for the development of new products and processes. These new centres are also expected to enjoy greater autonomy than in the past. The first such research centre is the Kurchatov Institute in Moscow. It has been responsible for co-ordinating research in nanotechnology and an allied network in Russia; three R&D institutes were subordinated to the Kurchatov Institute in 2009.

### Evaluation of R&D units' performance

Efficient restructuring, coupled with improvements in the way state-funded R&D institutions operate, requires comprehensive tools for performance evaluation. Such instruments are widely used in many countries where they have proven their worth. During the immediate post-Soviet period in Russia, research evaluation exercises were mostly confined to the procedures followed by government agencies and state foundations when deciding which competing R&D projects to finance; the actual output of R&D institutions was not evaluated. This situation caused R&D spending from the federal budget to spiral upwards between 1998 and 2008. Spending tripled, even as the growth rate of certain output indicators fell below zero. To reverse the trend, a government policy statement was adopted in 2008, entitled *On the System of Performance Evaluation for Civil R&D Organizations*. Its main goals are to establish procedures and criteria for regular performance assessments of government R&D organizations and to optimize their network. The policy calls for a statistical survey to be conducted every five years, combined with

## **Box 3:** Modernizing Russia's Academies of Science

The Russian network of state academies includes the Russian Academy of Sciences and the five academies for agriculture, medicine, architecture and construction, education and arts. Together, these academies control 865 research institutes which employed a total of 137 500 R&D personnel in all occupational categories in 2008. Over two-thirds of R&D personnel are employed by the Russian Academy of Science's 468 institutes.

The most unusual feature of the academies` legal status is their 'mixed' nature, combining elements of a government institution, public association and corporation. In reality, academies act as holdings, 'owning' non-profit organizations. As government institutions, the academies are responsible for managing, controlling, creating and closing these organizations.

The most worrying issue is the mismatch between, on the one hand, the amount of public resources spent on funding research and running costs like maintenance of the academies' premises and, on the other hand, the performance of the academies in terms of R&D output.

In 2005, a programme was adopted to modernize the structure, functions and funding mechanisms of the state academies of science. The aim was to streamline the network of institutes governed by the academies. Some which did not meet quality standards were to be closed, staff numbers were to be reduced and salaries increased. Also envisaged was the reorganization of the way in which R&D was conducted to improve efficiency. This programme was supposed to be fully implemented by 2008 but had still not been completed in early 2010.

*Source:* authors

reviews by evaluation commissions involving major interest groups, such as government agencies, businesses, academia, the scientific community and nongovernmental organizations.

Evaluation criteria are based on the relationship between input and output. At the end of the evaluation process, every R&D organization will be assigned to one of three performance groups: the leaders, middle-runners or outsiders. Subsequent recommendations can then vary from closure for outsiders to earmarked support for leaders.

### A better legal framework for IPRs and the commercialization of new technologies

In recent years, the government has made a determined effort to promote the market for intellectual assets in Russia and develop a national system for registering and controlling publicly funded research projects. It has also created a single legal and organizational tool addressing intellectual property rights (IPRs) generated at the expense of the federal budget. The idea is to involve them in the economic turnover more widely and effectively than before.

In 2005, the government adopted two resolutions to improve the efficiency of intellectual property protection and promote lawful business transactions, co-ordinate the activities of partner agencies and strike a balance between the interests of all stakeholders. These are entitled *On the Procedure for Disposing of Rights to the Results of S&T Activity* and *On Government Registration of the Results of Civil-Purpose R&D.*

Subsequently, the government focused on developing and enforcing legislation to regulate the commercialization of technologies and protect related rights. In 2006, the Parliament adopted a new Part IV of the *Civil Code* which was designed to regulate intellectual activities in Russia. Two years later, the Law on the Transfer of Rights to Integrated Technology was adopted. This law aims for a multiple use of IPRs due to greater patenting and licensing activities. IPRs created at the expense of the federal budget will be transferred to market actors on the basis of open competition. This will allow public R&D organizations and universities to sell technologies developed under government-funded contracts to companies which, in exchange, will be obliged to commercialize these technologies. Subsequently, most publicly financed IPRs will not remain in state possession out of the reach of industrial demand but rather will enter into market transactions.

The ultimate objective of these and other laws and regulations is to improve the economic, legal and organizational framework for the commercialization of technologies to generate income from this activity and make the national R&D sector more competitive. Another important objective is to harmonize national legislation with the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), in order for Russia to meet the requirements for joining the World Trade Organization.

### Promoting public–private partnerships

Faced with the low demand for innovation and an insufficient influx of private investment into high-tech industries, the government decided to set up the Russian Venture Company (RVC) in 2006. This move was complemented by the founding of sector-specific state corporations, such as Rosnano (nanotechnologies), Rosatom (nuclear energy) and Rosteknologii (Russian Technologies) in 2007 and 2008.

The role of the RVC is to promote the investment of venture capital and other forms of financial support for S&T countrywide. Resources for its capitalization are allocated from the Investment Fund of the Russian Federation. The RVC then invests in regional and sectoral venture companies. The financial role of the sector-specific state corporations is to ensure that resources are concentrated in areas of national interest. As a rule, these corporations are established by special federal laws that determine their legislative framework, goals and organizational principles. For example, Rosnano is specifically dealing with the growing challenges posed by the rapid development of new nanotechnologies. Its key objectives include the commercialization of nanotechnology, investment in nanotechnology-related new businesses and infrastructure and the development of professional training in this field (Gokhberg *et al.*, 2009*a*; HSE/IWEIR, 2008).

### Tax incentives for strengthening R&D and innovation

After much debate, several new regulations for reducing the tax burden on R&D and innovation were adopted in 2007, followed by tax breaks established by the latest changes to the *Tax Code* taking effect in 2008. The most important novelties include new rules for calculating value-added tax (VAT), a tax on profits, and an overall simplification of the taxation system. For example, profits generated by selling or licensing IPRs are now exempt from VAT. A list of tax-exempt services that support the development of new or improved products was also approved. Regarding the taxing of profits, the list of R&D-sponsoring foundations whose goal-oriented funding does not have to be included in the calculation of the taxation base at R&D organizations has been lengthened. In addition, more favourable accelerated depreciation conditions have been introduced for R&D fixed assets.

These innovation–friendly taxation instruments will help to create a more favourable climate for innovation. In order to encourage business investment strategies to promote R&D and innovation further, a new round of tax legislation initiatives was launched recently. For example, in 2009, the government introduced tax benefits for entities investing in R&D and priority S&T areas, such as bio- and nanotechnology, nuclear energy and new types of transport system. The next round of favourable tax novelties will take effect in 2010, with a particular emphasis on easing conditions for compulsory social security payments for employees of companies whose main economic activities are ICT development, engineering and R&D; and tax breaks for profits generated by medical and educational services. It is planned to simplify the procedure for customs registration of imports of high-tech equipment and materials, as well as to introduce financial guarantees for exports of high-tech products.

### Improved infrastructure for innovation

Infrastructure for technology commercialization and transfer makes up an important part of Russia's national innovation system. This infrastructure includes 66 technology transfer centres, 84 technoparks, 174 innovation and technology centres, and 81 business incubators. In most cases, these are associated with research institutes or universities (HSE, 2008*b*).

Government schemes to strengthen infrastructure promoting innovation have primarily been concentrated in three areas:

#### *Technoparks*

There are dozens of technoparks in Russia, although technopark policies are fraught with problems due to multiple 'white spots' in the legislation that dramatically weaken the capabilities of universities and R&D institutions to commercialize new technologies. On account of their legal status, state universities and government R&D institutions have limited rights when it comes to creating or directly supporting innovative small and medium-sized enterprises; in particular, they are not allowed to provide any funding or facilities for start-ups[2]. That is why Russian technoparks either do not function autonomously but rather as part of a 'host organization', or do not engage in innovation at all, merely leasing the premises and facilities to others.

To make better use of technoparks, the government is considering the following options: providing technoparks with federal land on a competitive basis, both for purchase and long-term leasing; direct investment in technopark infrastructure by government agencies and publicly sponsored venture companies; and sharing costs between federal and regional authorities.

#### *Special economic zones*

These were introduced in Russia in 2005 in order to provide a favourable regime for innovative entrepreneurship in certain areas of S&T. Particular locations were identified specifically to encourage the development of new high-tech businesses. Special economic zones can be found in Saint Petersburg, Dubna, Zelenograd, Tomsk and elsewhere.

#### *Science cities*

The concept of science cities follows the Soviet-era tradition of urban settlements specialized in S&T. At one time, about 70 municipalities were ranked as science cities, 29 of which were located in the Moscow region. During the 1990s, their heavy reliance on S&T activities resulted in economic and social hardship. In a new approach, the government is determining priorities for each city and a state programme for S&T development, with specific forms of federal support. Science city funding, along with assistance with logistics and maintenance, is provided by the federal budget, by the budgets of regional and local authorities, and by other funding sources. Once science city status for 25 years is confirmed by the President of the Russian Federation, this decision serves as a catalyst for the allocation of additional federal funding on a competitive basis for the implementation of innovation projects. In addition, more efficient mechanisms for transferring federal funds to local innovation-related initiatives are to be introduced in 2010–2011 through amendments to existing legislation.

2. A special law to eliminate these barriers was adopted in 2009 and further legislative initiatives in this direction are in the pipeline.

## INTERNATIONAL CO-OPERATION IN S&T

In order to facilitate its integration in the global S&T arena and assume a greater role, Russia has been stepping up its efforts to develop international co-operation. A crucial aspect of this co-operation are the ties with the EU, international organizations and regional economic associations.

The *Agreement on Co-operation in Science and Technology between the European Community and the Government of the Russian Federation* was adopted in 1999. Although this formally expired in 2007, both sides have agreed to prolong its validity until a new accord can be signed. A road map for setting up the EU–Russia Common Space of Education and Science has been developed jointly with the European Commission on the basis of the principles of equality and partnership, taking into account the mutual interests of both parties. At the same time, the EU and Russia are strengthening the co-ordination of their priorities for S&T and innovation in areas that include new materials, nanotechnology, non-nuclear energy production, ICTs and biotechnology in fields such as food and health. These efforts have already yielded a growing number of joint initiatives, including co-ordinated calls, for project proposals. Thus, for the EU's Sixth Framework Programme for Research and Technological Development (2002–2006), Russia ranked first among participating third parties, both in terms of the number of projects implemented with European partners and the amount of funding obtained from the EU (European Commission, 2009). Moreover, bilateral discussions regarding Russia's association with the EU Framework Programme started in 2008–2009.

Strategic importance is also attached to contacts with the European Organization for Nuclear Research (CERN), the Organisation for Economic Co-operation and Development (OECD) and other international bodies. Apart from the obvious benefits associated with access to modern multilateral programmes and facilities, participation in international projects allows Russian companies to secure large-scale orders. Other projects make it possible for Russia to adapt and adopt efficient instruments for promoting S&T and innovation. These instruments include various forms of public–private partnership, technology foresight exercises, cross-country co-operation and technology transfer, and support for small and medium-sized enterprises.

In addition, Russia continues to participate in most of the international projects and alliances involving space research, including the International Space Station in low orbit above the Earth[3] and the 'Sea Launch'.[4] These partnerships are supported by the Russian Space Agency, which considers them an essential element for implementing the national space programme. Russia is also an active participant in the International Committee on Space Research (COSPAR) and the United Nations' Committee on the Peaceful Uses of Outer Space (COPUOS).

Within the framework of international S&T co-operation, many joint laboratories, research, education and innovation alliances and partnerships have been established. Examples include joint laboratories organized with the participation of Russian research centres and universities together with the Dutch Organisation for Applied Research (TNO), CNRS (France), Industrial Technology Research Institute (Chinese Taipei), partner organizations from the Republic of Korea, etc., in chemistry, biology, nanotechnology and other S&T fields. In addition, legal and organizational tools for co-operation at both intergovernmental and interdepartmental levels have been improved. It is even more promising that a growing volume of commercial contracts and agreements are being concluded in the S&T sector with other countries and that an increasing number of joint ventures are being set up in Russia. Thus, the joint–stock enterprise Alcatel-Lucent RT established by the respective French company and state corporation Russian Technologies is starting to invest in 2010 in the development, manufacturing and marketing of telecommunications equipment for the Russian market and those of the countries of the Commonwealth of Independent States[5]. Rosnano and its Italian partner company Galileo Vacuum Systems is launching a new company to produce Radio Frequency Identification (RFID) labels at manufacturing units located

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3. The assembly of the International Space Station is expected to be completed by 2011. The project involves the American National Aeronautics and Space Administration (NASA), Canadian Space Agency (CSA), European Space Agency (ESA), Japan Aerospace Exploration Agency (JAXA) and Russian Federal Space Agency (RKA).

4. Sea Launch is a unique, mobile platform from which spacecraft can be launched and rockets fired at sea from an optimum position on the Earth's surface. It involves a consortium of four companies from Norway, Russia, Ukraine and the USA.

5. The CIS consists of nine former Soviet republics. See Annex I for the list of CIS countries.

in Russia, Italy and Serbia. The Russian side will contribute 49% of the requisite investment and the company will be a proprietor of any technologies that are developed. Meanwhile, the jointly owned US–Russian company IsomedAlpha has begun production of high-tech medical equipment like computer tomographs.

These international partnerships are making it possible to increase exports of high-tech products and services in certain areas. For example, in 2005–2007, exports of Russian ICT products doubled and those of electronic equipment, aircraft and spaceships grew by 40–50% (HSE/IWEIR, 2008; HSE, 2009*c*, p.65).

## CONCLUSION

As 2010 gets under way, Russia, like other nations, is in the throes of a highly complex global economic recession. Owing to its national peculiarities, the country not only enjoys certain advantages – primarily, its huge resource potential and substantial financial reserves – but also faces great challenges in its efforts to recover from the economic recession. The need to innovate in response to the crisis is obvious and is confirmed by the fact that most industrial nations are implementing economic recovery packages. These programmes normally focus on improving macro-economic parameters and on ensuring national competitiveness in the post-crisis period. To this end, the recovery packages of these countries envisage measures for supporting promising areas of S&T, as well as indirect incentives for innovating companies.

The Russian government today favours the same approach. Anti-crisis measures that are clearly innovation-oriented, along with other initiatives, are placing considerable demands on the R&D sector. This requires prompt intervention to move institutional reforms forward in order to overcome the lack of co-ordination at the departmental level, lower persisting administrative barriers between science, education and industry, and increase the efficiency of R&D organizations. This should lead ultimately to the concentration of resources in the centres of excellence created in leading research institutes and universities. These centres of excellence should be able to ensure the delivery of cutting-edge achievements in basic science, as well as applied results and technology that can meet growing demand from the national economy. This should be accompanied by additional policy measures to provide greater opportunities for public research bodies and universities to participate in innovation, facilitate academic mobility and radically modernize the professional training of scientists and engineers.

At the end of the day – recession or not – Russia will have no choice but to improve substantially the efficiency of its national S&T sector and innovation policies. All the necessary transformation processes have undoubtedly been set in motion but they call for a stronger focus on the part of all stakeholders; direct and indirect systemic support from the government; forward-looking innovation-based company strategies; and for monitoring of both the steps taken and their impact.

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Russian Venture Company: www.rusventure.ru

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