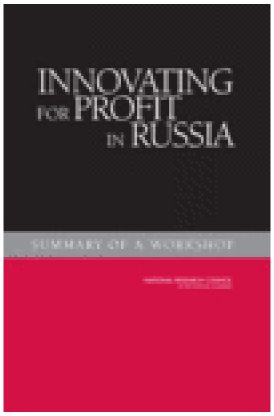

Innovating for Profit in Russia: Summary of a Workshop

Glenn E. Schweitzer and Rita S. Guenther, Editors, Committee on Innovating for Profit in Russia: Encouraging a "Market Pull" Approach, Office for Central Europe and Eurasia, National Research Council, Russian Academy of Sciences

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INNOVATING FOR PROFIT IN RUSSIA

SUMMARY OF A WORKSHOP

Glenn E. Schweitzer
and
Rita S. Guenther
Rapporteurs

Committee on Innovating for Profit in Russia:
Encouraging a "Market Pull" Approach

Office for Central Europe and Eurasia
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This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

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Introduction

From 1997 to 2003, the National Research Council (NRC), together with Russian counterpart organizations, sponsored a series of activities devoted to industrial innovation in Russia.[1] Initially, the joint efforts focused on the emergence of small innovative firms, with the emphasis subsequently shifting to the role of a few large Russian firms, in outsourcing research activities to Russian research institutes. As part of these efforts, workshops were held in Washington, Moscow, Samara, and Obninsk. Consultations by American experts were held in these and other Russian cities. Meanwhile, Russian specialists involved in the program met with officials in Washington and consulted with their counterparts in several additional U.S. cities.

The Russian Academy of Sciences (RAS), including a number of its institutes, served as the principal partner of the NRC for these activities. The former Ministry of Atomic Energy, former Ministry of Science and Technology, and former Ministry of Education also played active roles. Following the Russian governmental reorganization in 2004, the successor organizations to these ministries have increased their interest in science, technology, and innovation and continue to assist in facilitating interacademy activities related to innovation.

[1]The Russian Government has followed the lead of the Organisation for Economic Co-operation and Development in Paris by defining innovation to include the following activities: research and development; acquisition and use of equipment, technology, rights for patents and licenses, and software; industrial design; personnel training; and market research. See L. Gokhberg and L. Mindeli. 2003. *Russian Science and Technology at a Glance*, 2002, Centre for Science Research and Statistics, Moscow, Russia.

Some of the earlier interacademy efforts were documented in two published National Academies reports, *Technology Commercialization: Russian Challenges, American Lessons* and *Successes and Difficulties of Small Innovative Firms in Russian Nuclear Cities*.[2] Additional observations gained from these activities have been included in presentations by participants at conferences.

In view of this base of experience, the office of the Department of Energy responsible for the Nuclear Cities Initiative (NCI) awarded a grant to the NRC in 2003 to organize and conduct an interacademy workshop in Yekaterinburg on industrial innovation in the Urals region of Russia. The emphasis was to be on improving linkages between Russian industrial companies and Russian research organizations. Discussion of the concept of "market pull" was to be an important aspect of the workshop. Linkages between Russian researchers and international companies and foreign research centers are also important, and they were also to be considered. However, the focus was to be primarily on Russian-Russian linkages, which had previously received less attention by the NCI program.

The workshop was held in Yekaterinburg, Russia, in October 2004 (for agenda of plenary sessions, see Appendix A). Many aspects of the innovation process from basic research through successful marketing of new or improved products or services were considered. Experiences of many Russian organizations, together with relevant experiences of Western companies, research organizations, and universities were also presented. Successes of focused programs designed to improve existing products and production capacities, and experiences with technology incubators and related approaches were specifically addressed by Russian and American participants.[3]

As indicated in Appendix B, the NCI program assists in the creation of sustainable jobs in the nuclear cities of Russia for specialists who had been engaged in defense-related activities. The emphasis of the program has been on jobs which produce new and improved goods and services for the civilian market thereby drawing on the technical skills of former defense scientists. Often the creation of these jobs requires a closer link between the scientific-research com-

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[2]NRC. 1998. *Technology Commercialization: Russian Challenges, American Lessons*. National Academy Press, Washington, D.C.; NRC. 2002. *Successes and Difficulties of Small Innovative Firms in Russian Nuclear Cities*. National Academy Press, Washington, D.C.

[3]For a detailed discussion of the innovation process as viewed in the West, see Howard, William G., Jr., and Bruce R. Guile, editors. 1992. *Profiting from Innovation, The Report of the Three-year Study from the National Academy of Engineering*. The Free Press, New York. Some of the most difficult technology transfer problems in Russia are discussed in Nikolay Rogalev. 1998. *Technology Commercialization in Russia: Challenges and Barriers*. Austin: IC2 Institute, University of Texas at Austin. The following report is also useful in framing the issues: Organisation for Economic Co-operation and Development. 2001. *Bridging the Innovation Gap in Russia*.

munity and the industrial sector as well as a greater emphassis on technology transfer.

While improving linkages between researchers and industrialists is an important aspect of the commercialization of technology, there are other successful approaches to facilitating technology transfer, as has been documented in the previous NRC studies cited above. These approaches include, for example, establishing high-tech spin-off companies from research organizations, improving the management and marketing skills of research managers, and organizing technology exhibits. The fundamental links between research and industry, which make technology transfer possible, were the focuses of this particular workshop.

During the workshop, the experiences of specialists in the nuclear cities were discussed. At the same time, lessons learned by Russian specialists from other areas of Russia, in particular from Yekaterinburg, proved to be informative for both the American managers of the NCI program and for the nuclear city participants. Equally valuable were the experiences of experts from Russian universities. The perspectives of university technology transfer specialists underscored the importance of linking education with technology transfer efforts, even though the higher educational institutions in the nuclear cities have not yet developed technology transfer programs.

The workshop was intentionally held just before the Third Innovation Conference in Yekaterinburg entitled "Regional Aspects of Science and Technology Policy: From Basic Research to Putting Innovations into Practice." As a result, there were opportunities for the American and Russian workshop participants to interact informally with industrialists and local and regional officials who participated in the conference.

Finally, the workshop took place just after the Russian Ministry of Education and Science, with the support of President Vladimir Putin, proposed a dramatic change in the role and organizational structure of Russian research organizations, and particularly the RAS.[4] The basic ideas of the proposed change were to reduce the number of publicly supported research institutes throughout the country and to focus the remaining institutes more sharply on the economic and social needs of the country. This approach would presumably lead to closer research, education, and industrial development efforts.

These reorganization proposals will be debated and possibly implemented in part over the next several years. While they may not have a direct impact on the institutes in the nuclear cities, they are causing a reassessment of research institutes throughout the country; this introspection will most likely have effects in the nuclear cities.

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[4]Russian Ministry of Education and Science. September 16, 2004. The Concept for the Participation of the Russian Federation in the Management of State Organizations that Conduct Activities in the Sphere of Science. Moscow, Russia.

Against this background, Chapter 1 of this report includes summaries of the presentations given during the plenary sessions of the workshop, highlights of the conference on innovation that followed, and the significant issues discussed during the breakout sessions. Chapter 2 presents the principal themes that emerged during the workshop. Finally, the appendixes include three documents that help provide the context for the workshop. Appendix C sets forth the 2002 science and technology policy of the Russian Federation, which addresses many aspects of innovation. Appendix D presents an excerpt from a proposal of the Ministry of Education and Science to improve Russia's overall approach to innovation set forth in 2005. While this document was not available to participants at the time of the workshop, it provides valuable insight into strategic planning for innovation at the federal level. This perspective complements that of the perspective at the regional level. Appendix E provides the text of a workshop presentation by a representative from Snezhinsk that focuses on the special problems in one important nuclear city.

The two government documents (Appendixes C and D) reflect the Russian government's effort to take into account the many dimensions of national science and technology policy while developing practical steps to stimulate innovation. This indicates that the government is attempting to develop a complex innovation model for which it can claim ownership despite financial limitations. Difficult issues such as tax reform, two-way international outsourcing of technology development, and the adoption of metrics to measure success must continue to be addressed; but a start has been made.

While this report was prepared primarily for the NCI program and for its participants in Russia, other U.S. and Russian organizations should also find the report of interest. For example, the DOE program on Initiatives for Proliferation Prevention and the program recently launched by the Departments of State and Commerce to expand cooperation in promoting high-tech innovation are consistent with the topic of this report. Finally, while Russian colleagues have considered many of the observations presented here in a disparate fashion, the report may assist them in developing a broader context for their individual activities.

1

Summaries of Workshop Presentations and Discussions

PLENARY SESSIONS

Introductory Remarks

Academician Valery N. Charushin, vice chairman of the Urals Branch of the Russian Academy of Sciences (RAS), Yekaterinburg, and host of the workshop, presented an overview of the activities of the Urals Branch. More than 3,300 scientists work at the 39 research institutes and related organizations comprising the Urals Branch. The principal innovation activities of the Branch are directed to

- new information technologies
- materials sciences
- physical equipment
- scientific instruments, measuring systems, and control methods
- new chemical technologies, including synthesis of drugs
- biotechnology
- medical devices

The innovation infrastructure of the Urals Branch includes the following facilities

- innovation technology center
- technology transfer center

- nuclear center
- experimental nuclear reactor
- instrumentation research center
- multimedia technology center
- pilot plant
- academy-university innovation center
- academy-industry innovation center

A number of successful innovations have attracted Russian industrial customers. For example, a multi-channel amplifier is used for shock and vibration testing by a leading Russian aerospace company. A magnetic defect detection system is used by Russian industry to monitor gas and oil pipelines. New techniques have been developed for making locally produced titanium wire for medical applications. Internationally, companies in Japan, Korea, and the United States use technologies developed within the Urals Branch.

Alvin W. Trivelpiece, the chair of the National Research Council (NRC) committee and a consultant at Sandia National Laboratories, emphasized that a logical application for the skills of specialists in Russia's nuclear cities is the further development of nuclear power. Some estimates indicate that 1,000 new nuclear reactors will be required to meet the needs of developing countries for stable and reliable sources of energy. Also, there are many opportunities for innovation in nuclear medicine, a field in which Russian specialists have considerable relevant experience.

An interesting experiment in fostering contacts between laboratories and industry was a former policy of the U.S. Department of Energy (DOE) that encouraged U.S. nuclear laboratories to provide a few days of free consulting services to companies in need of technological advice. In one success story, a laboratory expert in graphite processing saved a pencil company from bankruptcy by recommending a change in a process that was rapidly wearing out the dies that extruded the graphite for the pencils. He discovered that the graphite was crystallizing in a way that scored the dies, and adoption of his recommendation to change the process that caused the crystallization returned the company to solvency.

In short, effective technology transfer requires close interactions between researchers and company personnel. Without continuous close contact, the likelihood that innovations developed by research institutions will find interest within companies is low.

George D. Pomeroy, who represented the Nuclear Cities Initiative of DOE in Washington, D.C. (the financial sponsor of the workshop), reviewed the objectives of the program. They are to: (a) prevent the proliferation of nuclear expertise by supporting the transition of displaced workers to commercial jobs; (b) support Russia's planned reduction in the nuclear weapons complex through the creation of jobs; and (c) encourage partnerships that focus resources and expertise on defense conversion. The cities of Sarov, Snezhinsk, and Zheleznogorsk currently participate in the program, and Seversk and Zarechny are being considered as future participants.

Thus far, the program has created or expanded 26 businesses with 1,600 new jobs. As this positive experience indicates, when considering linkages between researchers in the nuclear cities and industry, technology push is significantly less effective than responding to market demand. Good management is also key. Further, a good business plan and effective use of business consultants are essential. Multiple investors from both the private and public sectors are desirable. As linkages expand, commercial centers located outside the fences of the closed cities should be considered to ease access problems for potential foreign investors interested in technologies developed by specialists from the cities.

Building an Effective Partnership: From Idea to Market

Yury F. Maidanik of the Institute of Thermal Physics, Yekaterinburg, reported on the advantages of loop heat pipes. The thermal conductivity of a heat pipe can be hundreds of times higher than that of solid copper, but their heat-transfer capacity is relatively low. They have no moving parts, and so have the advantage of high reliability and a prolonged service life. They are very useful in spaceflight, but must be designed for the gravity environment where they are used. A heat pipe designed for space, for example, would not work in earth's gravity. One disadvantage, therefore, is a high sensitivity to changes of orientation in terrestrial applications.

The Institute of Thermal Physics has provided heat pipes for the space program since 1989. Now, it is exploring applications in automobiles, desktop and laptop PCs, avionics, and low-potential heat sources. During the past decade, the institute has had research and development contracts with companies and research laboratories in the United States, Europe, China, Japan, and Korea.

The institute has an experienced research team and adequate research equipment. It has an experimental production base and is prepared to enter into arrangements concerning patents and licenses. For mass production, however, it needs customers and investments.

Natalya Y. Pomortseva of the Urals Branch, Yekaterinburg, and a consultant to the Russian firm PRAD, described a successful technology transfer program that created a new business in which researchers were rewarded with royalty payments. A joint venture was established with paying customers, and the corporate culture of the Russian firm has improved via contacts with Western business partners. This new niche in the Western market created new jobs in Russia.

Pomortseva explained how the joint venture began. The Russian company PRAD faced a problem with a helicopter compressor engine that experienced severe erosion damage. The scientific team at the Urals State Technical University and the Institute of Electrophysics developed a proprietary ion-implanted coating technique that improves adhesion and fatigue properties while reducing coating imperfections. The approach prevents erosion of the compressor rotor from sand, dust, or volcanic ash. At present, the principal customer for the new technology is General Electric Aircraft Engines. Under a joint venture arrangement, PRAD has teamed with a Canadian partner that now has the rights for the U.S. market. The protective coating is being produced in Canada and Russia for these markets.

Among the problems that were overcome in developing the international partnership were cultural differences, intellectual property issues, and financial arrangements. Also, the scientific, production, and marketing teams had different objectives. The scientists wanted to improve airfoil properties, study structural and phase transformations, and explain the observed effects. The production team wanted to meet user specifications while fitting the innovations into an existing production facility. The marketing team focused on meeting the needs of the user, implementing a niche strategy, and maximizing profits. As a result each team had a different approach, a different perception of quality, and a different perception of time lines. But in the end, a smoothly operating arrangement evolved.

Vsevolod S. Kortov of the Institute for Innovation and Marketing of Urals State University and Urals State Technical University, Yekaterinburg, discussed the activities of a new technology transfer organization. The initial model was the approach taken by the University of New Mexico: an internal component focused on the intellectual property of the university and an external component emphasizing commercial service organizations.

Currently the new technology transfer organization has partners in the United States and England where the technologies of interest include nano-crystal magnetic transfer, scintillation detectors, pharmaceuticals, and mobile autoclaves.

The organization provides benefits to the university, including preservation of the intellectual potential of the institution, better understanding of commercial priorities and relevant laws which guide scientific and innovation decisions, and improved competitiveness of innovation products. The inventors benefit by receiving recognition for their scientific achievements, rewards for obtaining patents, and income from the realization of patents. The organization has helped establish three businesses, completed three licensing agreements with three percent royalties, and sold high technology products for one million rubles. Also, it has helped university scientists obtain 12 grants from the new Russian program "START," which supports small innovative businesses.

Despite initial success, the following transfer problems remain:

- low level of requests for high technologies
- poorly informed leaders of relevant enterprises

- small number of specialists in technology transfer
- inadequate regulations to implement new legislation
- absence of effective venture capital funds
- problems obtaining start-up capital

W. Mark Crowell of the University of North Carolina at Chapel Hill, North Carolina, discussed American approaches to encouraging linkages between academic researchers and industrial companies. U.S. experience in establishing technology transfer systems supported by universities dates back more than 25 years. These systems are built around university-industry partnerships, research parks, and, of course, personal contacts between faculty members and industrial colleagues. The Association of University Technology Managers has supported professional development, networking, surveys, and statistics; and now it will address economic development.

Among the mechanisms for university-industry partnerships are

- industry research contracts, typically involving a single laboratory receiving funding directly from industry based on a research plan with budgetary and intellectual property provisions
- industry focused research centers
- matching grant programs
- adjunct faculty from industry
- student internships within industry
- faculty consulting services
- professional education for industrial specialists

Looking ahead, evolving strategies for knowledge-based economic development include

- significant focus on growing new companies from an expanding research base
- expansion of technology transfer capabilities
- new inter-institutional partnerships
- alignment of research institution programs with market trends
- university-affiliated venture funds
- university-affiliated research parks
- international outreach

Identifying Opportunities for Moving Ideas to the Market

Boris K. Vodolaga of the All-Union Scientific Research Institute for Technical Physics (VNIITF), Snezhinsk, emphasized the importance of interactions between VNIITF and the Urals Branch of the RAS. With regard to possible industrial applications, VNIITF researchers are working with the Institute of High-Temperature Electrochemistry in developing batteries with power ranging from 4 to 500 watts. Together with the Institute of Metal Physics, VNIITF is exploring new ways to compact powder materials. In addition, its scientists are collaborating with colleagues at the Institute of Organic Synthesis in the field of computer modeling of molecular mechanisms of action, with a focus on applications in the development of drugs.

Among the problems inhibiting commercialization activities are inadequacies in the following areas:

- commercialization specialists
- entrepreneurial culture and in particular, initiative among technology developers
- operating laws on intellectual property
- operating funds for design work, modernization of equipment, and capital construction for essential production and office space

Education and training to prepare personnel to become technological entrepreneurs should concentrate on the following areas:

- economics during the transition period
- rights of citizens in the conduct of economic activities
- psychological aspects of the innovation process
- business management
- marketing
- legal protection of intellectual property
- quality certification
- basis for investments
- organization of production and services
- international cooperation and public relations

Viktor L. Kozhevnikov of the Institute for Solid State Chemistry, Yekaterinburg, described novel technologies and materials developed by the institute. Several of the technologies are designed to remove metals from industrial liquid wastes. The institute's achievements in materials science include aluminum alloys and powders, tungsten-free hard alloys, and dental materials. In one case, the Urals radiotechnical plant has adopted a technology for the removal of heavy metals from liquid wastes.

The closing of many of Russia's industrial institutes in recent years has left the academic community without intermediaries to transfer novel materials and technologies to industry. Also, the lack of experimental workshops means that limited quantities of new materials cannot be produced for industrial testing and demonstrations. At the same time, regional and municipal programs designed to support small businesses lack the capability for expert evaluations, which results in inadequate recognition of promising developments and inefficient use of funds. As a result, support for small innovative businesses using research results has declined. Finally, Russian industrial enterprises are not interested in medium- and long-term investments in R&D.

Mark B. Myers of the University of Pennsylvania, Philadelphia, and formerly with Xerox, Inc., discussed the importance of mastering the dynamics of market and technological interactions. To this end, building the bridge from science to commercial success is the challenge, and such a bridge depends on full innovation systems. A meshing of emerging markets and emerging technologies, coupled with customer feedback, can often provide opportunities for success.

Conceptually, the innovation pipeline involves several stages including both market and technological considerations: opportunity screening; concept development; and, proof of concept. Then comes a business incubation stage when decisions must be made as to whether to launch a business, terminate the project, or simply spin off technologies—perhaps under licenses—to other parties.

The advent of the thermal ink jet printer head provides a good example of balancing the risk of investment with the rewards of success. The rewards were successful entry into the photofinishing market and replacement of laser printing. The risks of course were both the technological risk of engineering failure and the market risk of competition.

Assessing Opportunities for Introducing New Technologies

Aleksandr Y. Ageev of the Innovations and Technology Support Group, Seversk, discussed the innovation potential of the city. Recently established enterprises process paper waste, sort and utilize solid waste, and produce heat-insulating peat blocks. There are plans to build a production line for oxidized atactic polypropylene. Also, new plants are being designed to manufacture silicon nitride/carbide ceramics, insulated pipes, and thread-form and needle-shaped mullite powders. Finally, a wood finishing enterprise is planned.

Thus, economic diversification of the city is under way. About 800 new jobs have been created at a cost of 685,000 rubles per job. Financing has been provided for 24 small businesses at a cost of 58,100,000 rubles. A business support infrastructure has been established, including a mechanism for accessing government funds. While small businesses have emerged and now employ 35.6 percent of the city's workforce, few of these businesses are technology-oriented. Future objectives are to establish joint ventures with international partners for technology-intensive projects and to encourage investments in technology-intensive businesses.

Ilya M. Paderin from the Akademichesky Regional Center for Technology Transfer, Yekaterinburg, described the problems in the commercialization of technology at institutes that have no policies or mechanisms for technology transfer. The scientists determine their own paths to establishing businesses, organizing production, or providing consulting services. This approach does not benefit the institute and provides no basis for future investments in personnel or equipment. Institutes should have policies concerning use of their intellectual property and exploitation of the experience of their researchers. It is better to withhold assistance to scientists in establishing privately controlled daughter firms than to receive nothing in return from such firms.

A regional network involving 22 Russian organizations and two foreign partners has been established to improve prospects for commercialization of technologies. There is also a linkage to a French network. In Russia, many members of the network are technology transfer centers and technoparks. Others are research institutes. Several companies are also members. The strategic task is for the participants to have a competitive advantage, with emphasis on the quality of their activities and their ability to mobilize resources. Linking investors with small innovative firms is a primary task.

Several companies in the city are of special interest to the leadership of the network in Yekaterinburg. They include the following:

- *Sonat*: construction equipment, gas burners, furnaces for medical wastes, X-ray diagnostics
- *Elektrum*: concentrates of valuable metals, technologies for extraction of valuable metals
- *Rezonans*: molybdenum production, telemechanics for controlling mining operations, radio-electronic connections
- *High-Dispersion Metallic Powders*: anticorrosive zinc materials, equipment for thermal diffusion of zinc, anti-friction material

Problems in Need of Solutions: Identifying Industrial Priorities

Aleksei V. Golubev of the All-Union Scientific Research Institute of Experimental Physics, Sarov, described the activities of SarovLabs, which offers software development and scientific consulting services. It is a fast growing company with gross revenues showing a three-fold increase in 2004. Its staff, which includes highly educated engineers, now numbers 200 full-time and 100 part-time employees. The company has its own hardware for computing and programming and a modern network infrastructure for high-speed communication. The issues it has addressed in order to penetrate the market are

- intellectual property
- export control
- pricing
- technology “packaging”

- business models: onshore vs. offshore, partnering, start-up capital, and optimization for delivery of services
- project methodology and quality assurance
- delivery model

Four of the company's activities are as follows:

- multiplatform graphic user interface for Motorola, USA
- a 3-D scanning solution for industrial application at the enterprise "Kristal," Smolensk
- design of house structures to withstand 140-mile-per-hour winds for Advanced Composite Structures, USA
- analyses of radioactive wastes for WMG, Inc., USA

The company will continue to build on its strongest assets—highly skilled scientists and engineers and available technologies—recognizing the effects of increasing energy prices and the need to reduce R&D costs as it expands its businesses.

Managing a Successful Industry-Research Partnership

Vladimir A. Khokhlov of the Institute of High-Temperature Electrochemistry, Yekaterinburg, reported that the results of research conducted in his institute are reflected in hundreds of articles in Russian and foreign journals, more than 30 books, and more than 50 innovation proposals. But only a few proposals are being implemented. The institute has three lines of innovation activities: production of novel materials for mechanical engineering in the aerospace, power engineering, and electronics industries; electrochemical power engineering (fuel cells, thermal chemical batteries, high-temperature secondary batteries, lithium-polymer power sources); and reprocessing of natural and man-made raw materials using non-traditional electrochemical methods (e.g., processing spent nuclear fuel, obtaining highly pure lead from industrial wastes).

Problems encountered in commercializing innovation projects include

- breakdowns in the research-development→pilot plant→industry chain
- lack of semi-commercial equipment at most universities and academy institutes
- reluctance of industry to produce novel high-tech products
- reluctance of private and state companies and banks to subsidize promising research and development work

Planning for Quality of New Technological Products: Requirements for Researchers

Yury V. Rumyantsev of the International Development Center, Snezhinsk, described the activities of the center to facilitate nonproliferation through conversion projects and services to local businesses. The center offers the following types of consulting services:

- guidance on registering firms and establishing private businesses in Snezhinsk
- assistance in developing and implementing business projects
- analysis of firms' financial standing and preparation of financial reports
- comprehensive financial and economic analysis of firms' activities
- assistance in database searches
- advice on using analytical programs from Pro-invest II

The center maintains a website, The Urals Business Center, that provides advertising opportunities for local businesses. It organizes conferences and training programs and offers English language lessons. It also arranged for the licensing and certification of Snezhinsk's first independently owned commercial radio station.

The center's successful industrial projects have included the production of plastic bottles, lacquer, insulated steel pipes, and die molds.

Assessing Opportunities for Introducing New Technologies

Alvin V. Trivelpiece discussed activities of the U.S. national laboratories, particularly focusing on the commercialization interests of Oak Ridge National Laboratory. Twenty-five years ago, none of the DOE national laboratories had extensive contacts with industry from the standpoint of technology transfer. Now, all of them do. The change did not occur suddenly, and it depended on improvements in the legal base controlling the laboratories' commercialization activities.

Two other developments have enhanced interactions between the laboratories and industry. First, a system has been established whereby inventors are rewarded for patents by sharing in the licensing fees. Secondly, the laboratories encourage industry to use their facilities for product testing and other purposes. Through such arrangements, the laboratory scientists have new opportunities to expand their industrial contacts.

In each of these areas, the Russian government might consider steps that will bring laboratory scientists and industry managers closer together.

Customer Driven Research

Eugene B. Krentsel of the University of Missouri, Columbia, discussed the importance of market pull, which emphasizes listening to potential customers prior to developing technologies intended for the commercial market. Technology push has been the traditional approach in Russia, whereby technologies are developed and then customers are sought. No institute should restrict itself to one approach or the other, and there are risks associated with each approach. Assessment of the proper balance for each institute is essential.

Strategies for technology commercialization should include

- identification of medium-term (5-10 years) market needs (market research, selection of industries of interest, expert assessment of technology trends)
- assessment of the potential of R&D groups (identification of centers of excellence, potential of groups to address industry requirements, evaluation of overall capabilities of institutes and laboratories)
- identification of opportunity areas (communication with key players, selection of specific business opportunity areas, identification of most promising "candidate partners")

The overall R&D assessment process should identify technological hurdles, propose ways of overcoming them, and anticipate the benefits. A key step is then matching R&D objectives with research competencies.

Vladimir V. Prokhorov of the Institute of Mathematics and Mechanics, Yekaterinburg, discussed a multifunctional system of internet video communications, including video streaming, video conferencing, video on demand, and video on schedules. The researchers had been involved in high-precision navigation and guidance of missiles based on earth and target images. Currently, they are developing codes for a number of civilian applications based on image recognition. The problems being addressed include low picture quality, vulnerability of data loss in internet channels, poor synchronization of video and audio, poor stability over long periods of operations (many days or months), and narrow applications of partial systems. A number of problems have been solved, such as synchronization of audio and video, algorithms to help retrieve lost data due to failures and processor overloads, and user interfaces for multipoint video conferencing.

Examples of systems that have attracted customers are

- InTech Communications: mobile satellite television reporting system
- television traffic link from Nizhny Tagil to Moscow
- video bridges between Athens and Moscow for ITAR-TASS coverage of the Olympic games

- one-year continuous internet transmission from a station of the Russian Orthodox church

E. N. Selivanov of the Institute of Metallurgy, Yekaterinburg, reviewed innovation activity at his institute. The main scientific focus of the institute is the development of physical-chemical principles of metallurgical processes, with specific attention to the following problems:

- thermodynamics, kinetics, and mechanisms of metallurgical reactions
- liquid metal state theory
- molten slag structure and properties
- theory and technology of pyrometallurgical and electrothermal processes of metal and alloy production
- physical-chemical principles of complex utilization of metal raw materials
- theory and technology of metal powders and composite materials production

Dennis I. Robbins of Techpiphany, Texas, and formerly with Texas Instruments, Inc., discussed opportunities for new businesses and for new products. First one would ask: What will you sell and why will customers buy it? The business plan is central to this process. Financing and execution plans should be oriented toward creating value. It is essential to build on successes and learn from failures. Key questions are as follows:

- What is the compelling market need?
- Who will be the beneficiaries of the research and are their needs well understood?
- What is the state of the art in the field and is there R&D work already being conducted to provide better solutions to problems?
- How will the proposed approach provide a still better solution?
- What is the product, and who will buy it?
- What is the intellectual property value and how will it be protected?
- What is the cost to execute the plan, and how will the project be financed?
- Who will do the work?

Several mindsets must be avoided. Do not become enamored with a technology. Do not underestimate the competition. Do not try to innovate with inadequate resources. Do not reject the notion that others can invent approaches that may be better than your own. Finally, keep in mind that applied research should be driven by customer and market needs.

Comments by Specialists from the Closed Nuclear Cities[1]

Specialists from the closed cities expressed their belief that the problems they are encountering in technology transfer are common throughout Russia. Entrepreneurs in the closed cities no longer are able to offer special tax exemptions to businesses, and they must play by the same rules as counterparts in other cities. One difference, however is that access continues to be a problem for foreigners; Russian nationals often do not face the same degree of difficulty, however. Similarly, Russian scientific delegations to the United States frequently encounter restrictions in traveling to national defense laboratories.

Specialists from the closed cities strongly advocated a Russian policy that would enable research institutes to donate or lease their excess research equipment to start-up high-tech firms. This would encourage laboratory scientists to spin off from the institutes and try their hands at entrepreneurship in the private sector using familiar equipment. Also, specialists from the closed cities suggested an initiative whereby scientists from the research institutes could spend one or two years starting up businesses but have re-employment rights at the institutes in the event the businesses fail.

Two interesting observations were set forth about procedures for raising the interest of Russian firms in the capabilities of research institutes. First, Russia is a country of personal relations. And it is particularly important that researchers use their contacts and the contacts of friends to make it through the doorways for discussions at companies. With personal contacts, opportunities for serious discussions will be much greater. Second, presentations about promising technologies should be delivered differently for potential Russian clients and for international clients. Indeed, the business plan models of the West may require considerable modification if they are to be persuasive to potential Russian investors, including companies interested in innovation. In particular, the estimates of costs must conform to Russian accounting regulations and respond to requirements of Russian customers. At present, Western requirements in these areas may not always be in line with the practical problems encountered in Russia. In time, however, the attraction of the international market and the requirements of working with foreign partners should encourage Russian approaches to become more consistent with internationally-accepted norms and practices.

General Discussion

A number of comments and questions were offered during the workshop. Among the observations of particular interest were the following:

[1]Please see Appendix A for a list of participants and the workshop agenda.

• Russian industry executives are interested in large projects (e.g., $10 million) and do not have time to consider small projects.

• The technical capabilities of companies, which pay much higher salaries than academy institutes or universities, are often much stronger than the capabilities of the institutes; naturally, there is little interest in engaging weak institutes in industry projects.

• Intellectual property rights are of great concern in Russia. Russia does not currently have national legislation that would facilitate an approach similar to the U.S. Bayh-Dole act.

• Those at the institute level expect little to change as a result of the improved innovation policies proposed in Moscow.

• In general, the government provides little financial or legal support for innovation activities. The one exception is the "Bortnik Fund" (Foundation for Assistance to Small Innovative Enterprises), which has helped most of the small innovative firms that have become successful.

• Creation and identification of new markets are the key issues, particularly when following the path of technology push. Researchers have little experience in facing this challenge. Therefore, greater attention should be given to market pull, but this will require changes in the ways researchers think and operate.

THIRD INNOVATION CONFERENCE

The Third Innovation Conference on "Regional Aspects of Science and Technology Policy: From Basic Research to Putting Innovations into Practice" was held in Yekaterinburg at the end of the workshop. The NRC committee did not participate directly in the conference, but the conference provided a backdrop for continued discussions with Russian counterparts. Some of the Russian participants in the workshop were speakers at the plenary and breakout sessions of the conference. The American participants in the workshop had an opportunity to meet with conference participants and discuss developments of special relevance to the workshop.

The main themes of the conference were

- establishing the Russian innovation system
- fostering regional grant competitions in fundamental research
- improving the effective use of the scientific-technical, intellectual, and industrial potential of the Urals Federal District
- developing contemporary forms of regional innovation activities in the Urals Federal District
- addressing practical aspects of innovation project implementation
- conducting innovation in the production sector

An eclectic mix of companies, universities, and research institutes was represented at the exhibition associated with the conference. Exhibitors ranged from companies producing artwork to food-processing firms, to electronics manufacturers, to developers of new materials. But they were not large companies. The company representatives in attendance seemed to be advertising rather than technical specialists. The attitude of company representatives toward working with external researchers was wide ranging, but in general they were not particularly enthusiastic. One company was interested in engaging scientists from closed cities but did not have enough information as to their capabilities in specific areas. Another was simply not interested in outsourcing innovation tasks. And another expressed reservations about working through intermediary technology transfer centers, preferring to deal directly with the laboratory researchers.

One exhibit of special interest was the display of Southern Urals State University in Chelyabinsk. The exhibit presented a number of technologies that seemed to have commercial potential in fields such as electrocardiogram diagnostics, remote environmental monitoring, and biopsy diagnostics. The specialists from the university have many industrial contacts and seemed sensitive to the need for patents.

Another exhibit of note was the "Three Hills" exhibit, which represented nine companies located in the Chelyabinsk area. These companies were involved in the following activities: providing ceramic beads for use in oil production (drilling muds); manufacturing fiberglass laminate for bathtubs using German technology; building electronic assembly boards; producing sensors for detecting ionizing radiation; and, selling detectors for pipeline leaks. The representatives were eager to promote the companies and seemed to have a good sense of marketing and other business aspects.

BREAKOUT SESSIONS

Breakout Session at the Institute of Metallurgy

The institute's main lines of research were presented at the workshop by E. N. Selivanov and are summarized above. The laboratories are extensive but were sparsely populated during the committee's visit. As to applied activities, the emphasis seemed to be on providing analytical services rather than innovative work with commercial potential. Most of the discussion was on past achievements, and the future R&D strategy was not clear.

Breakout Session at Urals State Technical University

This session provided an opportunity to elaborate on comments made during the workshop. The main topic of discussion was the role of the Technology Transfer Office established with the assistance of the U.S. Civilian Research and Development Foundation. The activities of the office include the following:

- identifying and evaluating the commercial potential of intellectual property resulting from research by universities, institutes, and small- and medium-sized companies in the region
- marketing intellectual property, contract research, and consulting services
- searching for partners and investors
- providing patent and technical expertise in the development of licenses
- licensing and selling intellectual property on behalf of R&D groups
- training and consulting in management, marketing, finance, law, and intellectual property rights
- providing up-to-date information on regional technologies through databases
- organizing exhibitions, conferences, workshops, and public presentations

Since there are no certified technology transfer specialists in the region, the university is providing training and is involved with the Eurasian Association for Technology Transfer.

Specialists at Urals State Technical University noted that there is a need for federal legislation in the area of technology transfer, building on a 2003 law affecting privatization of intellectual property rights. A national study group has been formed to assess the need for further legislation. While the role of the university community is vital at the regional level, the federal government's role in fostering greater innovation, such as through venture capital funds and other private efforts, is equally important.

Breakout Session at the Russian Electrotechnological Company (RELTEC)

The company is a private enterprise employing about 300 people, with no external investments to support growth. It produces induction furnaces and heating systems, high-power frequency converters, and ultrasonic cleaning systems. The company participates in international exhibitions to gain insights into the state of the art and thereby become more competitive in the worldwide market. In this regard, the company conducts its R&D in-house and considers external research activities too expensive and not totally reliable. From time to time it receives small amounts of support from the government.

In Soviet times, the facility was the Central Research Institute for Scientific Engineering, designing and developing special purpose equipment, mostly for civilian applications. In the early 1990s, the plant had serious financial difficulties, but now it is on a profitable course.

2

Themes that Emerged During the Workshop

This chapter highlights important themes that emerged during the formal and informal discussions at the workshop in Yekaterinburg. The workshop presentations identified some degree of success in transferring technology to industrial customers, but this success is limited by past practices, absence of incentives, and long-standing attitudes that inhibit communication and cooperation. While the workshop did not consider a plan of action to address these perennial issues, the themes identified below should provide useful guidance in developing such plans, either within Russian organizations or within external funding organizations.

Appreciation by research organizations of needs and interests of potential customers

1. Much of the basic and applied research in Yekaterinburg is of high quality, but it is often driven by historical and internal considerations with limited attention to the interests of potential funders and users of research products. With a few exceptions, there is limited interest within the research institutions in specific market and customer needs. This lack of customer orientation does not encourage industry to look beyond its own specialists for satisfying research needs.

2. "Market pull" is a western concept that emphasizes the importance of conducting research designed to provide results that should be of direct interest to specific customers or types of customers. Few Russian R&D organizations have fully embraced such an approach. Case studies of successful market-pull approaches that have been pursued by research organizations in Russia and in the United States can be useful in demonstrating to Russian research managers

that employing the market-pull approach as part of their R&D efforts can increase the likelihood of successful commercialization of research products.

3. "Technology-push" approaches can sometimes be an important complement to a market-pull orientation. However, investing heavily in development of a new or improved technology without having identified specific customer needs could be costly and counter-productive. Research organizations will benefit from a careful assessment of the likely commercial interest based on technical and financial trends in the relevant industrial sector, competitive technologies and their costs, and the costs of R&D through the pilot stage.

4. In general, Russian researchers have a limited understanding of technology needs that will enhance the profits of companies operating in their fields of interest. Few researchers spend significant amounts of time interacting with company representatives and visiting industrial facilities. As demonstrated by the conference on industrial innovation sponsored by the regional government in Yekaterinburg, there are unrealized opportunities for developing and nurturing contacts.

Orientation, organization, and planning of research organizations

5. Many Russian research institutions perceive their missions as primarily supporting academic research. Far fewer give priority to attracting customers for the results of their research.

6. There is a lack of strategic planning within Russian research institutes and university-sponsored technology centers for effective use of their core competencies in supporting commercial activities in the Russian and global markets. Such planning is best done in collaboration with government and industry partners.

7. Applied research at many research institutes is distributed across a diverse range of topics, resulting in an absence of critical mass for achieving technological leadership in specific fields.

8. In building customer bases for R&D products, Russian institutes and universities will benefit from considering both Russian and foreign clients.

Capabilities of research organizations to respond to industrial needs

9. Government support for R&D, which in the Soviet era had been tied in large measure to defense needs, has declined dramatically. There are no indications that it will increase substantially in the near future.

10. The difficulty in finding investment capital is a significant barrier for entrepreneurs interested in pursuing attractive innovation activities in Russia. There are however new sources of financing slowly emerging in Russia, as well as cost-sharing arrangements between industry, and various sources of capital, including venture capital.

11. There is a lack of technology transfer managers in Russia with experience working in a market economy. While very limited, the training programs sponsored by the U.S. and other foreign governments are helpful in this regard.

12. There is considerable uncertainty among R&D managers about the significance of intellectual property rights and the procedures and costs associated with acquiring such rights.

13. It is difficult for research institutes to persuade companies to outsource work to them when the companies have more highly qualified specialists than do the institutes due to higher pay levels within the companies.

Industry's awareness of capabilities of research organizations

14. Russian companies have little appreciation of the technical capabilities of scientists and engineers in the nuclear cities. Some companies assume that the costs of outsourcing innovation tasks to specialists in these cities would be unreasonably expensive due to the need to support expensive laboratory facilities. "Open houses" and joint research-industry workshops in the nuclear cities might help improve mutual understanding of technological opportunities, technical capabilities, and pricing that would be attractive to potential users of research.

In general, the strong technical capabilities of the research institutes and universities stand in marked contrast to their limited business experience and financial capital. While financial capital in the immediate future may be more likely to come from abroad than from Russian companies, the long-term interests of Russia and the stability of research programs are dependent on business relations between Russian companies and Russian research institutes. The Nuclear Cities Initiative has taken limited steps to facilitate such relations, and the observations presented at the workshop should be helpful in expanding these initial steps, recognizing that the road ahead will continue to offer many challenges as well as opportunities to Russian enterprises and researchers.

Appendixes

A

Russian-American Workshop: Innovating for Profit in Russia

October 25-26, 2004
Presidium Hall of the Urals Branch of the Russian Academy of Sciences
Yekaterinburg, Russia

LIST OF PARTICIPANTS

Aleksandr Y. Ageev, *Innovations and Entrepreneurship Support Group, Seversk*
Valery N. Charushin, *Urals Branch of the Russian Academy of Sciences, Yekaterinburg*
W. Mark Crowell, *The University of North Carolina at Chapel Hill, Chapel Hill*
Aleksei V. Golubev, *All-Union Scientific Research Institute of Experimental Physics, Sarov*
Eduard S. Gorkunov, *Urals Branch of the Russian Academy of Sciences, Yekaterinburg*
Rita S. Guenther, *The U.S. National Academies, Washington, D.C.*
Vladimir A. Khokhlov, *Institute of High-Temperature Electrochemistry, Yekaterinburg*
Vsevolod S. Kortov, *Innovatika Center, Urals State Technical University, Yekaterinburg*
Viktor L. Kozhevnikov, *Institute of Solid State Chemistry, Yekaterinburg*
Eugene B. Krentsel, *University of Missouri, Columbia*
Yury F. Maidanik, *Institute of Thermal Physics, Yekaterinburg*

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Anatoly N. Paderov, *PRAD, Yekaterinburg*
George D. Pomeroy, *U.S. Department of Energy, Washington, D.C.*
Natalya Y. Pomertseva, *Intellectual Property and Innovation Managament Group of the Urals Branch of the Russian Academy of Sciences, Yekaterinburg*
Vladimir V. Prokhorov, *Institute of Mathematics and Mechanics, Yekaterinburg*
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Alvin W. Trivelpiece, *Sandia National Laboratories, Albuquerque*
Boris K. Vodolaga, *All-Union Scientific Research Institute for Technical Physics (VNIITF), Snezhinsk*

AGENDA

OCTOBER 25, 2004

Welcoming Addresses

Valery N. Charushin, Urals Branch of the Russian Academy of Sciences
Alvin W. Trivelpiece, Sandia National Laboratories
George D. Pomeroy, U.S. Department of Energy

Presentations

Building an Effective Partnership: From Idea to Market

Yury F. Maidanik, Institute of Thermal Physics
Loop Heat Pipes—Highly Efficient Heat Transfer Devices and the Potential for their Commercialization

Natalya Y. Pomortseva, Intellectual Property and Innovation Management Group of the Urals Branch of the Russian Academy of Sciences, and Anatoly N. Paderov, PRAD, Yekaterinburg
Technology Transfer to a Foreign Partner: Erosion Resistance Coating Technology for Airfoil Protection Applications

Vsevolod S. Kortov, Innovatika Center, Urals State Technical University, Yekaterinburg
Technology Transfer at Russian Universities: Experiences and Problems

W. Mark Crowell, The University of North Carolina at Chapel Hill
From Research to Technology Transfer: Strategies for Linking Basic Research with Industry Needs

Identifying Opportunities for Moving Ideas to the Market

Boris K. Vodolaga, All-Union Scientific Research Institute for Technical Physics (VNIITF)
Review of Prospective Projects between VNIITF and Institutes of the Urals Branch

Viktor L. Kozhevnikov, Institute of Solid State Chemistry
Applied Research in the Institute for Solid State Chemistry

Mark B. Myers, Xerox Company (ret.) and University of Pennsylvania, Philadelphia
Consideration of Market and Technological Factors for Commercial Success

Assessing Opportunities for Introducing New Technologies

Aleksandr Y. Ageev, Innovations and Entrepreneurship Support Group
Innovation Potential of Seversk

Ilya M. Paderin, Regional Center for Technology Transfer, Akademichesky
On Work Practices of the Urals Regional Center for Technology Transfer

Open Discussion

OCTOBER 26, 2004

Welcoming Address

Eduard S. Gorkunov, Urals Branch of the Russian Academy of Sciences

Presentations

Problems in Need of Solutions: Identifying Industrial Priorities

Aleksei V. Golubev, All-Union Scientific Research Institute of Experimental Physics
Marketing and Commercializing R&D Capabilities: SarovLabs as a Case Study

Managing a Successful Industry-Research Partnership

Vladimir A. Khokhlov, Institute of High-Temperature Electrochemistry
Innovation Potential of High Temperature Electrochemistry

Planning for the Quality of New Technological Products: Requirements for Researchers

Yury V. Rumyantsev, International Development Center
Responsibilities for Introducing New Technologies into Practice: Organization, Assistance, and Financial Aspects

Assessing Opportunities for Introducing New Technologies

Alvin W. Trivelpiece, Sandia National Laboratories
Experience of U.S. National Laboratories

Customer-Driven Research

Eugene B. Krentsel, University of Missouri, Columbia
Technology Push vs. Market Pull

Vladimir V. Prokhorov, Institute of Mathematics and Mechanics
Multifunctional System for Internet Video Communications

E. N. Selivanov, Institute of Metallurgy, Yekaterinburg
Innovation Activity at the Institute of Metallurgy

Dennis I. Robbins, Techpiphany, Inc.
Commercialization of R&D through a New Business Development Process

Open Discussion

Adjournment

B

Nuclear Cities Initiative[1]

The Nuclear Cities Initiative (NCI) is part of the Global Initiatives for Proliferation Prevention program of the U.S. Department of Energy's National Nuclear Security Administration. NCI advances U.S. nonproliferation objectives by assisting Russia in downsizing its Weapons of Mass Destruction (WMD) complexes through infrastructure and worker transition activities that create civilian opportunities for the displaced workforce. The United States has a strong nonproliferation interest in assisting Russia with its WMD complex downsizing plans. NCI has developed and implemented strategies that lead to economic diversification of the nuclear cities and alternative employment opportunities for displaced weapons scientists, engineers and other workers. In addition, NCI is applying the lessons learned in Russia to redirect WMD experts in Libya and Iraq, and possibly elsewhere in the future.

IMPLEMENTATION

NCI has operated under a five-year Government-to-Government Agreement (GTGA) between the U.S. Government (USG) and the Government of Russia, which expired in September 2003. The agreement is currently being renegotiated; arrangements have been made with Russian agencies for NCI to complete approved projects during the interim. NCI is currently working in Sarov, Snezhinsk, and Zheleznogorsk, three of the ten Russian nuclear cities. Expansion to Seversk,

[1]Provided to the committee by DOE via electronic correspondence, April 27, 2005.

to assist in worker transition as the plutonium production reactors are shut down, will begin after a new agreement is in place.

NCI leverages its funds with resources from various partners, including other USG programs, non-governmental entities and foreign governments, to create employment opportunities for displaced WMD experts. Through local partnerships with Russian institutes, city municipal administrations and regional businesses, NCI assists in developing commercial infrastructure in the closed cities, along with business creation and expansion, thereby laying the groundwork for additional private sector investments.

NCI has accomplished its economic diversification objectives in the nuclear cities by building physical and business infrastructure, and by creating new businesses. This has included

- **Physical Improvements:** moving fences, renovating buildings, upgrading telecommunications, installing utilities
- **Business Development:** establishing International Development Centers, business training, providing marketing support, and supporting business plan development
- **Commercial Development:** creating and expanding self-sustaining businesses, focusing on core competencies and business partnerships; NCI facilitates the transition from weapons-related production to non-military business

NCI'S PATH FORWARD

NCI will remain focused on Russia, but the tools developed for commercial infrastructure building and displaced worker transition to sustainable employment are being applied to other regions of proliferation concern. NCI is completing work in Snezhinsk and Sarov, will continue efforts in Zheleznogorsk, and will expand to additional cities, including Seversk and Zarechny, when a new GTGA is established. NCI is coordinating with the Department of Energy's Elimination of Weapons Grade Plutonium Production program to support reactor shut down in Zheleznogorsk and Seversk. NCI is also forging a relationship with the International Science and Technology Center to develop a new multilateral, strategic program for economic diversification and worker transition in the closed cities.

C

Basic Principles of the Russian Federation Policy on the Development of Science and Technology for the Period to 2010 and Beyond

Approved by the President of the Russian Federation, Vladimir Putin
Moscow, 2002

I. GENERAL PROVISIONS

1. Basic Principles of the Russian Federation policy on the development of science and technology for the period to 2010 and beyond (hereinafter referred to as Basic Principles) define the most important directions of state policy in the development of science and technology; the objectives, tasks and means of their implementation; and a system of economic and other measures for stimulating science and scientific-technical activity.

2. The legal basis of the Basic Principles is the Constitution of the Russian Federation and the federal laws "On State Science and State Scientific-Technical Policy" and "On State Forecasting and Programs of Social-Economic Development of the Russian Federation."

3. Implementation of the Basic Principles is designed to ensure the following strategic national priorities of the Russian Federation: improving the quality of life of the population; achieving economic growth; developing fundamental science, education, and culture; and ensuring national defense and security.

4. The Basic Principles are formed and implemented on the basis of national interests and the interests of the subjects of the Russian Federation.

II. PURPOSE AND TASKS OF STATE POLICY ON THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY

5. Development of science and technology is intended to solve the tasks of the country's social-economic progress and should be among the highest priorities of the Russian Federation.

6. Science and technology are developed on the following bases:

a. scientific-technical complexes including all organizations of different organizational-legal forms and forms of property which are involved in science, scientific-technical activity, and training of scientific workers, including personnel of the highest qualifications
b. fundamental science, which has world-renowned scientific schools and a well-developed system of higher education
c. most importantly, applied research and development (R&D) capabilities, industrial potential, unique production and other technologies, and scientific-technical reserves
d. highly qualified scientific personnel and specialists, an information infrastructure, and material-technical and experimental bases
e. experience and concentrated efforts in solving complex scientific-technical and technological problems on a national scale
f. rich natural resources and well-developed transportation and communication infrastructures

7. The objective of state policy in the development of science and technology is the transition to an innovative means of the country's development on the basis of selected priorities.

8. In order to reach the state policy objective in the field of science and technology, the following main tasks have to be accomplished:

a. establishment of organizational and economic mechanisms for enhancing the domestic production demand for innovations based on advanced fundamental science and the most important kinds of applied R&D
b. improvement of the normative legal basis for scientific, technical, and innovative activities
c. adaptation of the scientific-technical complex to the conditions of a market economy, including the interaction between state and private capital with the purpose of developing science, technology, and engineering
d. rational combination of the state regulatory and market mechanisms for the direct and indirect stimulation of scientific, scientific-technical, and innova-

tion activity in order to achieve development priorities in science, technology, and engineering

e. improvement of the training system for highly trained scientific and engineering personnel

f. encouragement of support for scientific research and experimental development in priority fields of science, technology, and engineering while taking into account world trends

g. strengthening of the R&D capabilities of higher education institutions

h. facilitating of more active exchange of knowledge and technology between the defense and civilian sectors of the economy, and the development of dual-use technologies for wider application

i. accelerated application of scientific and technical achievements which can help prevent military conflicts, technogenic and ecological disasters, and can reduce the damage caused by such events

j. development and modernization of weapons and of military and special equipment; encouragement of industrial defense complex development

k. improvement of the technical means, forms, and methods for countering terrorism, including international terrorism

III. MAIN DIRECTIONS OF STATE SCIENCE AND TECHNOLOGY POLICY DEVELOPMENT AND MEANS OF IMPLEMENTATION

9. The main directions of state policy in the field of science and technology are as follows:

a. developing fundamental science and the main types of applied R&D
b. forming a national innovation system
c. increasing the efficient use of scientific and scientific-technical results
d. retaining and developing the professional potential of personnel throughout the scientific-technical complex
e. integrating science and education
f. developing international scientific-technical cooperation

Development of Fundamental Science and Main Types of Applied Research and Development

10. Fundamental science is one of the strategic elements essential for the progress of society. The results of fundamental research and of the principal types of applied R&D provide the basis for economic growth and steady development of the state, and they are factors that determine the role of Russia in the modern world.

11. The priority fields in the development of fundamental research are determined by the scientific community on the basis of Russian national interests, while considering world trends in science, technology, and engineering.

12. The most important applied R&D are conducted in priority fields of science, technology, and engineering; they should be aimed at solving complex scientific-technical and technological problems and be oriented toward final results that can be transformed into innovative products.

13. The main tasks of fundamental science and the most important kinds of applied R&D are the following:

a. elaboration of measures for providing state funding to top priority fundamental research which can ensure technological breakthroughs and their subsequent transfer to technical applications
b. forecasting studies for determining prospective directions in scientific-technical and technological development and an analysis of the consequences for administrative decisions
c. raising the role of social sciences and humanities
d. preservation of, and support for, scientific and scientific-technical schools and the dissemination of scientific knowledge
e. stimulation of scientific R&D of an applied military character in order to: detect and counter military threats; create qualitatively new types of weapons and military and special equipment; and improve the ways of waging armed conflicts
f. development of the research, design, and experimental base for making scientific instruments
g. providing resources for the establishment of unique scientific plants and a network of centers for unique scientific and experimental equipment, including the use of leasing
h. improvement of the information and information-telecommunications infrastructure and technologies in the field of science education; development of a unified codification system for scientific knowledge and technology; and establishment of a system for scientific-technical and military-technical information

Improvement of State Regulations Relating to the Development of Science and Technology

14. The state policy relating to the development of science and technology proceeds from the necessity to establish and implement the following:

a. the most important innovative projects of value to the state using dedicated resources provided by the state (hereinafter referred to as innovative projects of state value)

b. priority directions in the development of science, technology, and engineering in the Russian Federation, both at the federal level and at the subject level
c. lists of crucial technologies of federal, regional, and local importance

15. The priority directions in the development of science, technology and engineering of federal importance, lists of critical technologies of federal importance, and task-oriented programs of scientific research and experimental development are established to ensure implementation of the most important innovative projects of state value.

16. The priority directions in the development of science, technology, and engineering and the lists of critical technologies are to be periodically modified. State orders for scientific-technical products are to ensure an organizational integration of R&D at the federal, regional, and local levels, with efficient management of state property including intellectual property. The bulk of state orders for scientific-technical products are task-oriented programs of scientific R&D and major innovation projects of state importance.

17. The improvement of state regulation in the development of science and technology envisions the following:

a. the formation of mechanisms for state support for priority directions in the development of science and critical technologies of general, regional, and local importance
b. reforming state sector science and high technology with available finances, personnel, and other resources
c. enhanced operating efficiency across the state science and high-tech complexes and the development of the non-state science and high-tech sectors which are aimed at solving major social-economic and defense tasks of the country
d. the creation of conditions for adapting the academic scientific sector to market conditions, while considering the specific features of the organizational structure of fundamental research in Russia
e. the establishment of modern corporations (holding companies, federal centers of science and high technologies, inter-region/local scientific centers) that will solve significant problems in the development of high technology sectors of the economy and will penetrate the world market for science-intensive products
f. the improvement of state scientific centers as a result of the closer integration of the academic and higher education sectors of science with production sectors to develop competitive science-intensive products
g. the improvement of financing for the state sectors of science and high technologies predominantly due to a large scale transition to competitive, site-by-site financing of scientific R&D implemented by state scientific organizations

h. the development of the Russian Foundation for Fundamental Research, Russian Humanitarian Foundation, Foundation for Development Assistance for Small Enterprises in the Scientific-Technical Sphere, and extra budgetary funds for support of scientific and scientific-technical activity

i. the enhanced efficiency of property management across the state science and high tech sectors

j. the stimulation of scientific, technological, and innovative activities in the regions of the Russian Federation; assistance for the integration of their scientific potential with the science, technology, and engineering priorities; development of municipalities with high tech potential, and science cities and administrative areas with intensive scientific-technical and innovative development; and establishment of special scientific-technological zones

k. strengthening the role of leading industrial R&D organizations: further strengthening the role of chief designers of strategically-important systems (models) of civil, military, and dual-use applications, which are frequently responsible for the establishment and implementation of scientific-technical policy and for implementing science, technology, and engineering developments in their respective fields

l. maintaining the necessary level of financing for the development and modernization of weapons and of military and special equipment for the military-industrial complex, and for strengthening the positions of domestic producers of weapons and military equipment in the world market

m. improving the target program method of planning the development of science, technology, and engineering, initially for the medium-term

n. establishing a system for sharing the achievements of domestic science, technology, and engineering including informing the public about the measures taken by the state to encourage the development of science and education

o. establishing a climate favorable for the development of innovation activities, for the introduction of technological innovations in production, and for attracting private investments in the high-tech sector of the economy

Formation of a National Innovation System

18. Formation of a national innovation system is a major task and an integral part of state economic policy. The national innovation system should ensure the integration of: state administrative efforts at all levels; organizations in the scientific-technical sphere; and the business sector to accelerate the application of science and technology successes as a means of implementing strategic national priorities.

19. Formation of the national innovation system envisions:

a. creation of a favorable economic and legal environment

b. establishment of an innovation infrastructure

c. improvement of the state mechanism for assisting the commercialization of R&D results

20. Formation of a national innovation system will require the following major tasks:

a. improvement in the mechanisms for interaction between the participants in the innovation process—including organizations which facilitate the integration of state scientific organizations and state higher educational institutions with industrial enterprises—to promote new production technologies and to raise the qualifications of production personnel

b. implementation of an efficient economic policy with regard to the participants in the innovation process, the encouragement of extra-budgetary financing, and the development of institutional and legal conditions for venture capital investment in science-intensive projects

c. establishment and development of the physical components of an innovation infrastructure (innovative-technological centers, technoparks, etc.), a network of organizations for rendering consulting services concerning innovative activity, assistance in the establishment and development of small innovative enterprises, and special arrangements for intellectual property and scientific-technical services

Improvement in the Efficient Application of Scientific and Technological Results

21. Introduction of the results of scientific and scientific-technical activity into the economy by means of managing intellectual property, a special aspect of incorporeal assets, deserves special attention in the transition to the wider use of innovations in the economy.

22. The primary tasks for increasing efficiency in the use of scientific and scientific-technical results are the following:

a. development of an information registration system for the results of scientific research and technological development achieved by various types of organizations (various provisions would be made for access to this information)

b. development of state incentives for the development, legal protection, and use of the results of scientific and scientific-technical activities

c. norms and laws determining the state's right to intellectual property and other results of scientific and scientific-technical activities produced with financing from the federal budget; first and foremost, results connected to the interests of national defense and security

d. normative-legal aspects of mechanisms for transferring the rights to use scientific results in economic activities to the organization/developers, investors, or other economic entities

e. normative-legal support for introducing the results of scientific and scientific-technical activity into the economy (including the use of economic incentives); regulation of the system of registration, inventory, amortization, and taxation of intellectual property; and control of estimated costs of scientific and scientific-technical results

f. formation of the market for intellectual property

g. improvement of the patent and licensing system

Preservation and Development of the Professional Potential of Personnel Employed in the Scientific-Technical Complex

23. An indispensable prerequisite of preserving and developing the professional potential of scientific-technical personnel is raising the prestige of scientific and engineering work.

24. The main tasks in preserving and developing the professional potential of personnel employed in the scientific-technical complex are the following:

a. creation of conditions that can help attract and retain young people engaged in science and technology

b. correlation of the types and quantities of highly-qualified scientific personnel being trained with science, technology, and engineering priorities: the number of specialists trained should also be correlated with major innovative projects of state importance, paying particular attention to the improvement of employment opportunities for scientific workers and the availability of qualified specialists for training highly-qualified scientific and engineering personnel

c. improvement of the legal basis regulating the increase in the status, social protection, and incomes of scientific workers

d. improvement of training for scientific personnel with the highest qualifications (post-graduate studies and studies for doctoral degrees) at higher educational institutions, state academy institutes, and state research centers

e. creation of conditions which will encourage the return of leading Russian scientists and specialists who now work abroad and their employment in the scientific-technical complex

f. formation of a continuous training system for highly-qualified personnel, particularly training in the field of innovative business, including facilitating their rotation in scientific, scientific-technical, and innovation areas

Integration of Science and Education

25. Integration of science and education is a major factor in the retention and training of scientific personnel, the inclusion of a scientific research foundation in the educational process, and scientific research throughout higher educational institutions.

26. The main tasks in the integration of science and education are the following:

a. establishment and support of activities: integrating scientific-educational structures, inter-university complexes, and scientific-industrial production centers (including innovation centers) in order to consolidate efforts and resources; and developing international cooperation to train qualified personnel in scientific, technological, and innovation areas

b. development of modern information-telecommunication and other science-intensive technologies, and their introduction into the scientific and scientific-technical activities of the education process

c. joint use of research and educational processes of the scientific, research, and instrument base available in the academic, higher education, and local sectors

Development of International Scientific-Technical Cooperation

27. The most important task in this field is the establishment of favorable conditions and mechanisms for the development of mutually beneficial and balanced international cooperation in the scientific, technological, and innovation areas. Implementation of this task will require the following:

a. state support for international cooperation with the purpose of: implementing major innovation projects of national importance; supporting priorities in science, technology, and engineering; and extending fundamental research

b. developing a normative-legal base for stimulating the inflow of foreign investments in the domestic scientific, scientific-technical, and innovation spheres; adjusting the legislation of the Russian Federation in science, technology, and engineering to conform with the norms of international law in this area

c. encouraging the establishment of international scientific laboratories, centers, scientific-educational and integrated research and production structures; and promoting domestic scientific and scientific-technical products in the world market

d. improving the export and customs control systems concerning the transfer of scientific and scientific-technical results, including dual-use technologies

e. fostering interactions with counterparts engaged in scientific, scientific-technical, and innovative activities abroad and encouraging their active involvement in the implementation of Russian segments of international scientific programs and projects

f. utilizing international cooperation to train personnel for the domestic scientific-technical complex

g. developing scientific and scientific-technical links with the members of the Commonwealth of Independent States and the development of a uniform technological and informational space within the framework of the Union of Belarus and Russia

h. commercializing Russian technologies, and expanding training and retraining of foreign specialists in the state's higher education establishment and leading scientific organizations, including the use of mechanisms to amortize the foreign debt of the Russian Federation

IV. MAIN MECHANISMS FOR STATE STIMULATION OF SCIENTIFIC, SCIENTIFIC-TECHNICAL, AND INNOVATION ACTIVITY

28. Main mechanisms for state stimulation of scientific, scientific-technical and innovation activity in the priority fields of science, technology, and engineering development are the following:

a. In the field of finances

- financing appropriate scientific R&D activities through the federal budget at a level that ensures implementation of tasks of the Basic Principles
- providing annual increases of appropriations for the program "Fundamental Research and Stimulation of Scientific-Technical Progress" to support the most important projects of value to the state; ensuring efficient use of federal budget allocations for financing fundamental research and encouraging scientific-technical progress
- targeting the allocation of budgetary funds for support of the most important scientific projects of value to the state, concentrating budgetary resources on the implementation of priority tasks in the development of science and critical technologies of federal importance
- searching for, and efficiently using, extra-budgetary sources of funding R&D efforts; this will supplement funds from federal executive bodies and local administrations of the Russian Federation, all of which support the introduction of scientific and scientific-technical results into the economy
- encouraging the activities of charitable organizations and other economic entities involved in financing fundamental research
- providing state support for science cities from budgets of all levels

• stimulating the development of small scientific-technical and innovative businesses, including support from the budgets of all levels for the small business infrastructure; and stimulating the development of: venture investments; leasing; crediting and risk insurance for science-intensive projects; training of specialists in innovation management; and, support for a competitive basis of scientific-technical and innovative projects

b. As to the retention and training of scientific personnel

• raising the prestige and attractiveness of research professions
• changing the system of remuneration for the work of employees at publicly-funded scientific organizations, including providing the heads of state research organizations the right to raise wages (without imposing a maximum limit) for those employees who make considerable contributions to the development of Russian science, and the mastery of high technologies and engineering
• increasing additional payments to those with Candidates and Doctors of Sciences degrees employed in state scientific organizations and state higher educational establishments based on their achievements in obtaining scientific degrees
• creating conditions that can help attract and keep young people in the spheres of science and technology, including training young specialists in priority fields of science, technology, and engineering
• increasing the amount of funding (up to three percent) from the federal budget that is allocated for fundamental research and the stimulation of scientific-technical progress, for targeted support of scientific schools, and for R&D in priority fields of science, technology, and engineering conducted by young scientists and students
• increasing the volume of housing construction for young scientists, including housing based on mortgages
• improving pensions for scientists with advanced degrees (Candidate and Doctor degrees) by establishing non-state pension funds
• providing support for elderly scientists who have made outstanding contributions in priority fields of science, engineering, and technology

c. In improving the structure of the state science and high-tech sectors, strengthen the material and technical base of science and improve the efficient use of state-owned property by:

• undertaking an inventory of the scientific-technical complex, including science cities, and changing (if necessary) the organizational-legal status and the forms of property of scientific organizations
• improving the academic science sector by concentrating resources on fundamental scientific problems, optimizing the management of scientific and scien-

tific-technical activity, and specifying the number of subordinated scientific organizations and number of employees

- granting to the state research centers of the Russian Federation the functions of leading organizations in priority areas of technology and engineering development
- disposing of redundant property and unfinished construction projects made obsolete by the restructuring of the scientific-technical complex, and using the funds that had been designated for these activities for the additional financing of measures to strengthen the material and technical base of scientific organizations
- using some of the fixed assets of scientific organizations that became available during the restructuring of the scientific-technical complex to support small scientific and innovative businesses and to establish scientific and technological parks, innovative technological centers, and other facilities for innovative activity
- improving the existing system of accreditation for scientific organizations, while transitioning their attestation and certification to international standards
- increasing targeted financing for the instrument base, including for unique experimental stands, and R&D facilities in priority fields of science, technology, and engineering development, with up to five percent of the funds allocated from the federal budget for fundamental research and stimulation of scientific-technical progress targeting these needs
- providing budgetary compensation to state scientific organizations and state higher educational establishments through property tax rebates (property includes unique scientific equipment, stands, facilities, and installations) in accordance with a list approved by the government of the Russian Federation
- lowering customs duties on imported specialized scientific equipment which has no domestic analogs (within the general strategy of lowering customs on imported equipment)
- increasing the budgetary allocations for civil R&D in correlation with the transfer of profits of scientific organizations, generated by the leasing of federal property to the federal budget
- compensating state scientific organizations and state unitary enterprises for the rent of land using government funds at all administrative levels (within the limits of land lots recognized in inventories as indispensable for scientific and scientific-technical activity)

d. in the field of efficient application of scientific and scientific-technical results and the creation of conditions for their commercialization:

- completing a normative-legal base regarding intellectual property and other results of scientific and scientific-technical activity, ensuring a balance of interests among all legal parties involved

- assuring adequate compensation for the purchase of scientific-technical products, which have intellectual property rights belonging to the Russian Federation, and other results of scientific and scientific-technical activity
- coordinating activities by federal executive bodies concerning the exposure and suppression of violations of intellectual property rights of the Russian Federation and other results of scientific and scientific-technical activity
- determining the procedures for assigning intellectual property rights of the Russian Federation and other results of scientific and scientific-technical activity obtained using funds from the federal budget to Russian and other investors who obtain these results on the territory of the Russian Federation using extra-budgetary funds
- regulating the transfer of intellectual property rights of the Russian Federation and other results of scientific and scientific-technical activity obtained using funds from the federal budget to other countries
- regulating the procedures for registration, evaluation, inventory, amortization, and taxation of intellectual property and other results of scientific and scientific-technical activity
- improving the procedures for the registration and use of secret inventions and improving the mechanisms for facilitating the mutual exchange of technologies between the military and civil spheres

V. MAIN MECHANISMS FOR IMPLEMENTING THE BASIC PRINCIPLES

29. Main mechanisms for implementing the present Basic Principles are the following:

a. development and implementation of the basic financial-economic and program documents

- federal budget and budgets of the subjects of the Russian Federation
- federal purpose-oriented programs, in particular, "Research and Development in the Priority Fields of Science and Technology" covering the period 2002-2006, "Integration of Science and Higher Education in Russia," for the period 2002-2006, and "National Technological Base," for the period 2002-2006
- state weapons program for the period 2001-2010
- state defense orders

b. development and implementation of major innovative projects of state importance

c. development, implementation, and periodic amendment of the documents which determine the country's level of scientific and technological development including:

• priority directions in the development of science, technology, and engineering in the Russian Federation and subjects of the Russian Federation

• list of critical technologies of the subjects of the Russian Federation, including the list of basic and crucial military technologies

30. Basic principles will be implemented incrementally. During the first stage (2002-2006) it is necessary:

a. to specify the normative-legal base of scientific, scientific-technical, and innovative activity, with special attention to the development of a system of economic and other incentives and also to protect the intellectual property and other rights of the Russian Federation

b. to create mechanisms for the development, implementation, and amendment of program documents in scientific and scientific-technical spheres

c. to ensure the introduction of a system of state orders for scientific-technical products; to elaborate the procedures for its formation, implementation, financing, control, acceptance of the finished products, and use of the obtained results

d. to orient innovations toward the structural modification and modernization of available products, first and foremost for the introduction of resource-saving technologies and the improvement of consumer products

e. to determine mechanisms of consolidated and multi-channel financing of purpose-oriented R&D programs and major innovation projects of value to the state through the use of budgets at all levels as well as extra budgetary resources

f. to determine the procedure for forming and operating the standardization system, which will ensure that unified standards of measures and certifications in the scientific-technical sphere are compatible with world standards

g. to elaborate drafts of the scientific-technological security concept and Basic Principles of the innovation policy of the Russian Federation for the period 2002-2006

h. to elaborate mechanisms for raising the economic incentives for the use of R&D results to solve social-economic tasks, the tasks of restructuring, and technological modernization of production with the purpose of improving the competitiveness of domestic products and services

i. to define the procedures for conducting R&D in areas which could undermine security of the Russian Federation, public health, or the ecological situation in the country

j. to re-orient the existing goal-oriented program of R&D to support science, technology, and engineering priorities, while considering a range of major innovation projects of state value; and to elaborate and approve the federal goal-oriented program "Scientific Personnel"

k. to establish an integrated system of the various bodies of state administration for managing scientific, scientific-technical, and innovative activities

l. to create a system that comparatively analyzes the levels of domestic and foreign R&D; and to establish a system of scientific-technical and military-technical information

m. to optimize the composition of the scientific-technical complex, including the establishment of integrated scientific, scientific-technical, and scientific-educational structures

n. to form a network of centers for shared use of unique scientific equipment

At the second stage (up to the year 2010) it is necessary

a. to finish the formation of the national innovation system and the integrated structure of the scientific-technical complex capable of operating efficiently in market conditions

b. to ensure a stable position of the Russian Federation in the sphere of science and high technologies

c. to establish mutually beneficial mechanisms of international integration and division of labor, including arrangements with states of the Commonwealth of Independent States

After the year 2010, it will be necessary to ensure the further development of the scientific-technological complex as an integral part of the social, economic, defense, and cultural potential of the country; and improve the efficiency of its use in the interests of domestic and international high technology markets.

D

Strategy of the Russian Federation to Develop Science and Innovations for the Period to 2010[1]

RUSSIAN FEDERATION MINISTRY OF EDUCATION AND SCIENCE
MOSCOW, 2005
(Excerpts from Draft Version of Strategy)

4.2 Creating an effective innovation infrastructure to promote the transfer of results from the research and development (R&D) sector into the Russian and global economies, as well as developing small and medium enterprises in the innovation sphere.

Sub-tasks:

1. creating financial institutions to provide uninterrupted funding for business projects at all stages of the innovation cycle;
2. developing the production technology infrastructure for innovation activity (technoparks, innovative technology centers, business incubators, technology transfer centers, and so forth);
3. promoting the development of cooperative ties among elements of the innovation system;

[1]Russian Federation Ministry of Education and Science. 2005. Strategy of the Russian Federation to Develop Science and Innovations for the Period to 2010. Moscow, Russia. This document was provided to the committee by the Ministry of Education and Science, May 27, 2005. Translated from the Russian by Kelly Robbins.

4. developing the information, expert consulting, and education infrastructures for innovation activities.

Key Problems

- The existing innovation infrastructure does not provide balanced access to various resources (capital) and services for participants in the innovation process, which limits commercialization of the results of scientific-technical activity.
- The sector composed of new innovative companies is the fundamental source of novel products and technologies; however, the development of the innovation infrastructure is inadequate for the real development problems faced by small and medium innovative enterprises, while the state system for the support of such enterprises is oriented toward the needs of the majority of the small business community (as it now exists) and not its innovation-oriented segment.
- Innovative small- and medium-sized firms are insufficiently integrated into the value formation chain, and consequently the cooperative network of "science and education→innovative small- and medium-sized businesses→big business" is undeveloped. This hinders the "diffusion" of knowledge from the R&D sector and its capitalization in the Russian economy.
- A very important role in the innovation process is played not only by the participants in the process but also by the relationships among them; however, institutions that stimulate linkages among scientific and educational organizations and innovative firms or between major companies and small- and medium-sized enterprises are currently poorly developed.
- The low level of effectiveness of innovation activity results from the undeveloped (inefficient) nature of existing institutions (rules, laws) regulating economic relations in the innovation sphere. Institutions in the innovation sphere do not facilitate the civilized and harmonious functioning of the following four competitive markets within the framework of the global economy: (1) intellectual capital,[2] (2) innovative capital,[3] (3) innovative products, and (4) services in support of innovation activity.

[2]Intellectual capital is the result of intellectual activity in the scientific-technical sphere (industrial property; unpatented results of research, development, and design work; know-how; topologies of integrated microchips; products of breeding and selection; computer programs; and databases).

[3]Innovative capital is capital associated with investment financing of innovation activity and the market for securities of companies in high-tech industries. It includes funding for scientific research and experimental design work as part of the innovation process, venture capital, capital attracted through securities offerings of high-tech enterprises, and long-term bank loans for the expansion of the innovation activities of companies.

Basic Measures

1. Creating financial institutions to provide uninterrupted funding for business projects at all stages of the innovation cycle; redirection of state financing toward programs to support innovative projects at the initial stage.

- Creating seed funds (for development and testing of product prototypes, patenting, and preparation of business plans); initiating seed funding programs in the Russian Academy of Sciences (RAS) and other state academies of sciences.
- Expanding state support for new innovative start-up companies.
- Insuring against possible losses by start-up companies as a result of technology-related investments.
- Providing financial support for innovative start-up firms; expanding the START program of the Foundation for Assistance to Small Innovative Enterprises.
- Stimulating the development of venture financing; improving the legal regulation of the activities of venture funds; substantially expanding the scope of activities of the Venture Investment Fund (a state-run "Fund of Funds" that provides capital for other venture funds).
- Forming the regulatory and organizational conditions necessary to establish a funds market for high-tech companies (creation of a "high-tech stock market"); assessing opportunities to create a specialized segment of the funds market for trading the securities of high-tech companies.
- Improving regulatory and legal conditions for the activities of state funds supporting innovation activities (primarily with regard to optimizing rules for the use of their financial resources).
- Determining procedures for establishing and transferring intellectual property rights in the course of carrying out innovation projects that have received support from state funds.
- Ensuring that support from state funds is awarded on a competitive basis and promoting the transparency of expenditures and results achieved.
- Improving the coordination of the activities of state funds supporting innovation activities to ensure the consistent support of innovation projects at all stages.

2. Developing the production technology infrastructure for innovation activity (technoparks, innovative technology centers, business incubators, technology transfer centers, and so forth).

- Facilitating the creation of technoparks for major universities and scientific organizations; developing normative mechanisms for transferring basic assets from universities or scientific institutions to technoparks, innovative technology centers, and business incubators.

• Developing regulatory and methodological documentation for determining the status of technoparks and business incubators that use state property to carry out their activities, as well as criteria for their creation and accreditation and for the duration of, and conditions for, their provision of infrastructure services to small innovative enterprises.

• Expanding the scope of activities of the Russian Fund for Technological Development with regard to the creation of elements of the regional innovation infrastructure, specifically innovative technology centers at major research and production complexes.

• Developing regulatory and legal procedures for transferring property complexes to innovative technology centers and technoparks in the course of privatization of state property.

• Forming technology transfer centers (patenting, investor searches, protection of intellectual property rights, and so forth) and resolving problems associated with budget financing and selection of optimal organizational and legal forms for independent technology promotion centers.

• Supporting the implementation of pilot projects resulting in the development of new mechanisms for the organization of scientific-technical activities (for example, with regard to the creation of Centers for the Commercialization of Scientific-Technical Developments at major scientific organizations).

3. Promoting the development of cooperative ties among elements of the innovation system.

• Providing financial support for R&D efforts carried out by small enterprises in cooperation with universities and scientific organizations.

• Developing the RAS "innovation belt," specifically by implementing a special project to provide incentives for innovation activities in the RAS system within the framework of the TASIS program of the European Union.

• Adding innovation activities to the standard university charter as one of the basic types of chartered activities of such organizations.

• Developing and disseminating a sample format for contracts between an educational (or scientific) organization holding the legal right to intellectual capital and a small enterprise wishing to put this capital to productive use.

• Determining legal regulations with regard to special economic zones and on this basis creating technical innovation zones in close proximity to major scientific, production, and educational organizations.

• Expanding support for commercializing the research results of scientific collectives working jointly with small innovative enterprises (and expanding the corresponding joint program of the Russian Fund for Basic Research and the Foundation for Assistance to Small Innovative Enterprises).

• Co-financing the participation of university undergraduates and graduate students in short-term scientific research projects in small innovative firms.

4. Developing the information, expert consulting, and education infrastructures for innovation activities.

- Creating and supporting a federal-regional database on research developments of a technical nature created with the help of budget funds, including information on the application of these results in the economy.
- Promoting the staging of venture markets in the various Russian regions.
- Creating specialized databases for remote access to services related to innovation activities.
- Promoting the creation of expert consulting organizations to provide services related to problems of intellectual property, standardization, certification, and technology auditing.
- Supporting the creation of training centers to carry out information, dissemination, consulting, and training functions, in the form of both independent networks of centers as well as centers established at universities.
- Creating a system of multi-level continuing education programs in the innovation sphere, as well as a related process for shaping a culture of innovation in the research and business communities.
- Developing a list of required qualifications for specialists in the area of innovation activities.
- Creating a state order for professional retraining (continuing education) in the area of innovation activities for employees of state scientific and educational institutions.
- Organizing mandatory training for employees of state educational and scientific institutions in the form of professional retraining (continuing education) on innovation management.
- Developing a network of Centers for Continuing Education and Professional Retraining in the innovation sphere at universities licensed in this field in order to train instructors, and prepare educational and methodological materials.
- Implementing programs to support the training of personnel from new technology companies.

Programmatic Component

The programmatic component includes the following:

- Implementation of the section on development of the innovation infrastructure in the Federal Targeted Science and Technology Program entitled "Research and Development in Priority Areas for the Development of Science and Technology for 2002-2006."
- Programs of the Foundation for Assistance to Small Innovative Enterprises.
- Implementation of the Federal Program for the Development of Education with regard to the training (retraining) of degreed specialists in the intellectual property sphere.

TABLE D-1 Target Indicators

	2004	2006	2010
1. Number of small enterprises in the science and science services sector (in thousands)			
If no action is taken	22.1	21.6	20.2
With implementation of strategy	22.1	22.1	30.0
2. Proportional sale of innovative products to the overall sale of good produced by small enterprises (in %)			
If no action is taken	0.4	0.5	0.6
With implementation of strategy	0.4	0.5	0.9
3. Volume of direct and venture capital investments in high-tech companies (in billions of rubles)			
If no action is taken	9.0	13.0	31.0
With implementation of strategy	9.0	25.0	125.0
4. Volume of goods (services) sold by organizations in the innovation infrastructure (in billions of rubles)			
If no action is taken	5.5	13.5	22.0
With implementation of strategy	5.5	17.5	50.0

E

Integration Opportunities for New Technologies: Organizational Support and Financial Aspects[1]

Yury Rumyantsev, Aleksei Kholodov, and Andrei Kruglov

The goal of doubling the gross national product (GNP) by 2010, which was set forth by Russian President Vladimir Putin in his Address to the Federal Assembly in May 2003, can be achieved through the qualitative growth of industrial production. Stable annual GNP growth should remain at a level of more than 7.2 percent up to 2010.

It is known that the economic upsurge of 7.3 percent in 2003 was achieved primarily by the priority development of the fuel and energy complex (raw materials sector). An increase in the small business sector will provide for an additional 2-3 percent in growth; however, in 7-12 years this growth will stop due to the poor technological base. Companies will be unable to compete without new technologies.

The only solution is to develop the technological base by applying the potential of the defense complex and that of small businesses to commercialize these capabilities creating new developments and technologies.

The commercialization formula is simple:

$$\text{Money1} \rightarrow \text{Development} \rightarrow \text{Commercialization} \rightarrow \text{Money2}$$

Commercialization success that can be described by the formula Money2 – Money1 > 0 is possible as a result of the following tasks:

[1]Yury Rumyantsev, Aleksei Kholodov, and Andrei Kruglov. 2004. *Integration Opportunity for New Technologies: Organizational Support and Financial Aspects. Thesis of the report to the Inter-academic Task Force of the U.S. National Academies and the Russian Academy of Sciences*. October 25-27, 2004.

1. Initial focus of the research process on addressing the economic and social needs of society.

2. Creation of mechanisms that facilitate the transfer of technologies from the research sector to users through

- creation of databases connecting new technological ideas and industrial needs
- creation of a network of technology brokers able to bridge the cultural gap between researchers with ready developments and industry, government, and those needing solutions
- development of technoparks and business incubators, including commercialization consulting centers in the fields of management, business planning, intellectual property, legislation, and so forth
- establishment of special technology transfer departments at universities and research and development (R&D) centers
- enhanced exchanges of personnel between the scientific community and industry on joint science and research projects

It is obvious that the problem of developing technologies and new kinds of products can be resolved mainly through the efforts of large science and industrial centers outfitted with adequate equipment and research infrastructure, as well as through the application of sufficient financial resources. The majority of technologies with potential commercial use are concentrated in the defense complex. Therefore, this field is the focus of enormous resources for commercialization. However, manufacturing of new products requires not only the money but also the skills to develop and produce competitive products in a short time frame while offering an acceptable price and meeting the needs of potential buyers. It is this stage, namely commercialization, that has been almost entirely absent. Some reasons for this include

- lack of motivation to commercialize the activity and to operate in the market, and a desire to obtain funding instead from federal and municipal budgets
- inappropriate enterprise structure to meet market requirements
- poor management and lack of expertise in the market

For these reasons, small innovative businesses are more suitable for the commercialization process. It is obvious that such companies should employ scientifically broad-minded managers who are keen on technological issues, but, on the other hand, also have practical expertise in operating in the market. As a rule, the creation of such "techno-brokers" is the main obstacle in commercialization.

Development of small innovative companies is especially urgent for cities like Snezhinsk because of their social and economic development. In particular, lack of infrastructure including industrial facilities, energy, labor, and other resources, as well as the limited access regime in place in the city, make it inexpedient to set up mass production enterprises. On the other hand, the availability of the enormous science and technical potential of the All-Union Scientific Research Institute for Technical Physics (VNIITF) accumulated over 50 years—highly-qualified personnel, unique equipment, and specific technical culture—provides the prerequisites for the development of small innovative companies.

By now, Snezhinsk has already accumulated some experience in the field of commercialization. There are both successful and less successful examples. An analysis of the experience of Snezhinsk shows the following:

1. Attempts to fund commercialization from the enterprise's own assets do not create efficient business.
2. Snezhinsk enterprises engaged in innovation do not usually have sufficient core assets, thus making involvement of venture capital unreasonable, because the share of co-founders becomes insignificant and leads practically to the loss of the business.
3. The most practical sources for raising small business investments in Snezhinsk are as follows:

- the Snezhinsk Foundation for Social and Economic Development, which funds projects aimed at social and economic development; it mainly provides loans to enterprises to procure fixed assets, such as equipment or renovations
- the Snezhinsk Foundation for Support and Development of Entrepreneurship, which provides loans to increase the operating capital of small businesses, mainly entrepreneurs and companies, using their fixed assets as collateral
- international nonproliferation programs, namely the U.S. Nuclear Cities Initiative (NCI) and the United Kingdom-Russian Federation Closed Nuclear Cities Partnership; these programs finance the establishment or development of commercial enterprises in order to create alternative jobs for employees downsized from VNIITF

However, it is unlikely that innovation activity will receive a loan or grant, as such activity is quite risky and has long pay-back terms. Almost all funds are provided for the support of businesses in the services, retail, food, and construction materials spheres. This means that an innovative enterprise must scatter its efforts and have several departments in its structure: purely innovative ones carrying out development work; and industrial ones providing for the company's current activity and survival.

4. Isolation. Most companies in closed nuclear cities have no access to up-to-date information, which is essential for doing business in the field of commercialization.

5. There is a lack of experience and knowledge in management, business operations, and commercialization issues, which cause poor decisions. It is typical for enterprises to underestimate the commercialization stage and focus their efforts on the technical aspects of product development, which eventually leads to a lack of assets and failure of the activity.

6. Poor knowledge of patent legislation and, as a result, neglect of intellectual property rights issues. This makes the development unattractive for the investor or allows it to be freely used by other enterprises.

7. Snezhinsk's city-forming enterprise [VNIITF] has no opportunities to support other innovative businesses besides its own projects or subsidiary companies.

Some of the problems mentioned here may be resolved by more active participation by entities like the Foundation "International Development Center Snezhinsk" (IDC) in various programs and initiatives aimed at developing innovations.

The IDC is a non-profit organization that began rendering its services on June 14, 2000. The IDC's activities are funded by the U.S. government through the NCI Program. The IDC's main objective is to support the business and the non-commercial sectors in Snezhinsk and their integration into the market economy. Over the course of its existence, the IDC has rendered more that 10,300 consulting and office services to its clients, which include public, municipal, and private entities, non-governmental organizations, and individuals. Some of IDC's clients are Snezhinsk companies implementing conversion projects co-funded by international non-proliferation programs.

In order to fulfill its mission, the IDC strives for partner relations with organizations that could be helpful in its aforementioned activities. Today, the IDC cooperates with the Snezhinsk Foundation for Social and Economic Development, the Snezhinsk Foundation for Support and Development of Entrepreneurship, and the Snezhinsk Employment Center.

During the four years of its operations, the IDC has succeeded in supporting Snezhinsk business development in the following areas.

EDUCATION

Today, the IDC is almost the only organization in Snezhinsk that arranges training activities to assist entrepreneurs and managers in various fields of activity. Seminars are arranged and conducted both by IDC employees and trainers invited from the leading universities and business schools of Moscow and St. Petersburg. The IDC organizes its own seminars on such topics as basic computer skills, Internet and information searches, English, and so forth. All told, about 820 students have taken part in these seminars. Invited trainers have led seminars on "Effective Sales," "Quality Management," "Logistics," "Finance and Competition," "Personnel Management," and others. More than 1,070 students have participated in these seminars.

IDC PROJECTS

The IDC operates on a project basis. The launch of each new project is preceded by a stage in which business needs are identified and marketing and economic research is conducted.

The IDC is currently implementing three of its own projects, namely the Language Center, the Urals Business Center (UBC), and the Licensing, Certification, and Patenting (LCP) Project.

The Language Center

The Language Center project is self-sustaining. The project is aimed at overcoming language barriers in the international activities of Snezhinsk entrepreneurs and other citizens. The project began in December 2001, and after six months its student enrollment had reached 165. A total of 200 students in 20 groups learned English during the 2003-2004 academic year, including 65 employees of Strela, Ltd., a company implementing scientific and innovation projects. Besides Strela, Ltd., the Language Center works with four other corporate clients.

The Urals Business Center

The IDC runs an Internet project called the Urals Business Center. The project was initiated to create better promotional opportunities for Snezhinsk enterprises that sell their goods and services outside the city by means of the Internet. The first version of the UBC website was registered and published in June 2002. Today, the site hosts the web pages of 14 companies. In addition, the site presents information on four innovation conversion projects operated by Snezhinsk citizens.

The Licensing, Certification, and Patenting Project

The LCP Project began in October 2002 for the purpose of overcoming administrative obstacles in the field of licensing, certification, and protection of intellectual property rights. The IDC provides advisory support for Snezhinsk business people regarding legal issues and helps them obtain licenses and certificates required for particular kinds of business activity. The IDC has signed three contracts to provide consulting services with regard to licensing.

ASSISTANCE TO NCI PROJECTS AND NEW ENTERPRISES ESTABLISHED IN SNEZHINSK

Besides its own projects, the IDC supports activities funded by the NCI program, in particular, those operated by Strela, Ltd., the Preform Plant, Ltd., the Snezhinka Paint Production Plant, SEST, Ltd., ITECH Company, and others. The IDC offers quite a wide range of services from routine economic solutions and staff training to business plan estimates, market research, translation and interpretation services, and advertising material development.

The IDC is helpful in the creation of new, efficient enterprises in Snezhinsk. For instance, the IDC was directly involved in setting up a new company in the city, Raster-Technology, Ltd. As a matter of fact, Raster-Technology is a group of companies, which includes a main office in Moscow and affiliated industrial enterprises located in Obninsk, Samara, St. Petersburg, and Novosibirsk. The company specializes in the production of sophisticated, high-tech tools for package manufacturing. In the spring of 2002, the IDC helped to register Raster-Technology in Snezhinsk, assisted in its staff recruitment campaign, and provided resources on a paid basis, namely an equipped workstation, Internet access, and communications. In 2003, this company managed to get funding from the U.K.-Russian Federation Closed Nuclear Cities Partnership and purchased industrial facilities (a former municipal printing shop). It is now setting up the production of stamping dies in Snezhinsk. By the end of 2004, 20 jobs will have been created for highly skilled employees. Moreover, the project also saved the jobs of about 30 people who had worked for the municipal printing shop.

SUPPORT OF INNOVATIONS

The IDC provides intensive support to innovation activities. For example, since 2002 the IDC has consulted for participants in the Russian Innovations Contest sponsored by the Audi Company and *Expert* magazine. Snezhinsk has submitted seven projects to the contest, four in 2002 and three in 2003. Of these seven, six were developed by the IDC. This allows Snezhinsk inventors to present their ideas to a broader audience. For instance, the project “Portable Mobile Robot with Locomotion Capabilities along Vertical Surfaces” received free promotion in the central mass media when information on the project was published in the Russian magazine *Expert* in 2002.

In 2004, the Foundation for Assistance to Small Innovative Business initiated a new federal program entitled START. The main purpose of this program is to help scientists, engineers, technicians, and students who are striving to develop and produce new goods or render services based on research activity. The START program assumes that new, science-intensive companies will be established for these purposes. It is estimated that it will take three years for a small innovative company to come into being and create a new product niche. START provides financial support to innovations during the first three years, with the funds provided in stages on an annual basis. The IDC helped eight Snezhinsk projects prepare their applications for the START program. Three projects received funding for the first annual stage in the amount of 750,000 rubles each.

SUPPORT FOR EXHIBITION ACTIVITY

The IDC helps Snezhinsk enterprises in their promotional activities. For instance, jointly with the Snezhinsk city government, the IDC arranged and funded the participation of Snezhinsk enterprises in the Moscow exhibition "High Technologies of the Defense Complex—2001." More than 300 companies representing 22 Russian regions and countries of the Commonwealth of Independent States took part in the event. Six Snezhinsk enterprises participated in the exhibition, including VNIITF, Spektr-Conversion, Ltd., and others.

The IDC provided organizational support to Snezhinsk companies that participated in the exhibition "Partnerships for Prosperity and Security," which was held in November 2004 in Philadelphia, Pennsylvania.

INTERNATIONAL COOPERATION

The IDC helped to arrange more than 20 visits by U.S. delegations. The IDC is an informational and advisory resource for foreign partners. Time has proven that the International Development Center has become an efficient tool for enhancing the business climate in the city of Snezhinsk. In our opinion, IDC involvement in implementing projects to create alternative jobs and introduce new technologies substantially increases the effectiveness of investments and shortens project time lines.

How can the IDC be helpful in commercialization?

1. Through the development and expert assessment of innovation projects from the standpoint of commercialization potential and economic efficiency; the creation of a database of promising projects; the promotion and hosting of projects on the Internet; and by other means.
2. Through consulting and business planning for investment projects.
3. Through consulting on legislation, particularly with regard to intellectual property rights.
4. By identifying and holding preliminary negotiations with investors and strategic partners.
5. By analyzing target market segments for projected innovative products.

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Biographical Information

Committee on Innovating for Profit in Russia: Encouraging a "Market Pull" Approach

Alvin W. Trivelpiece (Chair): Since May 2000, Trivelpiece has been a consultant to Sandia National Laboratories and an advisor to various government agencies. From January 1989 through March 2000, he served as the director of Oak Ridge National Laboratory (ORNL). In January 1996, he was appointed president of Lockheed Martin Energy Research Corporation, the managing and operating contractor for ORNL. Trivelpiece served as the executive officer of the American Association for the Advancement of Science (AAAS) from April 1987 to January 1989. He came to the AAAS from the U.S. Department of Energy, where he served as the director of the Office of Energy Research from 1981 to 1987. Trivelpiece was a professor of physics at the University of Maryland from 1966 to 1976 and was a professor at the University of California, Berkeley, in the Department of Electrical Engineering from 1959 to 1966. He is a past member of the National Research Council's (NRC) Committee on Science and Technology Policy Aspects of Selected Social and Economic Issues in Russia, the National Academy of Sciences (NAS) Committee on the Technical Aspects of the Comprehensive Test Ban Treaty, and several other NRC committees. He was elected to the National Academy of Engineering in 1993. He was a fellow of the AAAS, the American Physical Society, and the Institute of Electrical and Electronics Engineers, and is a member of the American Nuclear Society, the American Association of University Professors, Tau Beta Pi, and Sigma Xi.

W. Mark Crowell is currently associate vice chancellor for economic development and director of the Office of Technology Development at the University of North Carolina (UNC) at Chapel Hill. Prior to joining UNC in September 2000, he was associate vice chancellor and director of technology transfer and industry research at North Carolina State University for eight years and director of the Office of Technology Transfer at Duke University for five years. Crowell has been active in the Licensing Executives Society and has been a frequent speaker and member of the Board of Trustees of the Association of University Technology Managers. Additional professional activities include numerous consulting and expert witness assignments on intellectual property and business development issues, including a current project with AAAS evaluating technology-based economic development initiatives in the state of Michigan.

Eugene B. Krentsel serves as director of the International Technology Commercialization Institute at the University of Missouri, Columbia. He received his Ph.D. in chemistry from the Institute of Chemical Physics of the Russian Academy of Sciences. In his current position, he has developed and implemented numerous federally and privately sponsored technology commercialization projects; provided assistance to many faculty members from various departments across the university in building and maintaining national and international research and development (R&D) teams; guided various U.S. businesses in commercialization of technologies and scientific research developed by foreign centers of excellence; initiated and developed funding for the Series of Satellite Presentations "Commercial Applications of Russian Scientific Research;" and implemented a number of highly successful collaborative programs between University of Missouri, Columbia and several leading Russian institutions in the areas of joint research, education, and distance learning. Prior to joining the University of Missouri in 1992, he served as a vice president and director of international business for Polycom, Inc., a privately-held Moscow-based company involved in the technology transfer business.

Mark B. Myers is a visiting executive professor in the management department for 2002-2005 at the Wharton School of the University of Pennsylvania. His research interests include identifying emerging markets and technologies to enable growth in new and existing companies with special emphases on technology identification and selection, product development, and technology competencies. Myers is active in working on U.S. R&D policy through studies sponsored by the NAS. He serves on the NRC Science, Technology and Economic Policy Board and co-chaired its study of *Intellectual Property in the Knowledge Based Economy*. His other NRC service includes Assessment of National Institute of Standards and Technology Programs, the oversight board for the study of an *Assessment of the Small Business Innovation Research Program*, and the study of Innovation Models for Aerospace Technologies. Myers retired from the Xerox Corporation at the beginning of 2000, following a 36-year career in its R&D organizations. He was senior vice president in charge of corporate research, advanced development, systems architecture, and corporate engineering from

1992 to 2000. Myers is chairman of the Board of Trustees of Earlham College, has held a visiting faculty position in electrical engineering at Stanford University, and has served as an adjunct faculty member in material science at the University of Rochester. He holds a bachelor's degree from Earlham College and a doctorate in materials science from Pennsylvania State University.

Dennis I. Robbins is a founder and principal partner with Techpiphany, Inc., a provider of services and support in the area of research commercialization, with 27 years of experience in the semiconductor industry. Prior to his role with Techpiphany, he held a variety of management and executive roles at Texas Instruments (TI) during his 24-year career with the company. From 1997 through 2000, as a vice president of Texas Instruments, he managed the worldwide manufacturing operations for TI's analog and mixed-signal products, with ten factories worldwide, supporting $4 billion per year in revenue. Previously at TI, he managed an R&D project targeted at the development of Field Emission Display technology for the flat-panel display market and was a member of the board of directors of the U.S. Display Consortium. He is a patent holder in this area. Other TI roles include acquisition/integration manager for the $600-million acquisition of Silicon Systems Incorporated by TI; product department manager for TI's analog and mixed-signal ICs, with responsibility for design engineering, product engineering, production planning; and profit and loss and quality assurance manager for TI's Volume Products (all analog and logic products). He retired from Texas Instruments in January 2001 to pursue interests in the area of start-up companies. In addition to his role with Techpiphany, he is on the board of directors of MAI Logic, a Fremont, California, based fabless IC company, and is on the advisory boards of several start-ups. He holds a Ph.D. in solid state physics from Arizona State University (1976). He also holds an M.S. (Arizona State University, 1973) and a B.A. in physics (DePauw University, 1971). His research was in the field of Raman scattering analysis of crystalline defects.