PROJECT INFORMATION DOCUMENT (PID)
APPRAISAL STAGE

Report No.: AB2105

Project Name	Technology & Competitiveness Project
Region	EUROPE AND CENTRAL ASIA
Sector	General industry and trade sector (100%)
Project ID	P090695
Borrower(s)	The Government of the Republic of Kazakhstan
Implementing Agency	National Innovation Fund
Environment Category	[ ] A [X] B [ ] C [ ] FI [ ] TBD (to be determined)
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1. Country and Sector Background

Kazakhstan has made commendable progress in stabilizing its economy and carrying out structural reforms over the past decade. Increasing oil revenues, spurred by a favorable conjuncture of higher prices and larger production volumes, contributed to growth rates that have averaged around 11% since 2000, with per capita income rising above $2000 in 2004, 65% higher than in 2000. Against this favorable backdrop, Kazakh officials have concluded that the country's long term prosperity and economic well being will depend on how well and wisely the country invests its oil windfall to develop the non-oil sectors of the economy and promote sustainable, broad-based, economic growth. A key conclusion flowing from this review is that the country must make the transition from producing and exporting primarily unprocessed raw materials to producing and exporting more knowledge intensive, value added goods and services.

On the one hand, Kazakhstan would appear to be well positioned to become a prosperous participant in the knowledge-based global economy. At a time when many other developing countries are striving to develop the basic literacy and technical skills that are a pre-requisite for success in today's economy, Kazakhstan emerged from the Soviet Union with a well-educated, scientifically-literate labor force. But on the other hand, Kazakh science is not organized in a way that is conducive to converting knowledge into wealth. Experience suggests that modern science functions best when (i) research is linked to teaching; (ii) scientists and engineers from different disciplines collaborate in multi-disciplinary problem-solving teams, rather than working alone; (iii) the supposed distinctions between basic and applied research are minimized or eliminated; and (iv) there are close links between research scientists and business enterprises.

The current organization of Kazakh science violates most of these precepts. To cite just a few notable examples:

- The Ministry of Education and Science is responsible for basic research while the Ministry of Industry and Trade is responsible for applied research. Thus, at a time when the boundaries between applied and basic research are becoming increasingly blurred,

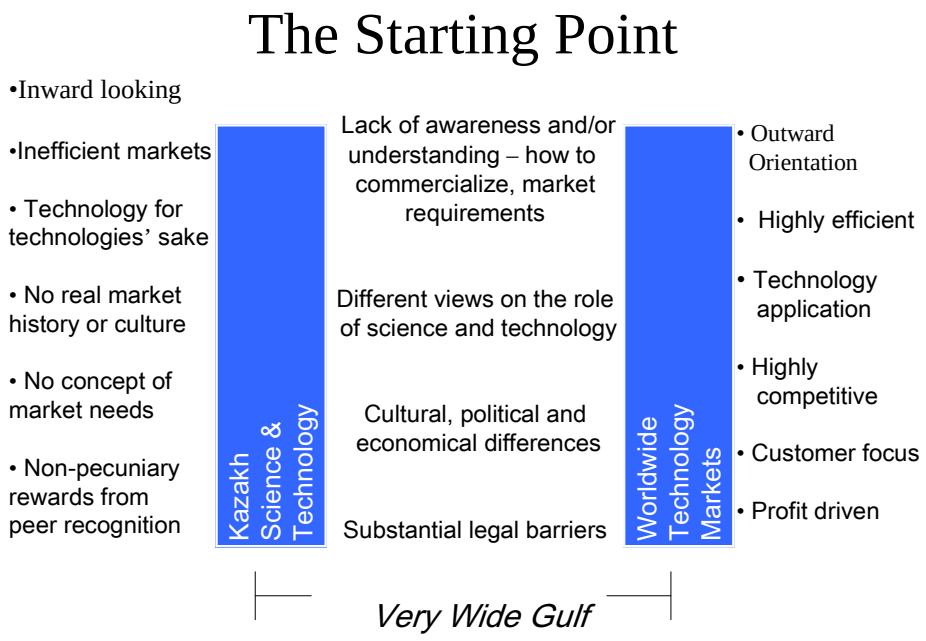
Governmental structures in Kazakhstan unwittingly serve to reinforce these artificial boundaries and distinctions.

- Teaching and research take place in separate institutions, with little interaction between the two. Higher education sector is primarily responsible for training scientists, engineers, and researchers, whereas the bulk of research activities is performed in the research institutes.[1]
- Research is organized vertically, with physicists in one institute, mathematicians in another, and chemists in yet another institute, rather than in broader, multi-disciplinary teams.

Cultural factors reinforce these organizational problems. There is a wide gulf between the outlook and cultural characteristics of Kazakh scientists on the one hand and the cultural characteristics of the global technology markets on the other hand. If they are to be effective, policy reforms much strive to reduce this cultural gap.

Isolation is another critical problem. Many Kazakh scientific institutions – academic research institutes, classical universities, technological/engineering universities – operate in isolation from each other and, more importantly, from domestic and foreign markets. Institutes and universities do not collaborate with each other or work closely with Kazakh or foreign industry. Research is performed primarily in independent laboratories and institutes which frequently set priorities without regard to market demand, the technology upgrading and competitiveness needs of local enterprises, or the Government's own scientific priorities.

[1] In 2001-2005, the government R&D expenditures grew from $26 million a year to $88 million a year. The bulk of financing is provided by the Government of Kazakhstan through the Ministry of Education and Science and other public agencies. By 2015, the government intends to increase the R&D expenditures by 25 times, including substantial increase in funding of fundamental research, applied research and innovation technologies.



Source: Boris Reznik, RAS Innovation

Government funding mechanisms reinforce these tendencies. Institutes and universities receive government support irrespective of the quality of their research or its relationship to economic, scientific, or market priorities. Moreover, most government science spending is not designed to stimulate linkages between technology markets on the one hand and Kazakh universities and research institutes on the other hand. On the contrary, existing funding mechanisms and bureaucratic practices reinforce the autarkic practices inherited from the previous system.

Government proposals to increase the efficiency of academic and university research must strive to reduce both forms of isolation. Universities and research institutes must be given strong incentives to work collaboratively with each other. But collaboration is not enough. If closer institutional cooperation still leaves them isolated from commercial markets and operating within the same cultural framework as before, the reforms will not generate an efficient, productive scientific research system. Recent reforms in Hungary and the EU, as well as earlier reforms in the US, Finland, and Israel, among others, were all designed to create closer links to market and, by doing so, to change the culture of scientific research institutions.

Compounding these organizational and cultural problems is the fact that the existing S&T base is a wasting resource that has already eroded significantly and is in danger of continuing to decline rapidly. For example, with nearly 41,000 research scientists at its peak, Kazakhstan was an important center of R&D in the former Soviet Union. But as space research and military orders dried up, the number of research personnel declined dramatically so that by 2004 only 17,000 researchers continued to work in the R&D sector. In addition, the average age of the remaining scientists is approaching the retirement age and their productivity is relatively low by global standards.

Furthermore, the quality of R&D equipment and instrumentation in research institutes and university laboratories remains very poor. Between 1993 and 2002, there was virtually no acquisition of new scientific equipment in Kazakhstan. At the same time, much of the remaining equipment was either obsolete or worn out. Not surprisingly, the output of scientific community is below the middle-income economies average. Kazakh scientists publish less than 100 scientific and technical journal articles per 10000 researchers in R&D compared with 330 in Russia. The number of patents per researcher places Kazakhstan on a par with such countries as Tunisia and Uganda.

Thus, despite its legacy of scientific excellence and substantial scientific capacity, the vast majority of Kazakhstan's exports today consist of such unprocessed raw materials as coal, oil, and non-ferrous metals. High tech or knowledge-intensive products, by comparison, comprise an insignificant share of Kazakhstan's total exports. Compounding the problem is the fact that high value-added activities in the oil sector are dominated by foreign firms. Kazakh industrial firms for the most part are relegated to supplying relatively low-skill and low value-added goods and services. For this reason, the Government has concluded that generating more value added from natural resource sectors, developing new knowledge intensive, innovative activities, restoring Kazakhstan's scientific and research capability, and linking Kazakh scientists more closely to domestic and international technology markets must become cornerstones of the Government's efforts to maintain long term economic growth and increase national competitiveness in the context of an open, global, knowledge-based economy.

2. Objectives

The proposed Project is grounded in the key pillars identified in the Country Partnership Strategy (P083068) between the GoK and the Bank. These include: (i) improving public institutions and policies, (ii) fostering competitiveness, (iii) investing in human capital. In addition, as noted above, the Project will contribute directly to the implementation of the IIDS.

The overarching objective of this project is to help Kazakhstan's national innovation system function more effectively and efficiently in a highly competitive global market environment so that Kazakhstan's legacy of scientific excellence, its still-impressive stock of scientific knowledge, and its educated citizenry can be converted into a long term, sustainable resource for generating wealth, improving national competitiveness, diversifying the economy, and raising standards of living. To accomplish this objective, Kazakhstan will need to create the right incentives for students to study science and to remain and work in Kazakhstan, using their talents and education for the development of the country.

The specific development objective of this pilot project is to demonstrate significantly improved scientific performance and commercial relevance of research performed by inter-disciplinary teams of scientists selected through transparent competitive process. By using merit based selection procedures, the project will help to rebuild, strengthen and restructure selected segments of Kazakhstan's R&D base. The project will also help to link this rejuvenated R&D capacity to national and international technology markets.

In line with the higher level objectives, a longer term follow-on development objectives of the project is to create stimulus to reform the existing R&D base. If the project is successful, five to ten years in the future Kazakhstan will have developed a new competitive, inter-disciplinary, problem-oriented, internationally peer-reviewed model of financing excellent, economically relevant scientific research. Kazakh science will have closer links to domestic and international private enterprises as evidenced by the fact that the scientific institutes supported by the project will be generating close to 30% of their

income from contracts with private enterprises or other competitive funding sources. Research activities will be performed in close collaboration with the international science community and on an interdisciplinary, problem-oriented basis rather than in the sealed silos that characterize the current system. And perhaps most importantly, a new generation of young, talented scientists will be attracted to conduct science in Kazakhstan at the state-of-the-art scientific laboratory supported by the project and under guidance and supervision of eminent Kazakh and international scientists.

3. Rationale for Bank Involvement

The Government's commitment to these objectives predates the Bank's involvement in the S&T sector. In May 2003, the Government formally adopted an Innovative Industrial Development Strategy (IIDS) which strives to encourage investment in non-oil sectors by fostering greater supply chain linkages between the oil and non-oil sectors, providing assistance to meet international quality standards, increasing the quality and economic relevance of R&D conducted in research institutes, helping research institutes obtain commercial contracts with foreign firms operating inside and outside Kazakhstan, and supporting a system of incubators and technoparks to facilitate technology commercialization and link Kazakh scientists to global technology markets.

Through these measures, the IIDS seeks to:

- Ensure 8% average annual growth rates in manufacturing output; triple labor productivity between 2000 and 2015; and reduce the power intensity of GDP by 50%;
- Increase capital investment in manufacturing sectors;
- Create a business environment that is more conducive to innovation
- Develop public institutions that will help the private sector improve its global competitiveness, especially in non-oil sectors, and support the emergence of knowledge-intensive, high wage and high value added economic activities;
- Encourage the growth of science-intensive, high-tech exports;
- Adopt international quality standards;
- Help Kazakh universities, research institutes, and enterprises become more active participants in global scientific, technology, and innovation processes.

To support these initiatives, the Government earmarked substantially-increased resources to finance innovation and fund tertiary education and scientific research institutes. The direct annual cost of implementing the IIDS is estimated to be approximately $1.2 billion, with about 20% coming from public funds, including the Republican Budget and local government resources. The remaining 80% is expected to come from the private sector.

Several new Government organizations were established to help implement the IISDS. These include the:

- National Innovation Fund whose goal is to support innovative development of the economy by financing applied scientific research and innovative venture projects.
- National Investment Fund whose goal is to help finance private sector investment in non-extractive sectors.
- Center for Marketing and Analytical Research whose goal is to provide marketing and analytical information to help diversify the economy, support the emergence of

knowledge-intensive clusters, increase national competitiveness, and boost high value added exports

- Center for Engineering and Technology Transfer whose goal is to help Kazakh industry import, adopt and adapt new, more innovative technologies.
- Development Bank of Kazakhstan whose goal is to support private sector and state initiatives (particularly for infrastructure projects) by providing medium and long term, low interest loans and by guaranteeing loans and credits made by other lending institutions.

These new institutions have more than enough budget resources to do their job. Moreover, the staff of these organizations is highly motivated and well educated. There is a solid cadre of young, ambitious technocrats who all have solid grounding in the theoretical fundamentals of a market economy, technology commercialization, and industrial innovation. Unfortunately, while the Government had devoted a great deal of time and effort to establishing new innovation support institutions and technology commercialization infrastructure, it had devoted much less time and attention to designing the specific programs and policies that these newly established bodies would implement and oversee. Therefore, these fledgling institutions had yet to develop effective programs that could produce significant improvements in Kazakhstan's national innovation system. With this in mind, in July, 2004 the Ministry of Industry and Trade asked the World Bank to recommend and design specific programs and policies that could be implemented under the auspices of the IIDS.

In response to this request, the World Bank assembled three teams of international experts who visited Kazakhstan in October and November, 2004 and provided the Ministry of Industry and Trade with detailed policy recommendations and program designs related to the three priority areas specified by MoIT: (i) Centers of Excellence; (ii) technology commercialization; and (iii) supplier development programs to help Kazakh enterprises become qualified suppliers of high value added goods and services to foreign investors operating in Kazakhstan. With the exception of the supplier development program, the Government adopted most of these recommendations in its Action Plan for Implementing the IIDS, which was formally approved in January 2005. In addition, the Action Plan instructed MoIT to begin preparation of a World Bank project on Technology and Competitiveness. This project is a direct result of that instruction.

From its inception, this project has been one of the Government's high priority activities. For example, a March 2005 letter from the Prime Minister to Mr. Wolfensohn specifically lists this project as one of the Government's leading priorities. More recently, the Project was approved at a January 2006 meeting of the National Council on Science and Technology. This is the highest S&T body in Kazakhstan. It is headed by the Minister of Education and Science and consists of representatives from all the major ministries and scientific bodies. Finally, in his March 1 2006 address to the nation entitled, "Entering the List of the Top 50 Competitive Economies," President Nazarbayev called on the country to create world class centers of scientific and educational excellence, link science more closely to the needs of business, and develop new high tech exports,– and to do so in cooperation with the World Bank and other multilateral development institutions.

World Bank involvement in designing and implementing this project will provide Kazakhstan with access to global expertise and best practice in a number of critical areas. Specifically, it will provide expertise to:

- Develop pilot programs that have the potential to transform the way research is financed, conducted and linked to industry. This transformation includes placing a greater emphasis on competitive financing mechanisms, international peer review processes, inter-disciplinary scientific teams, and a closer connection between teaching and research. Without these reforms, lavishing more financial resources on the existing R&D/S&T system will perpetuate the obsolete, ineffective ways of conducting science and will hamper the emergence of the innovative economy that GoK is striving to nurture.
- Establish and operate a world class laboratory that complies with best international practice in terms of laboratory management procedures, quality standards, and environmental safety.
- Link Kazakh scientists to global and local technology markets and, by establishing more effective links to markets, help them establish more productive links to various sources of private finance.
- Train Kazakh nationals to take over these functions after a suitably brief training period.

4. Description

The Project consists of two components: (i) a competitive fund to strengthen Kazakhstan's science base by supporting high quality R&D and a world class laboratory; and (ii) a technology commercialization office to link Kazakh scientists to local and international technology markets.

Component 1 -- Strengthening Kazakhstan's Science Base.

With its ageing cadre of scientists and ageing stock of physical equipment, Kazakhstan's existing S&T base is a rapidly depreciating resource which, in many instances, is generating revenues from past scientific achievements rather than new scientific breakthroughs. Immediate action is needed to stanch the decline, rebuild Kazakhstan's S&T legacy, and put the S&T system on a more sustainable and modern path of growth and renewal so that it can once again serve as a resource for economic growth and competitiveness.

Therefore, this component will finance pilot programs to support: (i) competitively selected, economically relevant Centers of Excellence (CoE) that will conduct world class research, and (ii) a National Instrumentation Center (NIC) furnished with modern, up-to-date laboratory equipment.

Sub-component 1.1 – Centers of Excellence Program

Funding under the pilot Centers of Excellence Program will provide grants to help transform groups of researchers into globally-recognized centers of excellence. These centers of excellence would be selected on the basis of the following criteria: (i) their potential for conducting world class scientific research; (ii) the relevance of that research to the current or future scientific and economic development of Kazakhstan, including potential relevance to Kazakh industry or the possibility of forging research partnerships with local or foreign business firms; (iii) their plans for teaching graduate and undergraduate students and for providing fellowships to train and attract the next generation of scientists; (iv) their potential for and

interest in conducting multidisciplinary research, and (v) their proposals for outreach activities to universities, secondary schools, and the general public.

The program's objective will be achieved by financing the following activities:

- Purchase of new, modern laboratory equipment
- Cooperative international scientific projects with research teams outside Kazakhstan
- Stipends for doctoral students and post-doctoral scholars to conduct research at the Centers. This will encourage a younger generation of scientists to pursue scientific careers in fields supported by the Centers.
- Grants to attract visiting professors from outside Kazakhstan to teach and conduct research at the Centers. These visiting professors could be either expatriate Kazakh scientists currently living and working outside Kazakhstan or foreign scientists.
- Organization of conferences and workshops in Kazakhstan and grants for Kazakh scientists to attend international conferences and workshops outside Kazakhstan.

The Project will finance grants to the winning Centers of Excellence. There will be two rounds of competition – one round will be conducted just prior to effectiveness and a second round will be organized during the project's third year of operation. Based on lessons of experience from the first round of competition, the RFP will be adjusted for the second round.

The Project is expected to finance approximately 10 centers during each of the two rounds of competition. The Government is expected finance subsequent Centers of Excellence with its own resources. Thus, the primary role of the Bank is to help finance the initial Centers of Excellence and, more importantly, to help the Government establish a competitive funding and selection mechanism for world class science.

Selection Mechanism

The selection mechanism will be based on the following principles:

1. The competition will be open to scientists from all disciplines. There will not be any attempt to pre-judge which fields should receive funding or to limit the competition to scientists from a select few disciplines.
2. A request for proposal (RFP) will specify the eligibility requirements and selection criteria.
3. Scientists who wish to compete for funding will be invited to fill out a short preliminary application.
4. An International Science Advisory Board (ISAB) composed of eminent international scientists will review the applications and rank the applications according to merit.
5. The best proposals will then be invited to submit a much more detailed application.
6. The detailed proposals would each be reviewed by at least three international peer reviewers selected by the ISAB.
7. The ISAB will rank the proposals based on their own judgment and the peer reviewers' recommendations.
8. A Policy Committee (PC) composed of leading Government officials and private sector representatives will make the final selection, but it will only choose from among those proposals that the International Science Advisory Board (ISAB) has recommended on the basis of scientific merit. During this last phase of the selection process, the Policy Committee can take factors other than scientific merit into consideration – such as strategic importance for Kazakhstan, but the selection will be limited to proposals that the ISAB has already certified as acceptable in terms of scientific excellence.

Sub-component 1.2 - National Instrumentation Center.

This component will finance the establishment of a National Instrumentation Center. Much of the laboratory equipment in Kazakhstan is either obsolete, worn out, or both. Most scientific instruments are obsolete and date to the 1960s or 1970s. The material base for modern science simply does not exist in Kazakhstan today. Moreover, many of the existing laboratories in Kazakhstan do not comply with international standards either for good laboratory practices or for waste management.

The Centers of Excellence will be procuring substantial amounts of laboratory equipment. The Government wants to avoid purchasing duplicate equipment only to find that each item is being utilized far below its rated capacity. In addition, the Government wants to avoid a situation in which isolated pieces of modern equipment are housed in third rate laboratories, surrounded by obsolete equipment. If Kazakhstan is to have a rebuild and refurbish its scientific base, the Government wants to be sure that Kazakhstan has at least one world-class modern laboratory with (i) state-of-the-art specialized scientific equipment; (ii) world class laboratory management practices; and (iii) world class standards for environment protection and waste disposal.

The real issue facing Kazakhstan, therefore, is not between geographic concentration and dispersion of laboratory equipment, but between scattering new equipment in obsolete laboratories vs. concentrating it in one, modern laboratory center where world class scientific experimental procedures, facilities, and hazardous waste disposal practices will be observed. The existence of this world class laboratory would, in turn, serve as a model and benchmark for other Kazakh laboratories. Moreover, a world class laboratory would also help scientists meet in one place, network, and exchange ideas. This, in turn, will foster cross sector collaboration and help to break down the rigid disciplinary silos that currently characterize Kazakh science.

The NIC will be this world class laboratory. The precise list of equipment that will be purchased for the NIC will be determined in consultation with the International Science Advisory Board and will be based on a review of the equipment requisitions submitted by the winners in the Centers of Excellence competition.

Initially a single contractor with experience managing similar world class laboratory facilities will be selected through a competitive bidding process to manage the National Instrumentation Center. The Instrumentation Contractor (IC) will be authorized to enter into subcontracts with other consulting firms to provide specialized services in order to maintain, service, upgrade and provide training for the use of NIC equipment on a continuous basis. Kazakh staff will be appointed by the NIF to work in the NIC. Kazakh staff would work side-by-side with the foreign experts and observe and participate in NIC activities. When sufficiently experienced, Kazakh staff would assume full responsibility for managing the NIC.

Scientists from all Centers of Excellence as well as from other laboratories, research centers, and universities would be eligible to use the NIC's facilities. The NIC would also be equipped with access to up-to-date electronic scientific journals and enhanced ICT capability.

Component 2 -- Linking Kazakh Science to Markets

Even if Kazakhstan improves the quality and relevance of its scientific output, Centers of Excellence will not generate the expected economic benefits unless these centers are connected to domestic and global technology markets. Unfortunately, too many Kazakh research institutes, universities and even some high tech enterprises operate largely in a "commercial vacuum." They do not know how to find investors, find customers, or determine whether they are selling an invention embodied in a concrete product or their

capacity to solve complex technical problems and conduct high quality research in response to orders from domestic and international customers.

Too many Kazakh scientists mistakenly believe that Kazakhstan has a large stock of inventions that can be easily commercialized, especially if venture capitalists can be induced to invest in the country. Unfortunately, most Kazakh scientists, like most scientists around the world, do not know how to commercialize their inventions nor do they have the connections to global markets and venture capitalists that would be needed to mount a successful commercialization effort. Last but not least, Kazakhstan does not have the necessary commercialization institutions to assist entrepreneurs and scientists. To be sure, many individual pieces such as technoparks and incubators are already present in one form or another, but they neither operate efficiently nor as a coherent, effective system. As long as this piece of the status quo remains unchanged, Kazakhstan will never realize its full technology commercialization potential.

Therefore, the objective of this component is to provide the expertise required to link Kazakh science more closely to domestic and international markets.

This component is designed to address these issues. Specifically, it will finance the establishment of a pilot Technology Commercialization Office (TCO) that would provide a wide range of complementary technology commercialization services. This might include such items as:

(i) coaching and training entrepreneurs in how to talk to investors;
(ii) teaching university and scientific institute managers how to commercialize technology, protect intellectual property, negotiate joint ventures, look for strategic partners and other essential business skills;
(iii) conducting technology audits to identify what locally available technologies, scientific developments and innovations developed in local universities and research institutes have the greatest prospect for commercial success;
(iv) operating a technology transfer office that would perform the following range of functions on behalf of the local scientists, institutes and educational institutions: apply for domestic and foreign patents, pay the necessary patent application and annual patent maintenance fees, license the patented IP, enforce ownership rights against alleged infringement, collect royalties from license holders, and distribute royalties according to a pre-determined formula between the TCO (to cover administrative expenses), the institute our university where the IP was invented, and the inventor(s);
(v) providing business and technology commercialization expertise to the technoparks and incubators that have already been established by the Government;
(vi) developing a commercialization strategy – licensing, joint venture, strategic partnership, etc. -- for each of the firms in the incubator and help to connect these local high tech entrepreneurs and scientists with potential customers, strategic partners, joint venture partners and venture capitalists; and
(vii) marketing the identified technologies at international fairs and helping to establish linkages between local research institutes and private companies/international research institutes operating in similar fields, etc.

The TCO will also provide technical assistance to help the National Innovation Fund **design and administer** the following grant programs which will be financed directly by NIF using the approximately $4 million of annual budget resources specifically appropriated for this purpose:

- **Pre-Commercialization Grant Program.** The objective of the pre-commercialization grants is to determine the commercial feasibility of ideas and to convert research into commercial applications. The program will provide grant financing to enable scientists to

demonstrate the technical feasibility of their laboratory discoveries and also to enable them to develop a business plan and detailed marketing strategy. The grants will be awarded in three phases to support: (i) development of a commercially interesting scientific idea at a concept stage, (ii) investigation of the feasibility of the idea, and proof of concept, and (iii) full R&D and prototype development. The grants will be awarded on a competitive basis to small businesses engaged in R&D, and also partnerships between small businesses and research entities such as research institutes and universities. Grant applications will be peer reviewed by Kazakh and international experts in the area of science and technology related to the proposal.

- **Joint Research with Industry.** The purpose of this grant program is to promote joint research with both domestic and foreign industry. Kazakhstan's research institutes and universities need help in obtaining contracts for joint research with industry, outsourced corporate R&D, and new product development. This program would provide grants to research consortia from universities, research institutes, and private industrial companies undertaking collaborative R&D, and research training, in areas of importance to Kazakh industrial development. The private industry and public sector agencies involved in the consortia will be required to make in-kind and cash commitments to support these cooperative activities.
- **Joint Research with International Research Partners.** Kazakhstan's research institutes and universities need help in establishing partnerships and obtaining contracts for cooperative research with international partners. The foreign participant would generally be expected to fund all their own expenses. Kazakh institutions generally do not have the funds to finance their share of the joint research project. The joint research grant program would be used to defray these costs. The technology commercialization contractor will assist the NIF to develop clear, transparent eligibility criteria and systems to ensure accountability for the use of funds. This program will have a simplified selection process, since the fact that a legitimate foreign partner is financing a portion of the project cost will provide some sort of de facto quality control.
- **International patenting.** The objective of this grant program is to help defray the cost of patenting inventions with commercial potential in North America, the EU, and Asia. For the pilot phase of this program, grant applications would be restricted to inventions generated by Centers of Excellence, proposals supported by the pre-commercialization grant program, and proposals generated by projects supported by the pilot technology commercialization office. Protection in high growth markets of the IP underpinning successfully commercialized Kazakh inventions is essential if global markets are to be accessed by Kazakh technology-based companies and research institutes, with sales of resulting products in these markets.
- **Industrial Internships for Scientists.** The purpose of this grant program is to help Kazakh scientists obtain economically relevant, first hand, on-the-job experience in how companies convert research into new products and services. They would obtain this experience by working for a short period of time alongside experienced industrial scientists in foreign company research laboratories. Most importantly, the program would help scientists develop professional contacts with industrial research laboratories. Experience shows such relationships are the most effective and fruitful source of technology commercialization deals.

Initially, a technology commercialization contractor (TCC) will be employed to establish and manage this component. However, from the inception of the project, the contractor's foreign experts will train staff hired by the NIF to manage and operate the technology commercialization activities. In order to eventually replace foreign staff within reasonable period of time Kazakh staff will go through

comprehensive on-the-job training and will work in close partnership and proximity with the foreign expert staff.

5. Financing

Source:	($m.)
BORROWER	47
INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT	17
Total	64

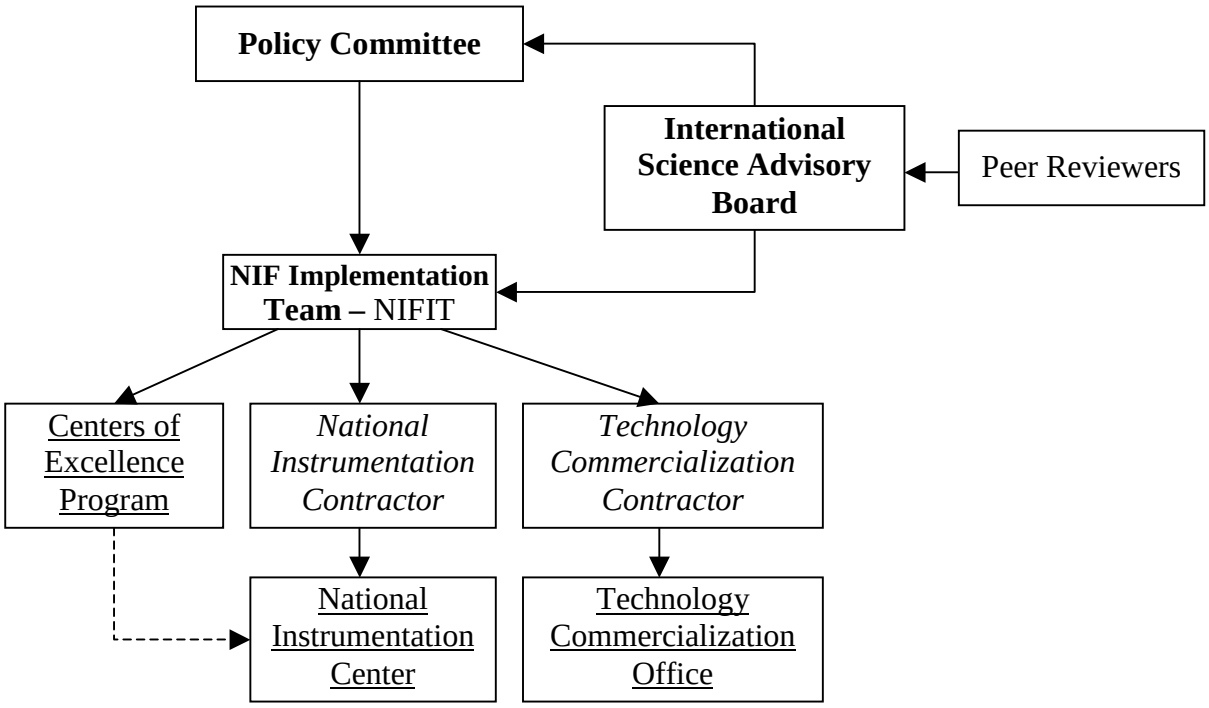
6. Implementation

1. Institutional and implementation arrangements

The Ministry of Industry and Trade will have formal administrative oversight for the project, with participation and assistance from the Ministry of Education and Science and the Ministry of Economy and Budget Planning.

The National Innovation Fund (NIF) will serve as the implementation agency for the Project. The NIF has been responsible for project preparation and will be responsible for the operation of the project during the implementation phase. It will manage the project according to the detailed rules and procedures agreed with the World Bank and codified in an Operations Manual.

Project Management Scheme



The Project will be administered by:

- A Policy Committee which will provide policy guidance and advice to the MoIT. The Policy Committee will consist of approximately eight distinguished Kazakh individuals representing a cross section of academia, business, and Government. Among other duties, the PC will select the final winners of the Centers of Excellence competition, based on the scientific recommendations of the International Science Advisory Board.

- An International Science Advisory Board which will provide scientific guidance related to all scientific matters associated with the project, including the selection of the Centers of Excellence, monitoring of their scientific progress and achievements, and management and operation of the National Instrumentation Center. The ISAB will be comprised of approximately eight distinguished scientists drawn from different parts of the world. The ISAB will represent the fields of scientific expertise that are of strategic importance for Kazakhstan including Physical Chemistry, Geophysical sciences (which would be especially important for proposals related to oil and gas and metallurgy), Engineering, Mathematics, Biomedical or bioengineering, Ecology, IT/electronics, and Materials Science. Candidates for the ISAB will be selected from lists of candidates solicited from such prominent scientific organizations as the Royal Society, the US National Academy of Sciences, the US National Science Policy Committee, the European Science Foundation, the Inter-Academy Council, the Third World Academy of Sciences, and the Nobel Committee and similar scientific organizations in Asia. The lists will present scientists from a large variety of technologically advanced countries, including Europe, North America and Asia. The lists will contain names of scientists with both academic as well as industrial research backgrounds. All scientists will be distinguished researchers in their fields. The nominations will be arranged into seven groups, one for each voting member seat. Ideally, there should be at least three nominations for each Board seat. The nominations will be evaluated by the NIF Implementation Team and the Policy Committee. Their recommendations will then be submitted to Office of the President, which will formally invite the scientists to serve on the ISAB.

- The NIFIT housed in the NIF will be responsible for day-to-day project implementation. This includes such issues as (i) procuring the specialists who will administer the NIC and TCO; (ii) overseeing procurement of all goods and services required by the Centers of Excellence, NIC, and TCO to ensure that the procurement procedures comply with all applicable rules and regulations; (iii) organizing the competition to select Centers of Excellence; (iv) liaising with the PC and the ISAB, bringing matters to their attention where appropriate, and implementing their decisions; and ensuring that individual project activities comply with all applicable World Bank FMS and Environmental requirements. The NIFIT will also liaise with the World Bank for routine, day-to-day implementation of legal, procurement and financial management matters.

The Project will finance the activities of three types of entities:

- The Centers of Excellence will consist of administratively independent groups of researchers. Each Center will be required to establish itself as a separate legal entity and to enter into a legal agreement with the NIF, specifying each party's rights and responsibilities. Financial management, procurement, and environmental activities of the Centers will be supervised by the NIF to ensure that they comply with all

applicable World Bank policies. Responsibility for overseeing each center's research performance will be vested in the ISAB. Centers could have their grants revoked for failure to comply with World Bank fiduciary or safeguard requirements or for failure to conduct satisfactory research as determined by the ISAB.

- The National Instrumentation Center will be an independent legal entity owned and established by the MoIT. It will be managed by an international contractor with demonstrated expertise in operating and managing these sorts of facilities. The NIF will appoint Kazakh staff to work side-by-side with the foreign management experts and observe and participate in NIC management.
- The Technology Commercialization Office will be an independent legal entity owned and established by the MoIT. It will be managed by an independent contractor with demonstrated expertise in technology commercialization and investor relations. Ideally, the contractor should have prior experience working in the Former Soviet Union. The contractor would be authorized to enter into subcontracts with other consulting firms to provide specialized services as needed, including legal services. Although the TCO will at first be staffed by foreign experts, Kazakh staff is expected to learn how to manage and operate a TCO. This will be accomplished by having the Kazakh staff working in close partnership with and proximity to the foreign expert staff. When sufficiently experienced, Kazakh staff would assume full responsibility for managing and operating the TCO.

7. Sustainability

Project sustainability will depend, ultimately, on continued Government determination to (i) maintain a stable macro-economic environment, (ii) maintain a business environment conducive to enterprise growth and firm level innovation, and (iii) continue to finance the centers of excellence and technology commercialization programs developed under the auspices of this project.

Several critical sustainability issues need to be highlighted at the outset. First, the costs associated with this project will be immediate and tangible. Benefits will accrue over a much longer period of time and will be in the form of economically relevant scientific research, increased collaboration between researchers and industry, increased international collaboration between research institutes and enterprises and, ultimately by increased enterprise innovation. Policy makers must be cognizant that benefits will begin to accrue only after most expenses have been incurred. Monitoring and evaluation systems and future policy decisions will have to take this time lag into account. Second, the government can expect to recoup its costs from the increased general tax revenues generated by a more dynamic, innovative business sector 5–10 years from the completion of the pilot project. Individual technology commercialization programs may generate some revenues (e.g., licensing fees), but it is highly unlikely that these revenues alone will offset the cost of the program. Attempts to make each program self-financing are destined to fail. Finally, explicit training programs are an integral feature of most project components. This will help to ensure that after the pilot project Kazakh nationals will have acquired the skills to design and implement the programs developed under the auspices of this project. This will aid project sustainability.

The following analysis addresses sustainability features built into individual Project components.

Component 1 (Strengthening Kazakhstan's Science Base): The Centers of Excellence grants program and world class research laboratories will serve as a model for scientists working with other Kazakh research institutes. If this model becomes the modus operandi for these other research institutes, the project will help to promote overall improvements in the conduct of Kazakh science. This, in turn, will help scientists working inside and outside Centers of Excellence to attract commercial research funding, grants for joint research with non-Kazakh research institutes, etc. These outside revenues will help to defray the cost of establishing and operating Centers of Excellence. But at the same time, it is important to recognize that Centers of Excellence will never be 100% self sustaining. The NIF expects that individual Centers will eventually be able to generate 30% of their income from outside sources. But this means that the remaining 70% will be provided in the form of ongoing public sector support. Nevertheless, if the Centers of Excellence model becomes the norm for financing wider swaths of Kazakh science, the project will help to ensure that Government R&D expenditures are being invested efficiently and generating economically relevant results that contribute to a more diversified, globally competitive, knowledge-intensive Kazakh economy.

Component 2 (Linking Kazakh Science to Markets): Sustainability will be enhanced by training Kazakh staff to take responsibility for all the tasks performed initially by the commercialization contractor. Sustainability will also be ensured by coupling the provision of technology commercialization services with the legal and regulatory reforms. While these steps will enhance overall sustainability, it is important to highlight that technology commercialization offices are not 100% self-financing in any OECD country. Therefore, continued government support will be required to ensure sustainability. Although Technology Commercialization Offices will not be self-financing entities, they can be expected to contribute to overall growth and development by promoting new knowledge-intensive businesses in Kazakhstan. Over time, the additional tax revenues generated by these new businesses and activities should more than compensate for the cost of establishing and operating a technology commercialization program. In addition, effective technology commercialization programs will help to ensure that the money that Kazakhstan is already spending on R&D will generate economic benefits by promoting growth, competitiveness, and diversification.

Recommendations on changes to legislation will be based on best international practice, modified to Kazakh circumstances. It is highly unlikely that the revised regulations will worsen the situation and there is a very strong likelihood that they will make Kazakhstan much more attractive as a place for technology commercialization, industrial innovation, venture capital, and high quality joint research. Reforms will help generate commercial success which, in turn, will enhance sustainability by creating a constituency to keep the reforms in place.

8. Lessons Learned from Past Operations in the Country/Sector

Lesson #1: Experience with Millennium Science Initiative (MSI) projects in Chile, Brazil, Mexico, and Venezuela suggests that a competitive selection process, focused on excellence in research and a commitment to teaching and training graduate students, will produce substantial

improvements in research quality, research productivity, human capital development and economic relevance. In Chile, for example, a $5 million investment in one research institute resulted in annual savings to the salmon industry of nearly $100 million as well as quantitative and qualitative improvements in research and teaching.

Lesson #2**:** Modern science is multidisciplinary and problem oriented. It cannot be divided along classical lines of chemistry, biology, etc. It cannot be neatly pigeon-holed into basic research vs. applied research. And it cannot be conducted in research institutes that are divorced from teaching. Boundaries between stages, institutions, and disciplines are much more porous. Therefore, to maximize its scientific and economic relevance, it is essential to organize research along multidisciplinary/problem oriented lines and ensure that there are close links to teaching and industry. The Centers of Excellence will introduce this new research model to Kazakhstan. If this pilot succeeds, as expected, this newer, more successful and more productive model will gradually replace the older organizational forms and ways of doing business.

Lesson #3: Research without links to industry is a luxury expenditure that will have a limited impact on economic and social welfare. However, in most cases it is a folly to expect good scientists also to be good entrepreneurs. Research excellence and business acumen are different disciplines and require entirely different skills. Not surprisingly, therefore, incubators and technoparks that are started and operated by scientists frequently fail to live up to their founders' expectations, in part because they tacitly assume that top notch scientists can handle the marketing, sales, financial, legal and overall managerial tasks performed by top notch entrepreneurs. Therefore, OECD experience suggests that it is important to support Centers of Excellence with professionally managed, specialized business support services dedicated to promoting linkages between scientists on the one hand and entrepreneurs on the other hand.

Lesson #4: Increasing the quantity and quality of trained scientists, technicians and engineers will lead to brain drain, if skilled personnel cannot find suitable employment afterwards domestically. Therefore, it is essential to couple training initiatives with complementary programs that will increase the demand for skilled personnel. The Centers of Excellence and Technology Commercialization components of this project are one important step in addressing this challenge. They can contribute to a solution, but an improved business climate and entrepreneurial culture will also have to be part of a long term solution.

Lesson #5: Developing an effective National Innovation System is a decades-long process. It requires sustained, focused Government commitment that must extend far beyond the horizon of any single World Bank project. This commitment can take the form of multiple follow-on successor projects – as was done successfully in Korea, Israel, India and Chile – or the Government can continue to support the process without further assistance from the Bank. But either way, ongoing Government support and involvement is essential.

9. Safeguard Policies (including public consultation)

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP/GP 4.01)	[X]	[ ]
Natural Habitats (OP/BP 4.04)	[ ]	[X]

Pest Management (OP 4.09)	[ ]	[X]
Cultural Property (OPN 11.03, being revised as OP 4.11)	[ ]	[X]
Involuntary Resettlement (OP/BP 4.12)	[ ]	[X]
Indigenous Peoples (OD 4.20, being revised as OP 4.10)	[ ]	[X]
Forests (OP/BP 4.36)	[ ]	[X]
Safety of Dams (OP/BP 4.37)	[ ]	[X]
Projects in Disputed Areas (OP/BP/GP 7.60)*	[ ]	[X]
Projects on International Waterways (OP/BP/GP 7.50)	[ ]	[X]

The key environmental safeguard policy issues associated with the project are: (i) laboratory safety and the safe disposal of wastes; and (ii) potential environmental issues arising in connection with the potential rehabilitation of existing laboratory space.

In addressing these environmental safeguard issues, all screening, monitoring and remedial measures will have to comply with Kazakh rules and regulations. In addition, the safeguard measures should comply with World Bank safeguard policies and procedures and with best international practice for laboratory safety, waste disposal and operating procedures. Many existing Kazakh laboratories do not currently comply with best international environmental and safety practices. Therefore, in addition to helping to rebuild Kazakhstan's research and scientific capacity, this project will help to introduce world class safety and environmental procedures to Kazakhstan and ensure that those facilities supported by the project serve as a model for other facilities.

In accordance with World Bank procedures and requirements, a Framework Environmental Management Plan was prepared which describes how environmental issues will be addressed as they arise. In addition, the Framework EMP was discussed at public hearings and public consultations in Kazakhstan. These were convened in Almaty and the framework was posted on the World Bank and NIF websites with instructions for readers to send comments or express their concerns, if any.

A research and laboratory safety expert from the Howard Hughes Institute of Biomedical Research in Bethesda, Maryland created an-in depth digest of international best practice standards for laboratory safety and waste disposal. These standards cover all classes of physical, chemical, biological, and radioactive hazards. They discuss procurement and transport, storage, protocols and facilities for use in research, training of personnel, segregation of waste types, and disposal of wastes. The standards also describes core processes for establishing functioning environmental management systems within laboratories, including development of training for personnel, designation of responsibility for environmental management, performance of needs assessment and waste stream assessment, installation and maintenance of appropriate equipment, treatment processes, and safe transport. These best practice standards were incorporated into the Kazakh Framework EMP so that they would serve as the environmental standards and procedures that will be employed by scientists working in the Centers of Excellence supported under Component 1.1 and the National Instrumentation Center supported under Component 1.2.

* *By supporting the proposed project, the Bank does not intend to prejudice the final determination of the parties' claims on the disputed areas*

The grant winners for research projects will be selected through a competitive process. This will also determine to a great extent the equipment installed in the National Instrumentation Center and the nature of the experiments conducted in those facilities. Therefore, it is not possible to know beforehand precisely what research disciplines will be supported under the auspices of the project and the precise, detailed environmental compliance issues that will emerge during the course of project implementation. Therefore, the (EMP) also describes the environmental screening process that will be employed as well as the institutional responsibilities for conducting the screening. The results of the screening process will determine the precise environmental safeguard processes that will be required for each research activity supported by the project. Although the potential environmental impact is expected to be modest in most cases, the EMP provides for the broadest range of situations.

The Centers of Excellence component will support approximately 5 large research groups and 5 small research groups during the first phase. The majority of these will involve relatively small teams (10-12 individuals) working in relatively small laboratories. Total waste generation, therefore, will be comparatively small. The nature of the research to be conducted will also keep the potential environmental impact of the project relatively modest. For example, the project will most likely not fund any research in such environmentally sensitive areas as clinical medical research or field trials of genetically-modified organisms. Several subprojects could also be in areas (e.g., mathematics) where no waste other than domestic waste will be generated. The other subprojects will most likely concentrate on areas of research that generate hazardous wastes in small amounts and of the kind that can be treated and disposed of with routine care and procedures. Nevertheless, to err on the safe side, the EMP provides for extraordinary cases as well as the more likely cases.

The NIF Project Team will have overall responsibility for ensuring that the provisions of the EMP are implemented. However, the principal investigators and Director of the National Instrumentation Center will be responsible for ensuring that their individual activities comply fully with the provisions of the EMP. The Agency responsible for Environmental Policies in Kazakhstan would be expected to work in partnership with the NIF to ensure that all project activities comply with Kazakh laws and regulations.

The EMP will also be incorporated into the Project Implementation Plan/Operational Manual. This will ensure that environmental requirements are integrated with other requirements which Centers of Excellence must satisfy prior to receiving grant contracts.

All laboratories and research facilities supported by the Project will be required to (i) identify *ex-ante* the environmental, social, and safety impacts of proposed research and research wastes generated; (ii) submit a plan for minimization, mitigation, and proper disposal for review and approval of both national authorities and the Project Team; and (iii) keep appropriate records and submit to periodic third person monitoring of safety and waste disposal practices.

A key component of the project will be the provision of funds to purchase scientific equipment. As such, it is expected that any construction that does occur will be primarily to rehabilitate existing buildings to accommodate new laboratory equipment. This may involve the construction of ventilation systems, the addition of laboratory bench and storage space, or the

rehabilitation of electrical systems to run larger equipment. Environmental Impact Assessment legislation and the World Bank's Environmental Assessment policy will cover these rehabilitations and any related minor construction. Again, as research activities are not pre-defined, it is not known with certainty whether any such activities will be undertaken. Therefore, the EMP describes the mitigation measures to be pursued if rehabilitation or minor construction does, occur.

10. List of Factual Technical Documents

NA

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