INTERNATIONAL SCIENCE AND TECHNOLOGY FOR THE ARMY: MISPLACED FOCUS?

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How leaders within the Department of Defense decide where to mine for international science and technology (S&T) is more of a random process than accepted methodology. Considering the importance to the commercial world of optimally located international research and development (R&D) centers, the military services' current practice of abdicating the decision-making process to a subjective evaluation versus application of accepted criteria and current information that allows quantification of the criteria invites technological surprise on the battlefield. By evaluating each criterion, the optimal decision for locating international S&T mining centers is possible. Finding the optimal technologies available for the nation's warfighters ensures world-class technologies for U.S. military programs and saves defense funding of R&D for developing existent S&T solutions.

Keywords: *International Technology Center (ITC); Research, Development, and Engineering Command (RDECOM); Research and Development (R&D); Science and Technology (S&T); Future Investment*

image designed by Miracle Riese »

Oslo
Drammen
Skagerrak
Sea
Cork
Clear
Plymouth
English Cha
Brest
Rennes
Nantes
of Biscay

The U.S. Army has International Technology Centers (ITCs) located worldwide. These centers seek the latest science and technology (S&T) across the globe by reporting in which foreign universities, industries, and government laboratories S&T is developed. Once the technology is found and identified as beneficial to a U.S. Army science or developmental program, certain measures are taken to form a collaborative project with the foreign entity to incorporate the foreign technology into the U.S. program.

Importance

The underoptimization of U.S. Army resources is a possible outcome for future decisions if the Army does not dedicate scarce available resources for mining international S&T productively (Dudley & Deylami, 2007, pp. 44–49). If the U.S. Army does not seek the best emerging S&T, alternative and competing science might defeat existing technology (Daniel & Loeb, 2006; National Academy of Sciences, 2007; Segal, 2004). At worst, technological surprise on the battlefield might result in defeat and destruction of the American way of life as we now know it (Defense Science Board, 2007). After setting the boundaries of the least and worst likely outcomes of misallocation regarding mining of international S&T resources, one may predict what is more likely to happen.

However, the U.S. Army does not have a mature process for deciding where to seek international S&T that might render the latest worldwide technologies for U.S. warfighters (Padgett, 2010). The current process used for deciding where the Army should seek beneficial, state-of-the-art S&T that will be incorporated into Army programs is not based on a systematic analysis of the countries and regions where the best S&T resides. This conclusion is based on a recent study that analyzed the Army Materiel Command (AMC) decision-making process, resulting in the location of a new Army International Technology Center (ITC) in Latin America (Padgett, 2010), as well as a review of the literature pertaining to military and commercial sector international S&T research and development (R&D) location decisions.

The Navy and Air Force also engage in seeking international S&T. The Navy's Office of Naval Research (ONR) has a central office in Great Britain, commanded by a Navy captain, dedicated to seeking international S&T worldwide for the ONR. A suboffice of the central office in Great Britain is the Navy's ONR office located in the U.S. Embassy in Santiago, Chile. The ONR office in Santiago was the first Service S&T office in Latin America. Its location in Chile influenced the Army leadership in their decision to co-locate a similar Army office—ITC Americas—in the U.S Embassy-Santiago (Padgett, 2010).

The Air Force Office of Scientific Research (AFOSR) is charged with seeking international S&T. AFOSR is one of 10 Air Force Research Laboratory (AFRL) technology directorates. AFOSR is the only AFRL directorate that maintains overseas offices for AFRL. Other U.S. government efforts to seek scientific data internationally are not known. Even though the other Services may exercise a more objective approach than the Army's to their decisions on S&T mining center locations, the study found that there are/were no widely accepted objective criteria used by either the Navy or Air Force upon which to base their past S&T mining center location decisions (Padgett, 2010; Roth, Perez, Wylie, & Luoma, 2002).

What is the Background?

Annual U.S. federal government expenditure dedicated to R&D was $129.1 billion for 2006, of which $72.1 billion was dedicated to the U.S. Department of Defense (DoD), leaving the remaining $57 billion for the next five highest federal departments combined (Gottron, 2006). The vast array of DoD laboratories and program offices spends most of the $72.1 billion internally. Resources are much more limited in the Army's international search for S&T.

The U.S. Army spends only $9 million to fund the three ITC regions to seek technologies worldwide (V. Baldwin, personal communication, February 26, 2007). This is sufficient for the Army to fund the overhead structures of three regional centers for S&T mining, with each region containing two subordinate offices. However, how and where the $9 million is spent remains critical since the budget has been relatively constant from 2004 to 2007 and is not expected to increase in the near future; and because the $9 million is not adequate for seeking S&T from all the countries within a regional territory.

The mission of the Army's ITCs is to promote cooperation between its Research, Development, and Engineering Command (RDECOM) and international researchers. By doing so, the RDECOM is made aware of possible technologies that might be of use to the subordinate Research, Development, and Engineering Centers (RDECs), as well as the Army Research Laboratory. This mission is relatively new, as the ITC centers were formerly called Standardization Groups. The AMC changed the title and mission of the Standardization Groups to ITCs in 2003–2004. The new mission focused on investigation and cooperation in the field of applied research, which is fundamental research to fully develop technologies versus the old mission that focused on standardizing the technologies developed by the U.S. Army with our closest foreign partners worldwide.

What Research Exists?

To more specifically review how the military has made past international S&T decisions, a study was made to examine a specific decision made by the Army to locate the newest international S&T mining center—a center called ITC Americas. ITC Americas was located in Santiago, Chile, with subordinate offices in Argentina and Canada.

A review of literature revealed the criteria used by the civilian sector and government sources in making international S&T location decisions, as well as the information sources used by the civilian sector to compose said criteria (Athukorala & Kohpaiboon, 2005; Doz, Wilson, Veldhoen, & Goldbrunner, 2006; Economist Intelligence Unit, 2004; Goode & Roberts, 2004; National Science Foundation, 2006; Organisation for Economic Co-Operation and Development, 2005). The criteria and information sources used are listed in a later section of this article entitled, "What Does the Existent Literature Say?" To augment the information found in the literature review, the study resulted in a survey of officials within the RDECOM aimed at determining the criteria rated best by the survey respondents for decisions involving the Army's international S&T locations. The survey provided RDECOM officials with the list of criteria used by the commercial sector for ranking and also provided respondents the chance to suggest their own view of the most important criteria that should be used by the military in international location decisions. As part of this section, a description of the study follows, including the details of the study methodology, population, and survey instrument.

Study Methodology

The specific problem this study examined was to understand, analyze, and explain the internal, external, and political influences on the U.S. Army decision-making process regarding location of a U.S. Army S&T center in Latin America rather than in another world region. The methodology for the study was qualitative and interpretive. The design was a case study on the decision to locate an S&T center in Latin America rather than other world regions. One part of the study involved using some aspects of the participant observer approach by examining the reports written by members of the ITC Americas. The survey in the study filled in the gaps in the literature reviewed and proposed answers to the problem statement and research questions.

The purpose of the qualitative study was to review the decision-making process used by Army leaders when the decision was made

to locate an S&T mining center within Latin America. Fundamental to the decision examined in the study were the factors considered by senior Army leaders in their valuation of one world region over another. The study indicated that the U.S. Army R&D leaders did not identify and leverage the most appropriate criteria upon which to base international S&T mining decisions.

Who Completed the Study Survey?

The population selected for the survey included 30 leaders within the Army R&D community. The 30 leaders received a survey, and the goal was to obtain responses from 20 of the 30 leaders. Persons involved with the decision included both military and civilian members who were part of the Army's S&T organization. The survey was sent to 30 DoD leaders believed to be most affected by the decision to locate the S&T center in Latin America. Most of the Army leaders were within RDECOM. Some of the other leaders were within the Army and Defense Department secretariats.

The survey participant list included senior leaders within RDECOM (n = 5), the deputy assistant secretaries of the Army for Defense Exports and Controls (n = 2), and the deputy assistant secretary of the Army for Research and Technology (n = 1). Also included were the past two leaders of the international section for RDECOM (n = 2), leaders within the international secretariat of Office of the Secretary of Defense (n = 2), and a past commander of the AMC (AMC; n = 1). The AMC was the organization with the final decision authority to locate the S&T office in Latin America. The first group included 13 people.

The second group of leaders was within the subordinate elements of RDECOM, called RDECs, and the Army Medical Command (MEDCOM) (n = 1). The RDEC leaders are Senior Executive Service (SES)-graded technical directors and are within the subordinate elements of RDECOM (n = 7). The technical directors in the subordinate elements of RDECOM and MEDCOM have advisors, called International Points of Contact (IPOCs; n = 9), who are of less senior rank (below GS-15 in grade), and were also in the second group. The IPOCs are the principal advisers for the RDEC technical directors on the integration of international S&T into Army programs. The second group of leaders included 17 people: the seven technical directors, the past deputy commander of MEDCOM's research center, and the nine IPOCs for the technical directors and MEDCOM. Twenty-two of the 30 leaders responded to the survey.

How Was the Survey Constructed and What Did It Reveal?

The survey instrument, a questionnaire with 12 questions, was created specifically for the study. The survey instrument contained

items addressing how Army R&D leaders made the decision to seek quality S&T information in Latin America, the criteria and information Army leaders used to decide to locate an S&T mining activity within Latin America versus other world regions, and the criteria Army leaders considered when they decided to locate an S&T center in Latin America.

The survey results revealed how the decision was made to seek S&T in Latin America versus other world regions, which criteria Army leaders used to open the S&T mining activity within Latin America, and the opinions of the leaders regarding the appropriateness of the criteria proposed in existent literature. The survey also revealed whether information currently available was adequate for international S&T location decisions and the opinions of respondents regarding the accessibility of S&T in one emerging world region versus another.

What Does the Existent Literature Say?

In Military Writings/Studies

The Army hired a contractor, CommerceBasix, to study where it would be best to locate future ITCs (Goode & Roberts, 2004). CommerceBasix analyzed the choices of investing in Latin America, India, Japan, China, Singapore, or Eastern Europe. The RDECOM requested CommerceBasix to focus on at least two but no more than five possible options regarding where to place international S&T locations. The study focused on considerations for current and future locations for Army S&T centers worldwide. Further, the study team expended much effort in detailing the current manning levels of the worldwide Army S&T offices, mission statements, and publishing comments from interviews of the worldwide S&T offices and staff elements within RDECOM. According to Goode and Roberts (2004), the study cited "several direct and indirect determinants are commonly believed to be important factors in innovation." The factors identified were available capital, economic life cycle of a prospective country, openness of the economy, market-based economic systems, protection for property rights, domestic demand for innovative products, and the balance of trade. The remainder of the study analyzed major countries of the world and how each rated considering the factors selected.

The ONR had contracted for two more focused studies. The Navy was the first to open an S&T office in Latin America, locating their office in Santiago, Chile. The Navy's original decision to locate their office in Santiago was one of the most significant factors that influenced the Army's 2004 decision. The first Navy study, by Guza et al. (2002) used database searches to determine what S&T areas

were strongest in each Latin American country. The reason for the study was to provide the information needed to determine where within Latin America an office should be located, and afterward, what S&T areas should be sought in each country within Latin America. The study looked at citations and S&T articles published within major S&T categories, such as bioscience, material science, naval architecture, human factors, electronics, computer science, radars, underwater acoustics, optics, manufacturing, and oceanography. The information to support the conclusions of the study was derived from Inspec® Direct and Science Citation Index (SCI) databases. The Navy study did not consider worldwide locations or selection criteria for their recommendations and conclusions, and the study was limited to Latin American countries (Guza et al., 2002).

The second Navy study was conducted by the Center for Strategic Studies (Roth et al., 2002). ONR requested an assessment of the factors that would indicate the best location for a Latin American S&T center. The factors recommended were: economic and political considerations, general living and working conditions, S&T funding levels, and international cooperation and activities. However, once again, this study only considered four countries within Latin America: Brazil, Mexico, Argentina, and Chile. Factors for locations worldwide were not considered (Roth et al., 2002). The Navy decided, as a result of the study's recommendations, to locate their Latin American S&T office in Chile.

The Air Force was also influenced by the Navy and Army decisions to locate S&T offices in Latin America and opened an office in the U.S. Embassy-Santiago in 2009 (J. Fillerup, personal communication, February 21, 2007).

In the Commercial Sector

Doz et al. (2006) wrote about the drivers, or selection criteria, for innovation and R&D expansion beyond corporate headquarters, called dispersion. They performed a survey of 186 companies from 19 countries and 17 sectors, with a combined $76 billion in R&D expenditures in 2004. The number of foreign R&D sites from all countries has increased from 45 percent in 1975 to 66 percent in 2004. Of the total percentage of new sites, 13.9 percent of them were located in China and India. Approximately 78 percent of the new sites remain in the United States or Europe. The remaining 8 percent will go into other Asian and Latin American countries. The forecast was that by the end of 2007, China would have 31 percent of the global R&D staff—up from 19 percent in 2004. The study predicted that the number of R&D sites and staff in Western Europe and the United States would remain unchanged. The Doz report cited the percentage of new sites: China–22 percent; United

FIGURE 1. ECONOMIST INTELLIGENCE UNIT SURVEY QUESTION—FUTURE INVESTMENT TOP 10 LOCATIONS

In which of the following countries does your company plan to spend the most on R&D in the next 3 years (excluding your domestic market) (top 10 locations out of 54)?		
1.	China	39
2.	United States	29
3.	India	28
4.	United Kingdom	24
5.	Germany	19
6.	Brazil	11
7.	Japan	10
8.	France/Italy	9
10.	Czech Republic	8

FIGURE 2. ECONOMIST INTELLIGENCE UNIT SURVEY QUESTION—LOCATION OF CORPORATE HEADQUARTERS

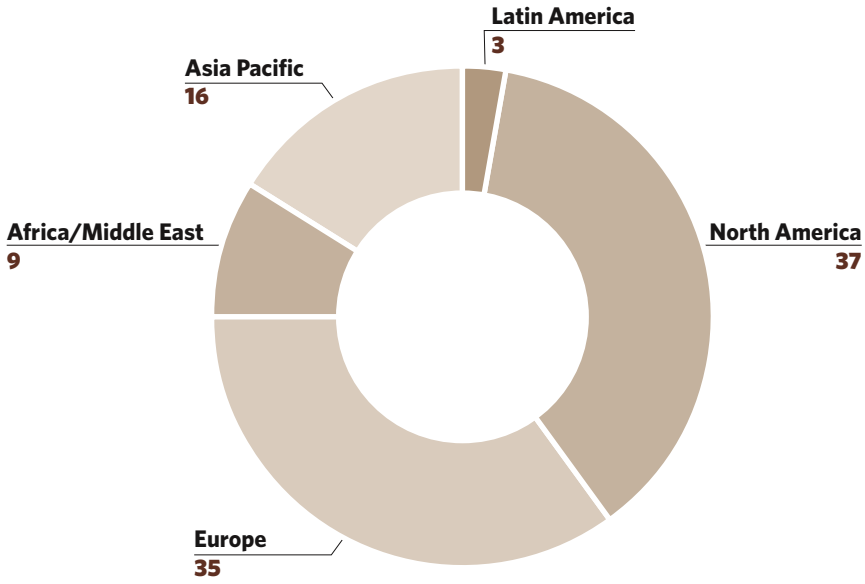


FIGURE 3. ECONOMIST INTELLIGENCE UNIT SURVEY QUESTION—OVERSEAS R&D EXPENDITURE OVER PAST 3 YEARS

Roughly what percentage of your company's overseas R&D expenditure over the past 3 years went to the following regions?		
	Under 10%	**Over 10%**
Latin America	86%	14%
Eastern Europe	78%	24%
Asia	50%	50%

Note. Due to rounding issues in the source from which the data was adapted, not all percentages add up to 100%.

FIGURE 4. ECONOMIST INTELLIGENCE UNIT SURVEY QUESTION—ANTICIPATED OVERSEAS R&D EXPENDITURE OVER NEXT 3 YEARS

Roughly what percentage of your company's overseas R&D investment will be allocated to the following regions in the next 3 years?		
	Under 10%	**Over 10%**
Latin America	83%	16%
Eastern Europe	65%	36%
Asia	38%	62%

Note. Adapted from *Scattering the Seeds of Invention: The Globalisation of Research and Development,* by Economist Intelligence Unit, 2004. Due to rounding issues in the source from which the data was adapted, not all percentages add up to 100%.

States and India–19 percent; Western Europe–13 percent; Eastern Europe–12 percent; Asia, excluding China–8 percent; and Latin America–5 percent. The report said the shift of R&D sites is towards India and China.

The Organisation for Economic Co-Operation and Development (OECD) (2005) also proposed selection criteria for R&D locations: patents, licenses, know how, R&D studies, trade in high-tech products, and protection of intellectual property. Rausch (2003), the World Intellectual Property Organization (2006), and two other OECD reports (2008a; 2008b) added to the importance of patents as an indicator of S&T. The OECD 2008 reports said patent statistics measure the output of R&D and its productivity. The reports said patenting activity is more concentrated than R&D effort, and

therefore is a better measure of a country's R&D activity. The OECD report (2008b) also said triadic patents are the best measure since they better reflect the quality of patents. Triadic are those patents filed in the United States Patent Office, Japan Patent Office, and European Patent Office.

A study by the Economist Intelligence Unit (2004) found that cheap labor was an insignificant factor in R&D location decisions. The study done by the Economist Intelligence Unit included 104 senior executives. It found that 52 percent of corporate executives plan to increase their investment in overseas research in the next 3 years, primarily in China and India. The study also addressed developments within Eastern Europe. The study said the relative skill sets of Eastern Europe are increasing, while Western Europe and the United States are declining, making Eastern Europe an attractive location for future R&D investment. Four questions were posed to executives; Figures 1 through 4 reflect their answers.

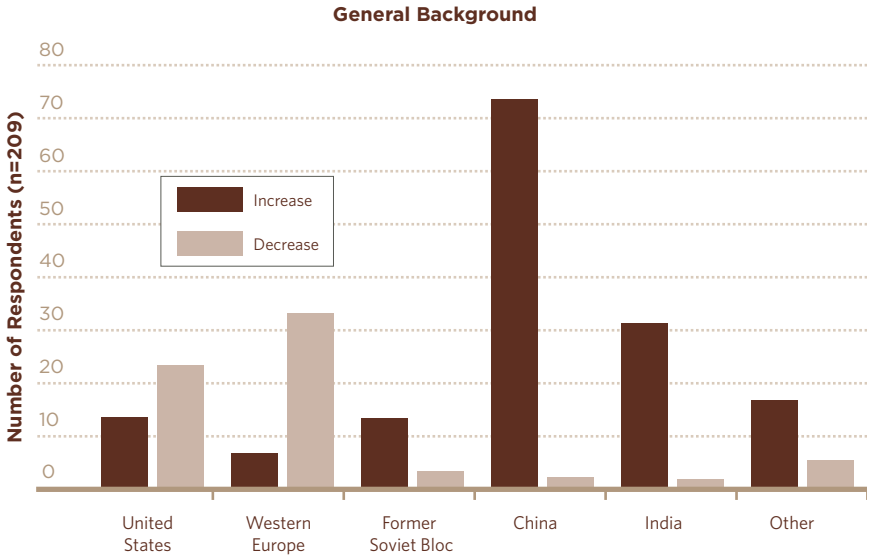
A study by Thursby and Thursby (2006) surveyed over 200 multinational companies across 15 industries regarding factors influencing location decisions for R&D facilities. The majority of companies surveyed were in the United States and Western Europe. The study was done out of concern that location decisions should be based on informed versus anecdotal data. The search used 61 articles, dating from 2002–2005, from the *New York Times* and *Wall Street Journal* describing R&D location decisions. Of the articles, 38 mentioned cost as the primary deciding factor and 29 the quality of R&D personnel. Figure 5 shows the increases and decreases in R&D employment in several world regions and countries.

India and China reflected the largest gains by far. The Thursby study also assessed the locations of U.S. and Western European sites recently opened or future sites the two regions may intend to open (Figure 6).

Cimoli, Ferraz, and Primi (2005) found Latin America to be a minor actor in patenting activity, and the patents filed are usually in chemicals and mechanics, not technology-leading areas such as telecommunications, biotechnology, genetics, and electronics. The report said Latin America innovative processes are adaptive in nature and are rarely inventions and scientific discoveries. Cimoli et al. also cited Latin American technology policy as following divergent and unsynchronized patterns.

The data in an OECD Report (2008b) reflect patent information designed to indicate innovative activity. As depicted in Figure 7, the United States has the top innovative performance at 36.4 percent of the total, followed by the European Union (30.3 percent) and Japan (25.7 percent). Changes that were cited as a measure of patent quality in the triadic patent top 20 indicate innovation in Asia is

FIGURE 5. REGIONS/COUNTRIES WHERE AN INCREASE/ DECREASE IN R&D EMPLOYMENT IS ANTICIPATED



Note. Adapted from *Here or There? A Survey of Factors in Multinational R&D Locations,* by J. Thursby and M. Thursby, 2006.

FIGURE 6. LOCATION OF RECENT OR PLANNED INTERNATIONAL TECHNOLOGY CENTERS

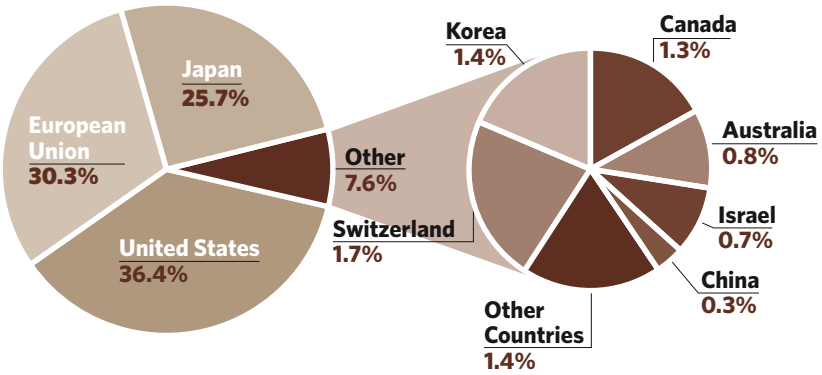
	Destination					
Home Country	**United States**	**Western Europe**	**China**	**India**	**Other**	**Row Total**
United States	0	19	30	9	13	71
Western Europe	14	10	23	9	12	68
Other	0	0	2	0	2	4
Column Total	14	29	55	18	27	143

Note. Adapted from *Here or There? A Survey of Factors in Multinational R&D Locations*, by J. Thursby and M. Thursby, 2006.

surging. No Latin American country is included in the top 30, in raw numbers or as compared to population or gross domestic product (GDP). Three countries from Central/Eastern Europe are in the top 30 of triadic patents as compared with GDP and population density: the Russian Federation, Czech Republic, and Hungary.

Pion-Berlin (2005) said that Latin America, unlike Eastern Europe, in the past has not encountered a security threat sufficient

FIGURE 7. SHARE OF COUNTRIES IN TOTAL TRIADIC PATENT FAMILIES, 2003



Note. Patent counts are based on the earliest priority date, the inventor's country of residence, and fractional counts. Adapted from *WIPO Patent Report: Statistics on Worldwide Patent Activities,* by World Intellectual Property Organization, 2006; and *Compendium of Patent Statistics,* by Organisation for Economic Co-Operation and Development, 2008a.

to motivate an investment in resources and talent to create sophisticated war machines nor "civilian overseers" that understand how sophisticated war machines can work for political purposes. The expenditure toward defense within Latin America is less than Western Europe, Asia, Africa, and North America.

D. Hill published a report (2002) that provided an overall assessment of various regions/countries (Figure 8). The technological infrastructure is viewed as the single most important item in deciding locations for international S&T locations.

A study by Athukorala and Kohpaiboon (2005) said that developed countries constitute around 90 percent of the U.S. Multinational Enterprise (MNE) R&D investment, down from 94 percent in the early 1990s. According to the study, the increase is going to Asia, especially Singapore, Korea, Malaysia, and China. Latin America, except Mexico, has declined in recent years in U.S. MNE R&D investment. These statistics add to the evidence that locating an Army S&T center in Latin America was not based on existent statistics of locations experiencing the greatest level of S&T activity internationally.

Freeman (2005) published a study citing locations where science and engineering (S&E) expertise in the form of university graduates lies worldwide. The study cited PhDs in S&E as the most critical indicator of where knowledge expertise in S&E lies. The top five countries where firms intend to increase R&D efforts outside of their homeland were the United States, India, the United Kingdom, and Germany, with the greatest growth rate of S&Es predicted to be

FIGURE 8. INDICATORS OF TECHNOLOGICAL COMPETITIVENESS: 1999 (INDEX)

	Higher Numbers = Increased Competitiveness			
Region/ Country	**National Orientation[a]**	**Socioeconomic Infrastructure[b]**	**Technological Infrastructure[c]**	**Productive Capacity[d]**
Latin America				
Argentina	41.3	53.3	27.5	31.0
Brazil	61.5	49.1	40.4	39.6
Mexico	41.8	40.4	21.8	24.8
Venezuela	39.8	49.4	21.3	24.3
East Asia				
China	65.3	52.4	46.4	41.9
Indonesia	53.9	43.8	19.2	23.7
Malaysia	69.5	58.9	31.9	44.1
Philippines	60.9	63.7	24.4	42.6
South Korea	74.9	73.5	44.6	48.8
Thailand	50.7	46.5	20.5	30.6
India	67.7	48.4	46.8	51.3
Poland	69.6	58.4	38.2	44.3
South Africa	50.2	53.6	40.5	28.7

Note. Adapted from *Latin America: High-Tech Manufacturing on the Rise, but Outpaced by East Asia* (NSF Publication No. 02-331), by D. Hill, 2002, National Science Foundation, Directorate for Social, Behavioral, and Economic Sciences.

[a] National orientation provides evidence that a nation is taking direct action to achieve technological competitiveness.

[b] Socioeconomic infrastructure assesses the social and economic institutions that support a modern technology-based industrial nation.

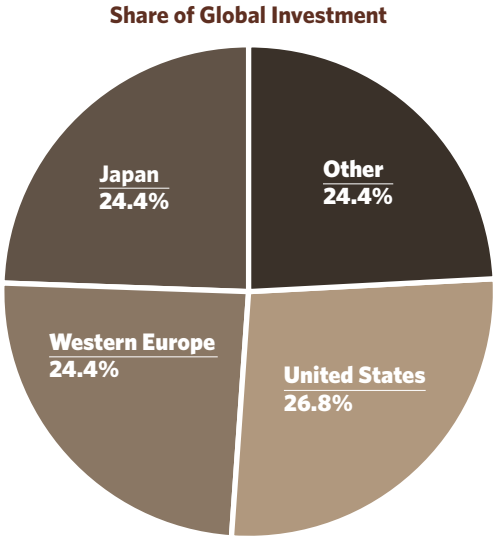
[c] Technological infrastructure assesses the institutions and resources that contribute to high technological development.

[d] Productive capacity assesses the level and efficiency of physical and human resources devoted to manufacturing.

in China by 2010. Murdock (2005) measured leadership in R&D as strength in investment, scientific publications, and patents. Figures 9 and 10 illustrate the percentage of global R&D investment.

To put this in perspective, Segal (2004) said that no one measure can measure a country's innovation. This is offered to show that location criteria for R&D location decisions found in commercial and government studies vary from study to study.

FIGURE 9. U.S. GOVERNMENT SHARE OF GLOBAL R&D INVESTMENT



The United States currently leads the world in government R&D investment, with a little over 25 percent of the total global investment.

Note. Adapted from *Nanotechnology: Where Does the U.S. Stand?* by S. Murdock, 2005. Testimony of Sean Murdock, Executive Director, Nanobusiness Alliance, Hearing before the Research Subcommittee on the House Committee on Science.

What Answers Emerged from the Survey?

Survey respondents thought that the Navy presence in Latin America, prior to the decision to locate an Army office, affected the outcome of the decision. The consolidation of scarce military S&T assets might appear to be optimal, but what if the quantitative data indicate a different location would be more productive than the earlier location decision made by a different Service?

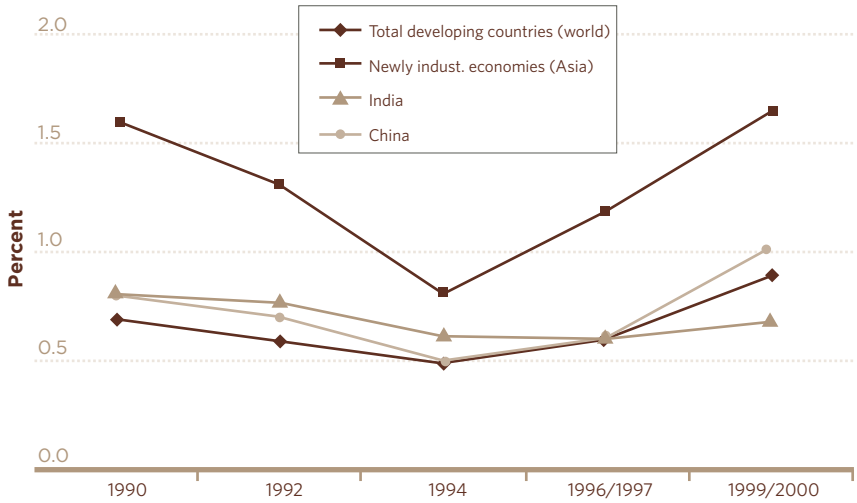
Some survey respondents thought that the decision might have been made to avoid technological surprise on the battlefield. The Army decision authority, who responded to the survey, did not mention avoiding technological surprise as a factor that influenced his decision. However, the decision authority did say that the prior absence of any Army S&T coverage of Latin America affected his decision.

Are There Answers Resulting from the Literature Review and Survey?

Conclusions

No. 1. The 2008 OECD Report indicated that triadic patents were the single most important criterion for selecting international S&T

FIGURE 10. R&D INTENSITY IN DEVELOPING COUNTRIES AND SELECTED COUNTRIES/REGIONS IN ASIA: 1990–2000



mining locations (OECD, 2008b). The reason triadic patents were viewed as an important criterion was based on the view that if a patent was of great value, the originator would want to protect it worldwide as much as possible. Although this decision contradicts the literature of patents—peer-reviewed articles, intellectual property rights protection, among a list of other things—it is a logical one. Knowledge is important, but the statistics reflect that the greatest numbers of S&Es are in China and India, and R&D intensity is not as important as raw R&D expenditures. The latter provides the degree and volume of opportunities for the military.

No. 2. Based on the data reviewed from commercial and military sources found in the literature, the decision made to locate an Army S&T center in Latin America versus another world region was not the most optimal decision for the best long-term interests of the U.S. Army. Instead, the data indicated that the office should have been located in the following locations, in order of priority:

1. India
2. Emerging Asian countries
3. Eastern Europe

China would be the No. 1 priority, but its choice as a viable location for an ITC is viewed as impractical due to the need to protect U.S. Army intellectual property.

No. 3. The decision authority for the S&T center in Latin America made the decision based on a personal evaluation; therefore, the decision was an intuitive-based one, relying on existing information without seeking input from his subordinate expert advisors (Padgett, 2010).

No. 4. The survey responses indicated the decision authority did not seek the expert knowledge of center directors at the subordinate research centers within RDECOM, even though they were general officer-level civilians, prior to making the decision (Padgett, 2010).

No. 5. The decision authority did not use a set of criteria for the decision or seek information that might support some set of criteria, but instead evaluated the existent information subjectively rather than objectively prior to reaching the decision (Padgett, 2010).

No. 6. Overriding factors, three of which evolved as a result of the study, motivated the decision authority to select Latin America as the location of the S&T mining center. Navy presence in Latin America prior to the decision to locate an Army center affected the outcome of the decision. This was followed by quantitative data that indicate a different location would be more suitable in the long term. The data indicate that locating an S&T center in a location where other S&T assets are already located to gain short-term efficiencies from the collocation is not the best alternative for long-term corporate, military, or organizational health.

No. 7. The Army decision authority used other factors to determine where to locate the S&T center, such as politics and security cooperation goals for the military. Survey respondents cited each of these factors repetitively. According to the survey responses, political considerations constituted the largest influence over the decision authority in his evaluation of the S&T center's eventual location.

Recommendations

No. 1. Decisions for international military S&T locations should use the following three objective criteria as the basis for the decision:

1. Triadic patents
2. R&D expenditure rates
3. S&E articles published

The second criterion was cited as the most important factor in a study by Athukorala and Kohpaiboon (2002). The third criterion

appears as the statistical factor used to measure international S&T activity by the National Science Foundation statisticians in their periodic reports (Hill, 2002, 2004).

No. 2. Since a subordinate office of the regional center in Japan, located in Singapore, is presently charged with oversight of India, perhaps a transfer of assets from the ITC in London to Singapore to better cover the explosion of science in India would present the best option. ITC London has the most international S&T resources at present, and those resources are covering an area where the Army S&T community already has strong ties, meaning the resources in ITC London might be better utilized to detect new technologies emerging from India and the emerging Asian countries. The same realignment, using ITC London assets, should be applied for the emerging Asian countries, except that the additional assets should be located in Japan versus Singapore for coverage of the emerging Asian countries.

No. 3. Based on using objective criteria, the office in Latin America should be transferred to Eastern Europe to cover the larger amount of S&T emerging from Eastern Europe. However, if political concerns are overriding in motivating relationship building with Latin America versus Eastern Europe, then the S&T regional office and suboffices in the Americas should remain in place.

No. 4. Senior-level decision authorities should seek the expert judgment of the SES directors prior to making international location decisions.

No. 5. An earlier study indicates the decision authority opted to exclude from consideration the objective data and input from experts when he decided to locate an S&T center in Latin America (Padgett, 2010). If a decision authority opts to exclude from consideration the existent objective data or the advice of subordinate experts, then the decision authority should clearly articulate why the alternative solution provides a more optimal outcome.

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