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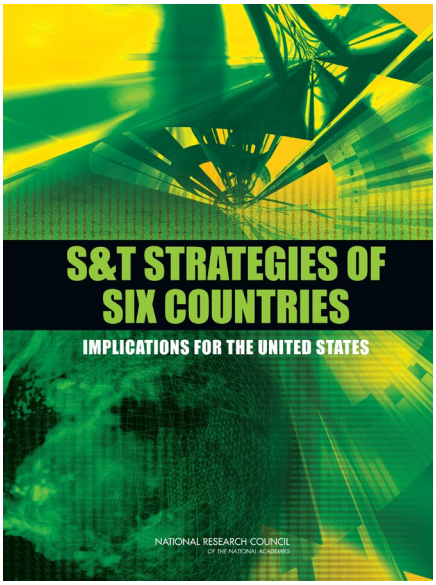
REPORT IN BRIEF

S&T STRATEGIES OF SIX COUNTRIES: IMPLICATIONS FOR THE UNITED STATES

Standing Committee for Technology Insight-Gauge, Evaluate, and Review
August 2010



The past 60 years have seen a dramatic rise in the number of countries working to increase their prosperity through the deliberate expansion of their science and technology (S&T) capabilities. Aided by the global spread of S&T and manufacturing networks, an unprecedented number of these countries will be able to offer contributions to the next generations of scientific discovery and technological innovation. The resulting increase in global competition for innovation is likely to bring about an acceleration in S&T advances worldwide, even as it threatens to erode U.S. dominance in a number of scientific and technological arenas.

This study provides an overview and analysis of the S&T development strategies of China, Singapore, Russia, India, Japan, and Brazil, six countries that have undergone or are undergoing remarkable change in their S&T capabilities. In order to illuminate what makes S&T development plans successful and how their successes may affect the United States, the U.S. Department of Defense requested that the National Research Council assemble a committee of experts to estimate the ability of each of these countries to carry out its strategy within its unique political, cultural and economic context, and to examine the possible consequences of their success in high-impact fields such as energy, neuroscience, materials science, and information technology. In the process of its research, the study committee made the surprising discovery that cultural characteristics, rather than measurable indicators of economic and intellectual output, were the most valuable predictors of a country's success in meeting its S&T objectives. In the interest of U.S. national security, the committee recommends that the evolution of global S&T innovation networks continue to be monitored, and that future country analyses focus more on cultural and political impediments to success.

Method of Evaluation

To determine which of the six countries were likely to be "winners" in the global race for innovation, the study committee examined traditionally-used metrics such as patents per capita and percentage of gross domestic product invested in research (see Figure 1), and "non-traditional" metrics chosen for their ability to capture the different economic and cultural contexts in which foreign government agencies, individuals, and organizations create and nurture innovation. No single set of indictors was found to be a satisfactory predictor of achieving S&T goals across all six countries. Instead, measures were chosen for each country that described, to the extent possible, the following characteristics:

- Leadership
- Economic assets/performance/corruption
- Natural resources/infrastructure
- Governance/legal system/immigration
- Customs /cultural norms
- Educational standards/achievements
- Government-industry-university relationships
- Relationships with multinational corporations

One of the most striking insights to emerge from this analysis was that cultural traits play an indispensable role in promoting or impeding the fulfillment of S&T development goals. While all countries must contend with cultural impediments to innovation and growth (such as corruption, undervaluing of education, or ideals that discourage the translation of scientific discoveries to product innovations), countries such as China and Singapore that have demonstrated an ability to adapt cultural characteristics to facilitate S&T advancement have made the greatest strides. The committee concluded that those countries that continue to demonstrate adaptability can be expected to meet with future S&T success, while those that do not will likely have difficulty meeting their stated goals.

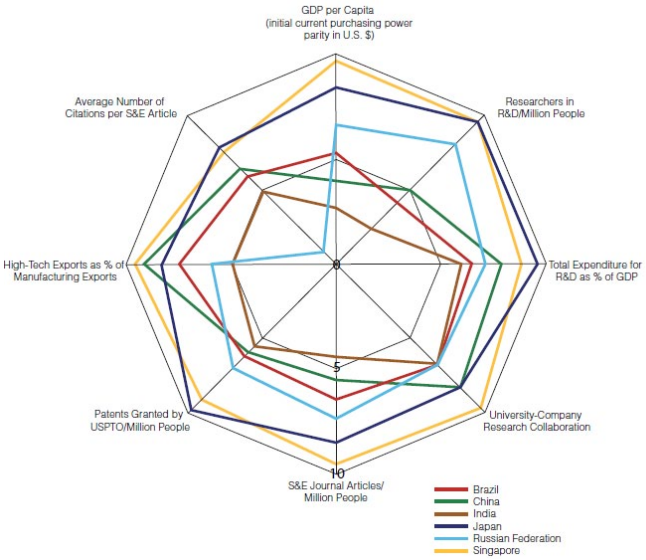


Figure 1: . Comparison of supply and output indicators in countries using the World Bank's Knowledge Assessment Methodology. The committee found that no single set of traditionally used indicators was a satisfactory predictor of success in S&T goals. Source: World Bank. 2009. Knowledge for Development (K4D) Website (http://info.worldbank.org/etools/kam2/KAM_page3.asp?default=1)

The Role of Culture in S&T Success

Though all of six countries have demonstrated a commitment to S&T development, they differ greatly in the degree to which their cultures' values align with their S&T development goals. Of the countries studied, Brazil, India, Japan, and Russia were found to have significant cultural barriers to S&T innovation. On the other hand, the cultures in Singapore and China have been reshaped to support their S&T strategies. From its observations, the committee concluded that the best indicator of a country's likelihood of achieving its long-term S&T goals is its ability to shape its culture to support S&T advancement. Such changes would need to respond to the needs of the country, but could include increasing the value given to education, eliminating corruption, gaining popular support for change, or dissolving social divisions that negatively impact a country's workforce.

Country Evaluations

The following paragraphs summarize the committee's observations for each of the six countries studied.

China

China's strong centralized government has enabled its leaders to introduce measures that align the priorities of its society with its needs for S&T development. Though the country's immediate goal is to maintain a high economic growth rate that will promote political and social stability, it also seeks to promote long-term security through military modernization, the reduction of environmental degradation, and establishment of a strong innovative base that can sustain future S&T growth. China is currently attempting to create internationally competitive national technology standards, and is reinforcing its efforts by requiring foreign firms to share their technology so that it can be "re-innovated" for the Chinese market. This policy will affect the type and amount of foreign direct investment that China receives, as will its policies that restrict open access to information.

Singapore

Like China, Singapore's leadership deliberately introduces policies that shape its society in ways that serve national S&T goals. Its emphasis on education of citizens, its stable government, and its effective anti-corruption measures have contributed to a successful fulfillment of S&T goals that is expected to continue in the future. Singapore's growth model relies on significant foreign investment and the deliberate recruitment of top international talent to advise government leadership and staff its state-of-the-art S&T facilities. Like China, however, it is still building its own innovation capacity, and is investing heavily in the development of a 'bottom-up' innovation environment. Potential future obstacles for Singapore may arise from cultural differences between foreign workers and its own traditionally conservative culture, or from terrorist attack.

Russia

Russia has great natural resource wealth, a high regard for education, and high levels of achievement in basic science. The Russian government been slow, however, to make the changes necessary for integration into the global economy, and must contend with the challenges presented by a declining and aging population and a poor system of health care. It is expected that Russia will maintain an advantage in areas of established strength, including energy resource technology and nuclear, military, and space technologies. Nevertheless, corruption, the inability to adapt government mechanisms for resource distribution, the rejection of international partnerships, the absence of a culture of innovation, and the lack of engagement between industry and universities are all barriers to near- and medium-term innovation and growth.

India

India has made great strides in the past 10 years, enjoying sustained economic growth and an improved standard of living for many of its citizens. Nevertheless, its ambitious goal of reliance on solely indigenous innovation is unlikely to be achieved in the near to mid-term. Regional security concerns, social and income disparities, uneven educational opportunities, and the lack of a long-term, comprehensive national strategy for governance all predict a future of uneven growth.

Japan

Though Japan remains a world leader in high technology and investment in research, its inward-looking culture and resistance to change are impediments to continued, competitive growth in a globalized marketplace. A lack of university-industry partnerships, low levels of direct foreign investment, lack of a supportive environment for start-ups and new businesses, and constraints on the upward mobility of young people in general and women in particular have combined with a shrinking population, declining workforce and adversity towards immigration to produce a stagnating S&T environment that is unlikely to reverse itself in the next decade. Mounting security concerns about North Korea are also likely

to influence Japan's regional relationships and its future S&T investments.

Brazil

Brazil's strengths lie in its natural resource wealth and strong financial and industrial base, which have propelled it to a position of leadership in South America. Its energy independence and economic development have been achieved through taxation rather than external debt, enabling the government to operate independently but also slowing the rate of government investment in S&T infrastructure. To speed its development, its industries will need to engage in research and provide employment opportunities for researchers, and training in S&T fields will have to accelerate to provide an adequate supply of scientists and engineers. Efforts are underway to improve some of these shortcomings through, for example, the recent launching of an initiative to strengthen networks of businesses and scientists.

Recommendations

The U.S. government should monitor the continued evolution of S&T capabilities in a variety of countries -- including but not limited to those addressed in this study. This should include the identification of country-specific measures of the health of S&T innovation environments, and an analysis of the capacity of a country to achieve successful integration with a globalized S&T environment. Observations regarding the transfer of intellectual property and the flow of talent into other countries should be acted upon appropriately either independently or in international partnerships. **(From recommendations 10-1, 10-2, 10-4)**

The United States should assess the national security implications of the continuing revolution in global S&T as a matter of urgency. That assessment should include an examination of its own ability to integrate successfully into the global S&T innovation environment, to ensure that it remains in a position that allows for continued prosperity and national security. **(From recommendations 9-1, 10-3)**

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