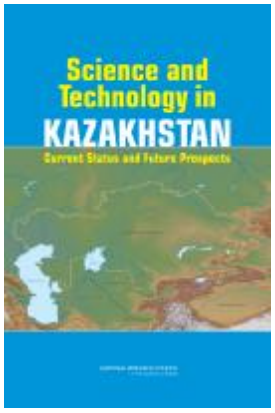

SCIENCE AND TECHNOLOGY IN KAZAKHSTAN: CURRENT STATUS AND FUTURE PROSPECTS (2007)

Kazakhstan has an ambitious program to increase its technological competitiveness in the global marketplace during the next few years. At the same time, the government has a wide variety of policies and programs in place that are intended to improve the social and economic well-being of a population of 15.2 million people dispersed over a vast geographical area. Government leaders have emphasized that achieving success both internationally and domestically will depend in large measure on the effectiveness of upgraded science and technology (S&T) capabilities—within the education system, research and development (R&D) institutions, and Kazakhstani production companies and service organizations.

In light of this, the government of Kazakhstan requested that the National Academies carry out a study of the current status and future potential of the S&T base of the country. Of particular interest were the S&T human resources of the country, the organizational and institutional structures of the public and private sectors that have S&T dimensions, the capabilities of research and educational institutions, the linkages among these and other organizations that have a role in the innovation process, and the sectors of economic and social development that deserve priority for investments of government funds to support R&D activities.

SCIENCE AND TECHNOLOGY POLICY CHALLENGES

Kazakhstani officials have correctly concluded that the country's long-term economic well-being will depend in large measure on how wisely its financial resources are invested in the development of non-oil sectors of the economy and in promotion of sustainable, broad-based economic growth. The country needs to make the transition from producing and exporting primarily unprocessed raw materials to producing and exporting more knowledge-intensive, value-added goods and services, but this transition will take many years. Upgraded S&T capabilities in both the public and the private sectors are essential in moving forward in this regard. However, during the next few years, Kazakhstan has no choice but to rely heavily on foreign technologies to operate and modernize its industrial base and to serve the requirements of its population.

The government must balance the urgent need to strengthen its industrial base through the use of imported technologies with a comparable need to support the rapid development of a capability to generate its own technologies. Thus, the government should support through financial, tax, regulatory, procurement, and other mechanisms the educational and S&T infrastructures necessary for the development in Kazakhstan of technology-intensive goods and services for the Kazakhstani and world markets. Establishing policies which encourage companies to invest in innovation, either in their own laboratories or through outsourcing tasks to research and development (R&D) institutions, is essential in creating greater "market pull" for technological innovations. Without them, the likely success of technology transfer programs in Kazakhstan will remain low.

Also, the coupling of research with education, which is currently weak, is essential. For example, universities are not able to take full advantage of the research capabilities of the 25 independent research institutes that had formerly been under the management of the National Academy of Sciences of Kazakhstan. This is due to a variety of factors, including (1) the long history of organizational separation; (2) higher levels of scientific development in most of the institutes and scientists' lack of interest in working in a university environment; and (3) competition among the educational and the independent research institutions for limited government resources, which discourages early sharing of concepts. While the Kazakhstani government should take steps to better to integrate the universities and research institutions, more generally it is critical that it develop policies to give more students the opportunity to participate in cutting-edge research in the country's best institutions.

HUMAN RESOURCES ARE KEY

Indeed, if Kazakhstan is to meet its development goals, it will do so largely by recruiting, educating, and retaining qualified young people in key fields of S&T. All reports currently available underscore the fact that the number of talented and well-trained students who pursue S&T careers in Kazakhstan following completion of their studies is currently inadequate. This loss of S&T-oriented talent is due in large measure to low salaries, poor laboratory facilities, and housing difficulties that inhibit mobility, along with the attractions of working abroad or entering private business in Kazakhstan.

The government currently has several programs or proposed programs to strengthen science education and recruit more students to S&T-related fields in Kazakhstan. The proposal to open a world-class university in Astana, which would focus on four high-technology fields and include cutting-edge research programs headed by leading Kazakhstani and foreign faculty, is likely to entice more highly-qualified and well-trained young people into scientific careers. Applied research laboratories to be established in priority fields at universities around the country also deserve support, although initially opening five such labs, rather than the fifteen proposed, would be a wiser distribution of resources. In addition, a model medical education complex should be established in conjunction with one of the medical universities in order to strengthen the link between research and education in the medical field.

Kazakhstan currently has an excellent program, the Bolashak (meaning *future* in Kazakh) Program, under which 3,000 Kazakhstani students at a given time can be studying at the leading universities in several foreign countries. Returnees from these programs are then recruited for key positions in the government as well as the private sector. This program is a crucial opportunity for Kazakhstani students to gain world-class skills and education and then apply the knowledge they gain to the S&T infrastructure of Kazakhstan. The Kazakhstani government should continue and extend its commitment to this and similar programs.

S&T PRIORITIES

As it makes decisions about funding for S&T, the Kazakhstani government should give special emphasis to several types of activities that cut across the entire range of S&T programs, particularly the following:

- Universal broadband access to the Internet by members of the S&T community.
- Appropriate modern equipment throughout the research laboratories.
- Maintaining the high level of pedagogy in mathematics, physics, biology, chemistry, and the earth and atmospheric sciences that has existed in Kazakhstan in the past.
- Economics training and research.
- Professional scientific societies, industrial associations, and academies of science and engineering.
- Standards and quality control.
- Publication in English-language journals.
- Ethics for S&T-related activities.

Turning to specific S&T areas that deserve priority, the following criterion for judging their importance was developed:

> **Within the area of interest, Kazakhstan has or could have in the next five years the technical leaders and the human and physical resources that are necessary to carry out R&D programs and/or provide S&T services that could contribute in a major way to the social and/or economic progress of the country. Such progress could over time be measured through (1) increased profits for Kazakhstani exporters of products based on R&D achievements or for providers of S&T services for foreign clients, (2) attraction of new domestic and foreign investments in Kazakhstan that utilize the R&D results or S&T services of local organizations, and/or (3) improved well-being of the general population as a result of the R&D products or S&T services.**

At the same time, expanded government support of the priority area of interest should (1) increase significantly the attractiveness of educational opportunities within the country that have the potential of leading to important S&T-oriented careers for highly talented young people and (2) enhance the prestige of Kazakhstani S&T within the country and internationally.

With this criterion in mind, the government of Kazakhstan should give priority to the S&T aspects of the areas listed below, with the understanding that priorities should be reviewed periodically, perhaps every three years. There may be other areas of particular importance, but the following deserve attention;

- Nuclear science and technology: assessment of nuclear power facilities; radioecology; uranium mining.
- Biomedical science and technology: disease surveillance and prevention; cancer therapies; natural products chemistry; orthopedic devices.
- Agricultural S&T: cereal grain production; livestock productivity; nutrition.
- Hydrocarbon resources: chemical engineering; catalysis; assessment of reserves; environmental protection.
- Minerals: metallurgy; assessment of ore deposits; environmental protection.
- Construction: seismic-resistant structures; construction materials.
- Water science and technology: irrigation systems; monitoring and assessment of water quantity and quality; protection and remediation of water quality.

As is evident throughout this article, Kazakhstan has an unusual opportunity to develop and use S&T for increasing its global economic competitiveness while enhancing the economic and social well-being of its population. The strong commitment of the nation's leaders to rapid development of S&T capabilities and the increasing availability of financial resources to support the S&T infrastructure are strong pillars for the ambitious programs that have been developed.

The Committee on Science and Technology in Kazakhstan: Current Status and Future Prospects

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For More Information

Copies of *Science and Technology in Kazakhstan: Current Status and Future Prospects* are available from the National Academy Press; call (800)624-6242 or (202)334-3313 (in the Washington metropolitan area), or visit the NAP website at www.nap.edu. For more information on the project, contact staff at (202)334-2644.