

Committee on Global Science and Technology Strategies and Their Effect on U.S. National Security

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Statement of Task: general

Examine the S&T strategies of Japan, Brazil, Russia, India, China, and Singapore and their relevance to U.S. national security

Compare and contrast the planning of those strategies to the U.S. S&T strategy

Evaluate the implication of S&T strategy differences to U.S. national security strategy

Statement of Task: specifics

For each JBRICS

- **Evaluate current, mid-term, and long term S&T strategies**
- **Estimate their likelihood of achievement of S&T goals (and when)**
- **Identify potential effect of high-impact pursuits on U.S. national security**
- **Recommend nation-specific indicators to monitor progress in high-impact research**
 - **These nation-specific indicators could include:**
 - **research priorities and drivers**
 - **funding sources and allocation by field**
 - **resource allocation - human and financial**
 - **intellectual property - growth rates and areas**
 - **management - policy, work force planning, operations**
 - **global financial climate, demography, environmental issues, incentives and penalties**

For the U.S.

- **Analyze relationship between foreign S&T strategies and military capabilities**
- **Provide recommendations to the U.S. government and the IC on the implication of the S&T strategies to the United States**

Observations

- **“National innovation environment” describes the context for institutions, public and private, that create/nurture innovation, top down (government) and bottom up (individuals & organizations). Progress toward creating a national innovation environment is limited by a country’s socio-economic and cultural factors, such as its:**
 - Leadership
 - Economic assets/performance/corruption
 - Natural resources/infrastructure
 - Governance/legal system/immigration
 - Customs /cultural norms
 - Educational standards/achievements
 - Government-industry-university relationships
 - Role of multinationals

Observations

- **All six countries show commitment to economic competitiveness; non-traditional measures best predictor of S&T achievements.**
 - Traditional: socioeconomic quantitative measures (e.g., % GDP in R&D)
 - Non-traditional indicators depend on country-specific cultural contexts – control the future
 - Cultural contexts slow S&T innovation in:
 - Brazil, India, Japan and Russia
 - Cultural contexts were changed to serve the S&T development needs in:
 - Singapore and China
 - Best indicator of the likelihood of achieving long-term S&T goals is capability to effect the cultural changes needed
 - Highest potential to achieve S&T goals: Singapore, China
 - Lowest potential: Russia
 - Estimates beyond 5 years unreliable

Observations

- **No common set of indicators, traditional plus non-traditional, provides reasonable assessment/prediction of the S&T achievements across all six countries**
 - Only nation-specific traditional plus non-traditional indicators are meaningful
 - Number of patents, publications, degrees not reliable
- **Evolution underway from a '*national innovation environment*' to a '*global innovation environment*' with talent, markets, financial resources, research, development, manufacturing integrated globally rather than nationally.**
 - Challenge for China and Singapore
 - Question for the U.S.

Observations

- **Multinational corporations transfer intellectual property into foreign domestic companies through S&T activities**
 - Some by policy (China) and all by leaks through employees/suppliers/visitors
 - India hosts 150 Fortune 500 companies; China 1,200 international corporations

- **Many of the six countries pursue high-impact, dual-use technologies**
 - IT/Telecom (microchips/supercomputers)
 - Nuclear energy
 - Ocean and space exploration
 - Biotechnology
 - Agricultural science
 - Green technologies
 - H₂O purification
 - Neuroscience
 - Nanotechnology
 - Robotics

Observations

➤ Military modernization:

- Priority in : China, Russia, India and Singapore
- Lower Priority in: Japan and Brazil
- China and India integrate military modernization into broader economic goals
- Singapore and Brazil have transparent military plans; not serious threats to U.S.
 - Singapore seeks markets
 - Brazil seeks border protection
- Russia's military is bedrock of national security
 - Counter balances a declining international stature and authority
 - Marginal economic performance raises concerns about reliance on military power to extend regional and international influence

Country Specific Observations

➤ **China – Impressive Progress**

- Top-down innovation environment. Building bottom-up.
- Top priority for China: continued high economic growth rate to maintain political and social stability.
- Top frustration: inability to create a bottoms-up innovation environment.
Key question for China and the U.S.
- Promotes home-grown technologies – develop regional & global standards.
- Requires foreign firms to share core technology; anti-monopoly law forces adoption of indigenous innovations or “re-innovations.”

➤ **Singapore – Model of S&T Innovation**

- Top-down innovation environment. Building bottom-up.
- Highly centralized, stable, agile country. Delivers on its plans.
- Relies on foreign investment and importing workforce for continued economic development.
- Challenges: balancing its tightly controlled social culture with the needs of foreign workers, new ideas, more highly educated citizenry and the potential of terrorist networks.
- Innovation environments of China and Singapore similar.

Country Specific Observations

➤ **Russia - Major cultural barriers**

- Slow integration into global economy.
- Population is decreasing. Health care poor.
- Traditional areas: energy resources, nuclear, military and space will remain strong.
- Reliance on military for international influence.
- Problems: Inadequate funding, Government control undermines market forces, lacks qualified leadership, isolated, rejects international partnerships, no national innovation culture, aging workforce, decreasing population, significant corruption, universities not engaged in research or with industry.
- Monitor: non-governmental funding R&D, foreign direct investment, education and age profile of S&T personnel, entry of Russian products in foreign markets.

➤ **India – High potential impeded by governance, cultural problems**

- Mixed quantitative S&T performance
- National goal for self-reliance has limited opportunities
- Government inefficiency compounded by national–regional tensions
- Regional conflict and domestic instability impede progress
- Only 5-year S&T goals; social disparities, poverty, uneven educational opportunity, no comprehensive national strategy for governance.
- Bumpy road ahead to regional power.

Country Specific Observations

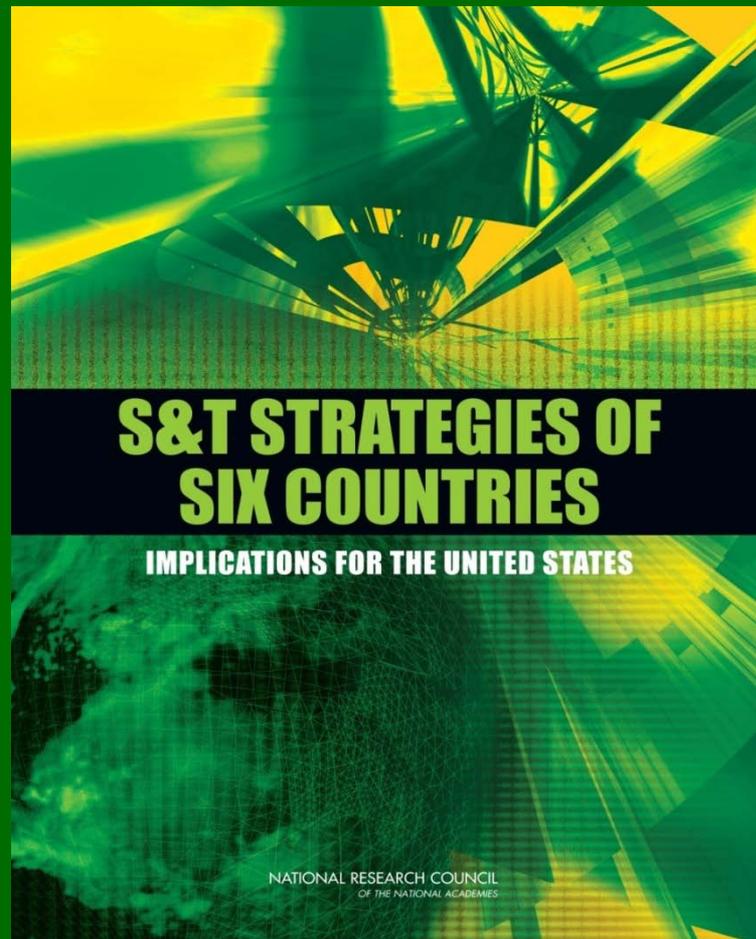
➤ Japan – Cultural barriers restrain high potential

- Bound by cultural limitations. Few partnerships between universities and industry, small foreign direct investment, small numbers new businesses and start-ups, decreasing size of workforce, few foreigners and women in the workforce, a country for Japanese
- Culture better suited to the pre-1990 isolation for “innovation control” than the current partnerships for “innovation creation”
- Unlikely to reverse this trend in 5 years. Even 10 years is optimistic.
- Growing security concerns with North Korea

➤ Brazil – Emerging regional power with big cultural obstacles

- Energy independent; energy is a strength
- Supports development through taxation, not debt.
- Leader in South America. Independently minded country.
- Major problems: Investment in R&D low; industry not engaged or supportive of research; insufficient interest in S&T among students; shortage of engineers and scientists; little engagement between industry and universities; business culture lacks enthusiasm for innovation and not connected well internally.
- Slow but continuous progress expected.

Key Recommendations



For US Government

- Assess country transformations from a *national innovation environment* to a *global innovation environment* for all countries of interest, including the U.S.
 - Use appropriate traditional and non-traditional indicators
 - Track impediments to transformation
- Aggressively monitor transfer of intellectual property through multinational corporations

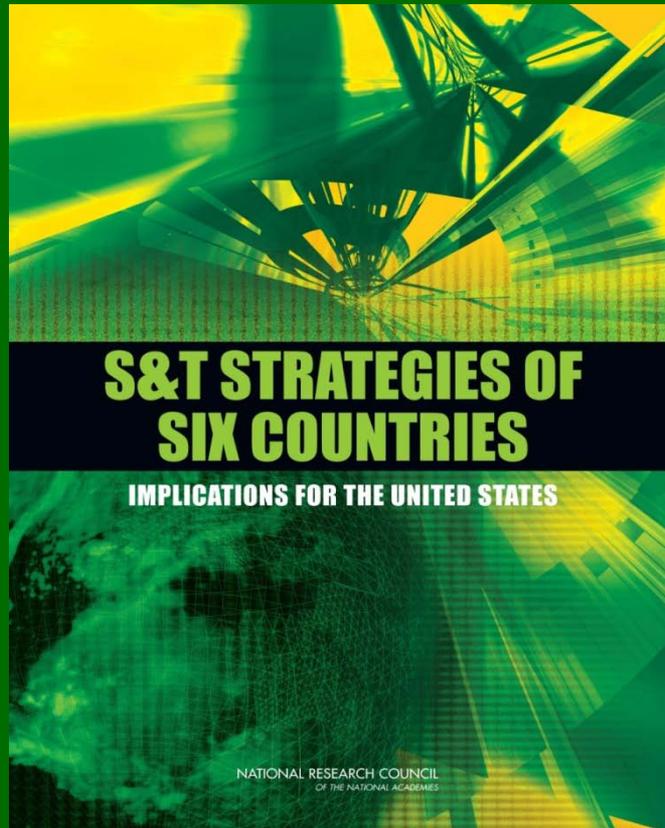
For US Government

- Assess U.S. transformation to a ***global innovation environment***
 - Research: talent, facilities, support, efficiency, globalization
 - Impediments: keys to the future
- Monitor country-specific cultural changes undertaken to facilitate S&T goals for all countries of interest.

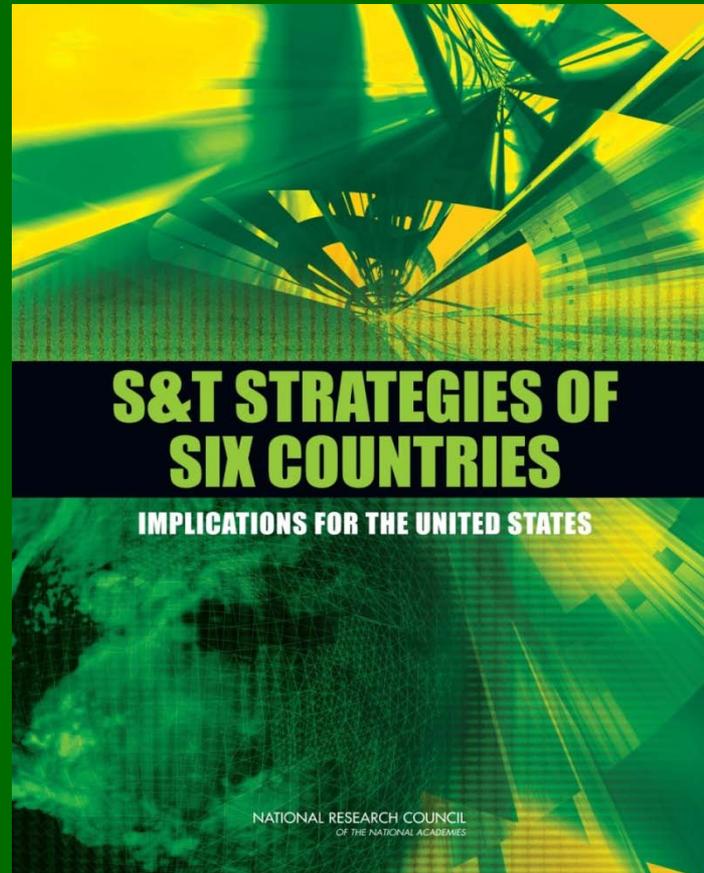
For US Government

- Global S&T revolution should be first-tier national security priority for the U.S.; has military & economic security implications.
 - Dispersion of R&D; diffusion of technologies
 - Globalization: borderless movement of know and know-how
 - Diffusion of technologies. Impact of disruptive technologies
 - Imperatives: International collaboration and interdisciplinary analysis
 - US slipping in primary/secondary education – a national security issue
 - Need stronger government leadership in S&T
 - IC should do more, regular estimates/evaluation of S&T
 - S&T (I) analysis and warning should be developed

Questions



Backup Slides



Recommendation 10-1

Because a successful global S&T innovation environment portends future prosperity and security for all countries, monitoring the transformation from a national to a global S&T innovation environment should be undertaken on a regular basis for the United States and all countries of interest. Because this transformation can take place before a national S&T environment is fully developed, monitoring should be conducted independent of a country's current achievement.

Recommendation 10-2

The transfer of intellectual property by multinational corporations into domestic companies through S&T activities should be monitored in key countries, particularly India and China. The United States could join with Japan, and possibly the European Union, to establish a united front against such practices

Recommendation 10-3

The United States should assess its own preparation for, and transformation to, a successful global S&T innovation environment to ensure that it remains in a preeminent S&T position for continued prosperity and national security. Specific areas for assessment should include global exchanges in education and R&D talent, international as well as national recruitment of R&D talent, multinational corporate collaborations, and public policies that facilitate or restrain the leadership of the United States in global S&T innovation.

Recommendation 10-4

For each country of interest, the United States should identify country-specific measures of S&T innovation environments, including nontraditional indicators that are appropriate for targeted technologies and developments. The United States should monitor each country's capacity to facilitate the cultural changes needed to achieve its global S&T innovation environment. These indicators are especially important for predicting future changes in S&T innovation environments.

Recommendation 10-5

The most successful global S&T innovation environments will recruit S&T talent into attractive positions with excellent facilities and research support. The United States should track the quality and availability of research facilities and research support as a significant indicator of any country's attractiveness to the world's S&T talent.

Recommendation 10-6

The United States should continue to gauge the efficiency of research, measured by the effective uses of research talent and research facilities, which portends the future of a country's innovation environment. Efficiency ultimately guides the use of research talent and facilities. For instance, the monitoring of non-research responsibilities of scientists (such as administration and proposal writing) and the quality of research infrastructure could be incorporated into measures of efficiency. Highly efficient S&T systems support the most attractive research careers for talented S&T contributors.

Recommendation 9-1

The U.S. government should assess, as a matter of urgency, the national security implications of the continuing global S&T revolution and the global dispersion of R&D. It should evaluate the impact of the decline in U.S. academic competitiveness at the primary and secondary levels, as pointed out in the 2007 report *Rising Above the Gathering Storm* report, especially with regard to the sciences. Equally important, the assessment should seek mechanisms for sustainable U.S. government collaboration with the international community to uncover and exploit potential scientific and technological breakthroughs, wherever they occur, and to contain whatever threats they may portend.