Testing One Framework for Measuring National Power in the Postindustrial Age

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Abstract

This composition was written in an effort to test a framework set forth by a group of researchers from the Rand Corporation. <u>Measuring National Power in the Postindustrial Age</u> is a book by Ashley J. Tellis, Janice Bially, Christopher Layne, and Melissa McPherson written with the specific goal of providing a detailed framework that would be useful to the United States' intelligence agencies as they attempt to determine which states will likely become prominent actors on the international stage, and the broader goal of allowing an evaluation of one or two countries rather than a mere rank ordering of states based on traditional uni-or multivariate approaches to measuring national power.

The testing of the framework was achieved through the use of two case studies: India and Pakistan. It becomes clear, after using the two case study countries to test the framework, that the framework is an excellent way to organize the collection of data toward the ends listed above, but that the framework has limitations pertaining to the ability to actually gather all of the data necessary to successfully fulfill its requirements. The complex nature of the framework made for an exhaustive search for data and information dealing with India and Pakistan but ultimately allowed for reasonable assessment of national power in the two countries, not in the sense of which one was definitively more or less powerful, but rather, in a way that allows for the assessment of areas of strength and weakness country that a country may have.

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CHAPTER ONE   *INTRODUCTION*

The concept of power lay at the very base of the study of political science. Although many great minds have mulled the topic, there seems to be little consensus on it, other than the fact that all agree power is a real and important concept when discussing international relations. One group of social scientists has developed an extensive model for measuring national power which is included in a book called <u>Measuring National Power in the Postindustrial Age</u>, written by Ashley J. Tellis, Janice Bially, Christopher Layne, and Melissa McPherson.

 In this analysis, I answer the question of whether national power can actually be measured in the way in which Tellis, et al. suggest that it can be. In other words, can a researcher with broad access to scholarly journals, books, and other open source intelligence materials as well as access to a number of related statistical databases actually hope to find all of the data, both qualitative and quantitative, necessary to flesh out the framework, and if so, does it provide, as the authors propose, a meaningful way to evaluate the national power of one or two nations in order to assess their relevance in the international community. As this composition relies on the framework introduced in <u>Measuring National Power in the Postindustrial Age</u>, a summary of the reading is appropriate and is offered below.

The authors attempt to take the traditional approach to measuring national power a step further in order to bring in some aspects of national power that have developed in and are applicable to our postindustrial society with the aim of allowing the United States intelligence community to better determine which countries may emerge to balance power against the U.S. in the future.

The organization of the book is fairly straightforward. The opening pages announce the intention of the study and introduce the reader to three basic assumptions that he must accept in order for the framework to function. These are: that a science based knowledge revolution is currently under way, that the performance of the state is critical to success in the postindustrial age, and that national power will continue to be best expressed in terms of military power.[1] The authors go on to explain why national power is even a concept that needs to be explored in the fashion in which they are proposing that it does. Tellis, et al. argue that "society stands on the

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[1] Tellis, Ashley J., et al., <u>Measuring National Power in the Postindustial Age</u>, Rand Corporation, January 2001, p. xiii.

threshold of a new age defined by a science based knowledge revolution"[2] and that because of this, our worldview must change accordingly. We have traditionally assessed the national power of the U.S. vis-à-vis other countries by using variables such as population size, GNP, land area, and the absolute size of a country's armed forces. The authors point out the need to not reject totally, but build upon this set of variables in order to account for the advent of the knowledge revolution and other postindustrial phenomena.

The authors, in chapter two, lead the reader through the translation of the measurement of power to the measurement of national power as a way to set the stage for their analysis. Tellis, et al. point out the difficulty of actually defining power, but define it in general on three levels: the allocation of resources, the ability to use those resources, and the strategic character (control over the course of events, understood mostly in terms of military events) of an entity. These general parameters for defining national power translate well into parameters for measuring national power as applied in this study. Basically, the authors add "of a state" to the end of each of the levels mentioned above to outline the conceptual framework for the report.

Proceeding onward, Tellis, et al. outline in more detail the traditional means of measuring national power. The authors take the reader through various models for studying national power, some single variable approaches (military force size, or gross military capability), some multivariate approaches (G=national power=N(L+P+I+M)), in order to point out some of the weaknesses of these approaches given the current international climate. They dismiss the single variable models as too base to provide meaningful insight into which countries may be making significant advances militarily and dismiss traditional multivariate approaches because they often allow only for the rank ordering of states. The main arguments against these traditional approaches are that they "focus on the country as a container for power" and are simply gross indices of power.[3] The ability to rank order states does not necessarily allow the U.S. to investigate the national power of those nations that may not be powerful at the present, but that, given the knowledge revolution and its related technologies as potential equalizers, may emerge as powerful nations.

Finally, in chapters 4-7, the authors delve into the core of the design. They argue that true national power comes from "a nation's ability to dominate the cycles of economic

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[2] Tellis, p. 1.
[3] Tellis, p. 31.

innovation at a given point in time and translate the fruits of dominance into effective military capabilities."[4] In other words, the intelligence community needs to begin to focus not just on a nation's resources, but on how innovative a country can be in turning those resources into outcomes (i.e. military capabilities and ultimately victories).

The authors go back to the elements that make up power and thus national power (national resources, national performance, and military capability) and take each one in turn, illustrating how best to measure each of these elements. The national resources examined in the study are technology, innovativeness or entrepreneurship, human resources, economic resources and physical resources.

Each of these resources is carefully defined by the authors so that the reader has a complete understanding of what could be considered to be fair indicators of them. For example, when discussing technology, the authors stress the fact that in order to measure technological capabilities in a country, a researcher would need to take into consideration a nation's ability to produce "critical technologies" both now and into the future and whether or not they can apply these technologies militarily.[5]

Tellis, et al. follow the same organizational pattern when discussing national performance, the second element of national power. The authors attempt to help the reader understand what motivates countries to "produce intermediate and final goods," and "those variables that depict the level of state and societal performance necessary if these intermediate and final goods are to be produced efficiently."[6] In other words, the authors are examining what external and internal pressures are motivating production in a country and how well the state and society collaborate to make this production possible. Here the authors focus on the relationship that a country enjoys with other countries (external constraints/pressures), the self control and social control (elite cohesion and the permeation of social regulations and norms) or infrastructural capacity of a country, and perhaps the most qualitative sub-element of national power introduced in the reading, ideational resources or the resources that allow a state to problem solve effectively. This concept proves the most difficult to conceptualize in terms of what state information might be available to a researcher to properly examine these variables.

The next and longest chapter of the book houses the discussion of the third and most important element of national power which is military capability. The authors divide this broad concept into

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[4] Tellis, p. 36.
[5] Tellis, p. 54.
[6] Tellis, p. 92.

categories of strategic resources, which are the resources that people traditionally associate with military capabilities i.e. number of weapons, size of each branch, production capabilities, etc.; conversion capability, or the ability of the military to use the strategic resources that it has available to create an effective and efficient operational force; and combat proficiency which is the ultimate "output" of the military.

After having laid out the new framework for measuring national power in our postindustrial age, the authors conclude by cautioning the reader that this is by no means a perfect model, and that, in fact, it needs testing and revision in order to further enhance its usefulness. They also point out that this model is best suited for evaluating the potential of one or two countries for comparison rather than for rank ordering states by their level of national power. In the concluding pages of the work, the authors call for a testing of their framework "by using it to organize data collection for one or two countries on an experimental basis."[7]

Before moving into the actual test of the framework, I will first lay a basic foundation of the concepts of power, balance of power, and measuring power as they apply to international relations. The pages below are an amalgamation of some of the more pertinent literature on the above-mentioned concepts. While one could write volumes on any one of the topics presented, the hope is that this brief introduction will give the reader a clear starting point for assessing the work presented in the pages that follow it.

Power

In all of the vast literature that is available on the concept of power in international relations, one writer sums it up well when he says, "Power in international politics is like the weather. Everyone talks about it, but few understand it."[8] This sentiment, as one can imagine, is the direct result of the fact that there are many conflicting views on just what is power. In reviewing the literature on power, we learn that power, for the most part is linked to control. Dahl defines power in terms of A and B. He states "A has power over B to the extent that he can get B to do something that B would not otherwise do,"[9] or to put it another way, A has control over the outcome of his encounter with B. To take that idea a step further, getting B to do something that he would not normally do would necessarily require resources of some kind, and

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[7] Tellis, p. 178.

[8] Nye, Joseph S., Jr., "The Changing Nature of World Power," *Political Science Quarterly*, v. 105, no. 2, 1990, pp. 177.

[9] Clegg, Stweart R., <u>Frameworks of Power</u>, Sage Publications, London, 1989, p. 69.

therefore power is also linked to the control of resources. Some of the more traditional resources that have been associated with power when speaking specifically in terms of national power are population size and the size of a state's territory, as well as state's natural resources, economic prosperity level, military size, and political stability.

We also learn that power is not necessarily contained to possessing resources, but also includes possessing the ability to translate those resources into outcomes.[10] Most often, in the context of national power, "outcomes" means increased military strength or military victories. Furthermore, an entity cannot be said to have power simply because it achieved *some* outcome, but rather, the entity must have achieved its *intended* outcome. In other words, A cannot simply get B to do anything B would not normally do, A must get B to do something that A intended B to do.[11]

To further complicate matters, the literature on power teaches us that power itself is not a stationary entity[12] and that, in thinking about national power, the nature of the resources that contribute to power are constantly changing as well.[13] The governments of nations are constantly gaining and losing power vis-à-vis other nations' governments as well as within their own borders, with governments constantly seeking to increase both types of power. This tells us that power is a concept that is both internal and external when discussing international relations.

So what is power? At its most basic level, power is the ability to achieve one's own goals through the control of others. It is this notion that nations keep at the forefront when constructing both foreign and domestic policy. The effort to gain power permeates every fiber of a nation, from the domestic build up of industry that could be used to support military operations if necessary, to the declaration of a war that might be necessary to increase a nation's power from a global standpoint, and is therefore why the study of power is so important.

Balance of Power

The amount of literature dealing with the concept of power is rivaled only by that dealing with the concept of balance of power. What does the term actually mean? Is there really such a thing as a balance of power in the international system? Balance of power theory began

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[10] Nye, p. 178.
[11] Clegg, p. 72.
[12] Boulding, Kenneth E., <u>Three Faces of Power</u>, Sage Publications, Newbury Park, 1989.
[13] Nye, p. 183.

developing at the end of the Renaissance period[14] and has been entwined in the study of international relations ever since. The concept is basic, but confusion arises because the phrase is used to describe so many situations in international relations. A definition of the phrase has been so difficult to nail down and the term "balance of power" has been used so widely in political science that, as one writer notes, it has even been used to describe the exact opposite (the possession of predominance) of what is considered to be its traditional connotation (an equity in power among nations or blocs of nations).[15]

While the term balance of power is sometimes used to describe how power is distributed in the international system[16], the basic concept of a balance of power system is that it is one where states are attempting, as rational actors, to maintain and increase their power,[17] but that, because of tactics to increase power such as forming alliances with other nations, no one state is able to harness an unusually large amount of power.[18] The balance of power system strives toward equilibrium as do molecules in nature. When nations balance power against one another, the system is supposed to be stable. It is when one nation or group of nations becomes too powerful or seeks to gain more than its share of the available power (the equilibrium is disturbed) that conflicts arise. Thus, understanding how nations may try to balance power against one another is essential in determining what course of foreign policy action a nation may need to pursue in the future.

Measuring Power

In order to better assess a nation's power vis-à-vis other nations and then, in turn, to be able to assess how nations may try to balance power against one another, one must attempt to measure power. The literature suggests that there may be as many ways to go about measuring power as there are to define the term power itself. One "crude" method of measuring power at the national level is to look at a nation's attempts at exercising power and the outcomes of those attempts. [19] Other, more traditional approaches involve looking at a nation's control over resources. In other words, how large are its population and military? What is its GNP, how stable is its government, and how large is its territory? Scholars have developed often-

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[14] Sheehan, Michael, The Balance of Power, Routeledge, New York, 1996, p. 52.
[15] Sheehan, p. 19.
[16] Nye, p. 185.
[17] Pruitt, Dean G., "National Power and International Responsiveness," *Background*, v. 7, i. 4, February 1964, p. 166.
[18] Sheehan, p. 4.
[19] Hart, Jeffrey, "Three Approaches to the Measurement of Power in International Relations," International
    Organization, v. 30, i. 2, Spring 1976, p. 293.

complicated mathematical equations to add, subtract, multiply and divide these factors in an attempt at determining a nation's power. Many scholars have settled on the size of a nation's military as a reasonable univariate measure of national power. What we quickly learn, however, is that, as stated in the discussion of power, the nature of what makes a nation powerful is constantly changing according to world conditions. Many believe that factors such as a nation's technology base, educational level, and economic growth are becoming more and more important to a nation's power.[20] In fact, it has been said that the overemphasis on military power alone has been a weakness in current thinking about national power specifically and international politics in general.[21]

Testing the Framework

It is with this weakness in mind that Tellis, et al. developed their framework to include factors that go beyond those traditional factors mentioned above to include some qualitative factors that heretofore have been almost completely omitted from the study of national power. I have used the framework to organize the collection of data for two cases: India and Pakistan. Before discussing the criteria that will be used to determine if the model is suitable for use in measuring national power, insight into why India and Pakistan make for quality case studies is appropriate and is offered below.

India is perhaps one of the more fitting countries to examine when contemplating a test of the Tellis model. First and foremost, it is one of a select few countries that has the potential to become a true major power.[22] Not only is it a nuclear power, but it also has a large military capable of supporting traditional warfare if necessary. It also has a rapidly emerging technological base[23] which is one of the assets that Tellis, et al. point to as being relevant in our postindustrial society. Furthermore, India has a growing economy. Some predict that India's economy could grow to be one of the largest in the world over the course of the next decade or so.[24] In addition, India is sometimes referred to as the world's largest democracy. This puts India in a unique position in the region and is of interest when assessing national power. All of

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[20] Nye, p. 179.

[21] Baldwing, David A., Power Analysis and World Politics: New Trends Versus Old Tendencies," *World Politics*, v. 31, i. 2, January 1979, p. 180.

[22] Shah, Aqil, "Democracy on Hold in Pakistan," *Journal of Democracy*, v. 13, no. 1, January 2002, pp. 67-75.

[23] Wilcox, Richard, "Yes, a Security Council Seat for India; America Should Insist," *International Herald Tribune*, February 10, 2003.

[24] Rajghatta, Chianand, "US panel tells Bush India emerging as 'great power,' Pakistan going down the tubes," *The Indian Express*, December 6, 2000.

these factors put India in an excellent posture to become a world power and therefore policy makers in the U.S. need to be well appraised of India's true level of national power. Finally, statistics on India's government and private sectors are relatively easy to find. The fact that India is in such a strong position globally makes it an interesting and relevant case study, and the fact that the government regularly and accurately publishes national data makes it a viable one for testing the framework.

In Pakistan, we see quite a different scenario. On the surface, there appears to be no reason why Pakistan should not have become a major power contender as India has.[25] It did become a nuclear power in 1998,[26] but has not enjoyed the same legitimacy globally as has India. Furthermore, we see that while Pakistan has a sizable, well-educated population and fertile land,[27] it has not had the same economic success as India. It is a large but poor nation.[28] In addition, Pakistan does not have a true democracy in place. The military government there continues to suppress legitimate political activities and to manipulate the political process in its favor.[29] All of these elements combine to make Pakistan an interesting foil to India, and furthermore, data on Pakistan are much less easily found due to the nature of government there and is therefore more difficult to collect than is the case with India, allowing a test of the framework under less than favorable conditions. Two countries in the same region in very different situations both militarily and as far as their relationships with the U.S. are concerned should make for interesting case studies and at the same time provide a perfect opportunity to test the framework's viability. Furthermore, the fact that India and Pakistan have similar historical, geographic, and cultural experiences orients the research design toward the "most similar systems" design and thus helps to deal with extraneous variant questions that may be present with the use of other countries as case studies.

Determining the success of the Tellis framework is mostly a heuristic process. I use an approach that includes both measurable criteria and common sense. In order for the framework to be useful, a researcher must actually be able to gather the data that Tellis et al. suggest are necessary for measuring power in our postindustrial age. One hundred percent success would

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[25] Khan, Humayan, "The Future of Pakistan," *The Roundtable*, no. 354, p. 260.
[26] Shaika, Farzana, "Pakistan's nuclear bomb: beyod the non-proliferation regime," *International Affairs*, v. 75, i. I, 2002, p. 30.
[27] Khan, p. 260.
[28] Khan, p. 264.
[29] Shah, p. 71.

require being able to find government (whether it be from Indian, Pakistani, or U.S. sources) or private sector information or statistics for each one of the variables in the model. I argue that, given the extremely detailed nature of the model, the likelihood of this being possible is remote, however, we can learn as much about the application of the framework based on the information that we are not able to collect as we can by what information is available.

In order to represent the success or failure of the attempts to collect the information, I provide tables for each subset of variables in each of the broader components of the three elements of national power. The variables are listed with their indicators, and a score is given based on whether or not I could find information/statistics for the indicator, or whether I could find information that could be construed as a reasonable substitute for the requested data. A score of 0 is given in a case where I could find no information, a score of .5 is given in the event that substitute information is used, score of 1 is given if some information about the indicator is available but perhaps not to the extent that the framework deems necessary, and a 2 is given when the data requirements of the framework are fully met. This allows the reader to determine what areas of the framework were most difficult to flesh out as well as those areas where data was readily available. I argue that the picture of national power is quite clear if one finds some data/information relative to at least eighty-five percent of the indicators, based on the fact that the framework is so intricate and that even that much information goes beyond what most models would deem necessary to assess national power. It is imperative to the reader's understanding of the project to keep in mind that the scores do not indicate the presence or absence of a phenomenon, but rather they refer to the researcher's ability or inability to gather data in a particular area of the framework.

The authors suggest that once all of the data is collected, one should be able to compare national power in India and Pakistan, keeping in mind that the point of the exercise is not to rank them among other states, but rather, to compare them in the major areas outlined in the model. The researcher should be able to glimpse into the national power strengths and weaknesses in each area in order to determine if either of these nations have become or may become important players on the international scene. This is where common sense comes in. If the overall sense of the data does not run generally parallel with reality, there may be something wrong with the framework. In other words, for example, existing scholarly research tells us that India has a stronger economy and a larger, more organized military than does Pakistan. If the data collected

suggests that, in fact, Pakistan is in a stronger economic position than India, perhaps the variables used as indicators for economic power are not based in reality. The combination of measurable criteria and common sense analysis allows a conclusion to be drawn as to whether national power can be measured as Tellis, et al. suggest in their book <u>Measuring National Power in the Postindustrial Age</u>.

As explained in the pages above, Tellis, et al., in presenting their framework for measuring national power, use a "three-level" organizational approach. The first realm is national resources, the second is national performance, and the third is military capabilities. This paper will examine each of these realms and the variables that flesh them out first for India and then for Pakistan.

NATIONAL RESOURCES

National resources are defined as the "building blocks" that a country needs in order to develop the capability to dominate the cycles of innovation critical to the creation of a sophisticated military and thus to national power.[30] The five components that combine to develop the picture of a nation's national resources are technology, enterprise, human resources, financial/capital resources, and natural resources.[31]

Technology

The Tellis framework identifies six technologies that are critical to the production of national power. They are information and communications, materials, manufacturing, biotechnology and life sciences, aeronautics and surface transportation and energy and the environment. Assessing the technology base of a nation requires a researcher to make a determination as to whether a country has indigenous production capabilities in the technology area, has transplanted production capabilities deriving from its status as a host for foreign-owned facilities, has trade access to foreign capabilities in a given technology area, and engages in research and development work even if not in commercial production.[32] These questions will be answered for each of the components that make up a nation's technology base mentioned above.

Information and Communications

According to the Tellis framework, there are several indicators of a nation's information and communications technologies. They are high performance computing, networking, software, data storage and peripherals, computer simulation and modeling, macro and optoelectronics in

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[30] Tellis, p. 45.
[31] Tellis, p. 46.
[32] Tellis, Ashley J., et al., Measuring National Power in the Postindustrial Age: Analyst's Handbook, Rand Corporation, January 2001, pp. 9-10.

the form of sensors and signal processing, and high definition imaging and display technology.[33] A nation must have knowledge and capabilities in these areas in order to be considered on the leading edge of information and communications technology.

High Performance Computing

Whether or not a country has high performance computing capabilities must be determined by examining its computational power, the extent of its input/output capacity, its ability to accommodate different software, and its storage capacity. Data in this regard was difficult to acquire for India, perhaps because the information is so specialized that it is not widely written about. Figures related to the number of calculations in a given unit of time for Indian computers were elusive, and I could not find information on the number of bits computers in India can take in or produce in a unit of time, both suggested by Tellis as a way to measure high performance computing capabilities.[34] India did, however, develop a supercomputer called the PARAM Padma which boasts over 500,000 million theoretical operations per second.[35] The fastest U.S. supercomputer can perform far more than that, but this shows some development in this area.

Of the other two indicators of high performance computing, a high capacity to accommodate different kinds of software and a large storage capacity, I was able to discover information for India that points to the latter, but nothing for the former. An article published in June of 2003 indicates that the Ministry of Information Technology in India and the country's main software trade association are in the process of developing legislation that would help to ensure that data outsourced from the U.S. and Europe is protected with privacy safeguards. India is taking these steps to put themselves in a position to better serve European Union nations which require that countries storing data follow strict E.U. privacy, and to address concerns from the U.S. in a similar regard.[36] The fact that India has gone as far as to develop national legislation related to this issue points to the possibility that there are a significant number of countries/companies that send data to India for storage. This, in turn, would seem to indicate that India has enough data storage capacity to meet its own data storage needs as well as plenty

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[33] Tellis, p. 56.
[34] Tellis, p. 57.
[35] "India develops one Tflop supercomputer," from www.smh.com.au/articles/2003/01/01/1041196677610.html, January 1, 2003, downloaded January 5, 2004.
[36] Vijayan, Jaikumar, "Offshore ops to get stronger privacy lock: U.S. firms that outsorce work to India welcom legislation to protect data," *Computer Worlds*, v. 37, i. 22, June 2, 2003.

of additional capacity to meet the needs of others who may not be able to meet their own. So while not definitive quantitative data, the article points to the strong possibility that India is excelling at least in the area of data storage capacity even if it is unclear whether India can be said to have "high performance computing" per se.

Pakistan's capabilities in the area of high performance computing were also difficult to ascertain. I could find no information directly related to Pakistan's overall or average computational power, but the U.S. did relax export controls on supercomputers to many countries, including Pakistan, which will make it easier for Pakistan to import the kind of technology that it needs to develop its high performance computing capabilities.[37] I also could not find information related to the input/output capacity of Pakistani computers, the ability of Pakistani computers to accommodate different kinds of software, or the storage capacity available in Pakistan. Given the fact that none of the indicators for this variable can be found, it is impossible to determine whether Pakistan has high performance computing capabilities as defined by the Tellis framework.

Networking

The second component of information and communications technology is high quality networking capabilities.[38] The quality of a country's networking is indicated, according to the Tellis framework, by the extent of bandwidth, the quality of transmission, the speed of signal processing and the security of the transmissions.

In the area of bandwidth, India does not appear to be faring well. India's communication system is grossly over extended. Its international capacity is about 1/500th that of the United States which means an ultra long wait to connect to the Internet in some cases.[39] One estimate puts India's need for bandwidth by 2005 at 300 Gbits for international connections, a far cry from the approximately 800 mbps currently available in India.[40] In the past, the major obstacle to the enlargement of India's bandwidth capacity appears to have come in the form of a company called Videsh Sanchar Nigam, Ltd. (VSNL), which until 2002 was a monopolistic international carrier. The government has begun to take steps in the direction of easing the so-called

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[37] "Pakistan to benefit from new US supercomputer export rules," from www.hoise.com/primeur/99/articles/monthly/AE-PR-08-99-14.html, July5, 1999, downloaded January 5, 2003.
[38] Tellis, p. 57.
[39] "Bandwidth Bottleneck: India sorely needs more telecom capacity," *Asia Week*, September 6, 2000.
[40] "VSNL is India's Largest Datacenter…," from www.directi.com/products/virtual-web-hosting/datacenters/india, March 13, 2003, downloaded January 5, 2003.

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bandwidth bottleneck, including ending the VSNL monopoly on bandwidth,[41] but as it stands now, India is still struggling to meet demand.

While no information on the quality of the transmissions zipping to and from India to destinations worldwide was available, the lack of bandwidth mentioned above hints at the speed of those transmissions. After waiting sometimes thirty minutes to even get online, users in India find that their data often move at 9.6 kilobits-per-second. The standard is 56 Kbps.[42] The discrepancy between India's transmission speed and the norm is quite large in many cases and therefore leads one to believe that India is weak in this area.

The final indicator of high-quality networking technology is transmission security. India has had problems with network security as recently as 2002 when the websites of several Indian military and research organizations were hacked. The Indian government, however, has taken the necessary steps to combat such problems, including the creation of the Society for Electronic Transactions and Security (SETS), which has been charged with developing a strategy for eliminating such breeches in the future.[43] SETS began its work in early 2002 and has managed to successfully coordinate with private industry to address security concerns. In fact, this organization launched its first security product called WEBguard in August 2003 with more products to come as early as 2005.[44] In addition, at least one major private networking company in the country, Cisco systems, is enhancing their network security applications.[45] India has worked hard not only to recognize security concerns but has swiftly moved to implement changes to make for a safer future.

Pakistan's telecommunications infrastructure is extremely poor. Its bandwidth is estimated at 600 mbps.[46] This again points to the fact that the speed of transmissions in Pakistan is likely to be very slow although no information directly stating that was available. Pakistan has been trying without success to fully privatize the mostly monopolistic Pakistan Telecommunications Corporation Limited for more than a decade.[47] This is considered to be

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[41] "VSNL Monopoly ends in 2002," The Tribune, September 7, 2000, from http://www.tribuneindia.com/2000/20000907/main3.htm, downloaded April 18, 2004.

[42] "Bandwidth Bottleneck…"

[43] Krishanidas, K.C., "India sets up agency to guard against hackers," *Electronic Engineering Times*, July 1, 2002, p. 28.

[44] "SETS Prefers Chennai for Setting Up Headquarters," *The Hindu*, June 6, 2003.

[45] "Cisco Broadens Network Security Solutions Platform in India," *Xinhua News Agency*, February 14, 2002.

[46] "Pakistan Catches IT Revolution," *The Korea Herald*, March 22, 2003.

[47] BoKari, Farhan, "Pakistan telecom's sale left hanging on the line…," *The Financial Times*, London Edition, May 1, 2003.

both a major obstacle to the expansion of bandwidth in Pakistan as well as a barrier to private domestic and international investment in Pakistan's IT sector. Information regarding the quality and security of transmissions in Pakistan was unavailable.

Assessment of networking capabilities based on the limited information available leads one to believe that perhaps Pakistan does not have suitable networking capabilities, however, one project in particular provides a glimmer of hope that the government will move to better networking in Pakistan. In March of 2003, the Pakistani government announced plans to modernize communications between public sector universities there. The Higher Education Council is to supervise this process and has on its list of projects "computerization and networking enhancements."[48] Perhaps this project, if it is successful, will give the government impetus to recognize the need for enhanced networking capabilities throughout the country.

Software

The third component of information and communications technology is software. The framework tells us that quality software is best judged by its level of sophistication, its diversity, and the flexibility of its program design. It can also be assessed based on its flaws.[49] No specific quantitative data on the sophistication, flexibility, or diversity was available. This being said, Indian software will have to be assessed on its flaws. It is clear, however, that software design and development is an area in which India excels. Evidence of this comes in the form of a recent announcement from the National Association of Software and Services Companies, one of India's major IT industry association. NASSCOM puts India's software services exports at 9.5 billion US dollars for the fiscal year which ended in March of 2003. This represents a 26.3 percent growth over last year.[50] The assumption here is that India would not have had such a dramatic increase in exports if it was producing and then exporting low-quality, flawed software and therefore India receives high marks for its accomplishments in software development.

Information regarding the sophistication, diversity, and flexibility of design of Pakistani software was scarce. We do, however, see a situation in Pakistan where its software currently has a reputation of being highly flawed. Pakistan's own Pakistani Software Export Board laments the fact that certain software exports were banned from European and U.S. markets because of failure to meet international quality standards. Furthermore, even Pakistani

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[48] "Education," *Pakistani Newswire*, March 17, 2003.
[49] Tellis, p. 58.
[50] "India's software services exports up 26.3% in 2002-03," *Xinhua News Agency*, June 3, 2003.

customers have difficulty trusting domestically produced software because of past problems with it.[51] Pakistani exports of software were estimated at just $20 million in 2003,[52] so we see a situation where Pakistan's flawed and low quality software is not in demand either domestically or in foreign markets.

It appears, however, that Pakistan is taking steps to both improve its software and its reputation in the software industry. The Pakistani Software Export Board is trying to create a greater awareness among domestic software producers surrounding software testing. The Board is stressing the importance of testing software and getting it certified using internationally recognized testing tools.[53] As more companies are beginning to recognize ISO standards as the benchmark for quality, the PSEB is footing the bill for much of the cost of obtaining ISO 9001 certification (the current bar) and has the aim of helping at least eighty companies toward that goal.[54] So while Pakistan cannot be said to have quality software at present based on an assessment of its flaws, there is at least a concerted effort in that direction by the Pakistani government.

Data Storage and Peripherals

The fourth component of information and communications technology is data storage and peripherals. The framework defines this as those items that allow "the entering, viewing, manipulation, and storage of data."[55] Examples of this include CD-Roms, floppy disks, keyboards, mice, printers, etc.[56] An exhaustive search turned up no information on either the number or the reliability of the specific items mentioned, but if one assumes that people who have personal computers have at least some of these items, one can get an idea of India's capabilities in this area. The UN Statistics Division reports that in 2001, India was home to approximately 6 million personal computers. In the year prior, Indians owned about 4.5 million personal computers. These numbers are not necessarily what one might expect for a country that is so focused on becoming an IT hub worldwide, but the they do show that there is a large quantity of what Tellis refers to as peripherals at work in India.

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[51] Husain, Asim, and Mubashir Abbas, "Importance of Quality for Pakistani Software Businesses," from http://www.pseb.org.pk/News/QualityBusiness.cfm, downloaded April 13, 2004.
[52] "Pakistan's Software Exports Decline," *The Pakistan Newswire*, April 5, 2003.
[53] Husain.
[54] "55 Pakistan Software Firms Signed up for ISO 9001 Certification," *AsiaPulse News*, November 1, 2002, p. 3590.
[55] Tellis, p. 58.
[56] Ibid.

Using the same assumptions that were used in assessing data storage and peripherals for India, we see in Pakistan just 600,000 personal computers in 2001, according to the UN Statistics Division. This represents a jump of just 10,000 from the year prior.[57] Based on the low number of PC's, one must assume that there is a corresponding low number of what Tellis, et al. describe as data storage and peripherals in Pakistan.

Computer Simulation and Modeling

The fifth component of information and communications technology is computer simulation and modeling. Its importance lies in the fact that simulation and modeling allow for better planning and/or production of processes, plans, interactions, or even objects.[58] India has an organization in place called The Centre for Mathematical Modelling and Computer Simulation that falls under the purview of the Council of Scientific and Industrial Research. This organization is heavily involved with computer simulation and/or modeling on everything from pollution to climate changes to the production of new drugs. The Centre credits its capabilities to a world-class computing environment equipped with two extremely large servers, a half dozen workstations, and several powerful laptops.[59] The existence of this agency and the depth of its work shows that India seems to both understand the importance of computer simulation and modeling and the need to put it into practice in a variety of fields and environments.

Pakistan's capabilities in the area of computer simulation and modeling remain unclear. I was unable to find any information specifically related to computer simulation and modeling, and an attempt to determine its capabilities using related technology such as CAD and CAM as a substitute also failed to produce more than cursory information.

Micro and Optoelectronics

The Tellis framework places special emphasis on the sixth component of information and communications technology which is a nation's capabilities in the field of micro and optoelectronics.[60] The significance of these technologies lies in their ability to facilitate the transmission and processing of information. Sensor and signal and high-speed imaging and

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[57] "Personal Computers, ITU estimates," Millennium Indicators, United Nations Statistics Division, United Nations, 2003.

[58] Tellis, p. 58.

[59] "About CMMACS," from http://www.cmmacs.ernet.in/cmmacs/About_cm/aboutcmm.html, downloaded August 12, 2003.

[60] Tellis, p. 58.

display technologies represent prominent applications of micro and optoelectronic technologies.[61] The fact that these applications have significance in a number of critical industries such as defense, weaponry, medicine, manufacturing, and high speed communications makes it no wonder that countries are scrambling to both put these technologies to good use in their current forms as well as to try and improve upon them. The Tellis framework tells us first to find out whether a country has access to these technologies and then to measure their quality by looking at operating speeds, reliability, power, efficiency, longevity, and cost of the applications associated with micro and optoelectronics mentioned above.[62]

In examining the micro and optoelectronic applications that India currently has in place against the indicators outlined by Tellis, it is unclear whether India has true "quality" micro and optoelectronic capabilities. There is no data on the reliability or longevity of these systems, but the literature does reveal that India is using some of the applications of these technologies in a variety of ways, focusing primarily on military applications. India is either in the process of developing or has already purchased some micro and optoelectronic technologies.

Prior to the launch of a program aimed at increasing India's satellite reconnaissance capabilities, India had four remote-sensing satellites capable of rendering clear images of objects five meters wide. It also had a handful of communications satellites. Under a 2000 initiative, the Indian Space Research Organization began construction of a constellation of high resolution imaging satellites for both military and civilian use.[63] The first satellite of the constellation was rolled out in 2001,[64] and the rest are slated to be complete by 2005. At least three satellites would have a one-meter resolution and one would have a 50-centimeter resolution.[65] The new satellites would also be able to see through clouds and have infrared sights for night imaging.[66] The cost of the program is estimated at around 25 million dollars,[67] and it will put India in line with other countries on the cutting edge of the sensor and imaging applications related to micro and optoelectronics.

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[61] Tellis, p. 59.

[62] Tellis, p. 59.

[63] "India to Develop Powerful New Imaging Satellites," *Defense Week*, February 14, 2000.

[64] "India Launches Military Imaging Experiment," *Space and Missile Defense Report*, v. 22, i. 22, October 25, 2001, p. 5.

[65] "India Plans 50-Centimeter Imaging Satellite," Space and Missile Defense Report, v. 3, i. 5, February 28, 2002, p. 3.

[66] "India to Develop Powerful New Imaging Satellites."

[67] "India Launches Military Imaging Experiment."

In addition, India has purchased sensor and thermal imaging equipment from Israel. Indian troops installed the equipment along its borders with Kashmir and Pakistan in an effort to enhance their surveillance of Islamic guerillas operating in the area. This technology is so advanced that it will allow the Indian army to see three miles across the border, even at night. The equipment will also allow soldiers to track body heat emissions with such precision that they will be able to tell the difference between animals and people; all of this from a unit designed to be handheld.[68]

After looking at the available information concerning India's use of these technologies, it becomes clear that the systems that are being developed or, in some cases purchased, are extremely powerful, power being one of the criteria for assessing the quality of India's micro and optoelectronic applications. The Tellis framework also tells us to look at the reliability and longevity of the systems as well as their cost and efficiency. As already mentioned, no data yet exist on this as the systems are in the first stages of development and use in India. We do have a cost estimate for one major micro/optoelectronic project under way in India. Twenty-five million dollars is a healthy allocation for such a project which will likely lend to its overall success. It also tells us that India understands the importance of applying these technologies and will thus fund projects with that aim accordingly. The power of these satellites is certainly in line with the leading technology available and the sensor technology purchased from Israel is extremely acute, but again the efficiency of the systems has yet to be determined.

Only time will tell if India is properly harnessing the amazing power of micro and optoelectronics through the use of applications stemming from that technology such as sensors and signal processing and high definition imaging, but the beginning phases of a major project to do so as well as the purchase of such powerful technology from another country certainly make the chances of success look promising.

The available information on Pakistan's use of micro and optoelectronic applications also does not allow one to assess quality based on the criteria of reliability or longevity as it is unclear whether Pakistan is even using them for more than the basic sensor and signal processing associated with military applications such as missile technology.

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[68] India installs sensors on Kashmir border," *United Press International*, July 9, 2002.

High Definition Imaging and Display Technology

An examination of this type of technology will reveal information about image resolution, picture quality, and the speed and efficiency of imaging transmissions.[69]

India does have high definition imaging and display technology as well. In fact, Philips India Limited, part of Royal Philips Electronics, introduced the world's first thirty-two inch high definition plasma television in India in 2001.[70] The technology makes television viewing, provided the signal is a high definition signal, an experience full of high contrast and brilliant colors. A 160-degree viewing angle provides for constant quality and brightness from any angle. The latest in plasma technology allows this set to have the sharpest, brightest picture available. In addition, a company called Real Image Technologies is helping the Indian film industry to reduce costs and increase quality through the conversion of feature films into high definition format. The product, called Qube cinema, will also allow satellite and fiber optic delivery of the digitized films.[71] These are not what one would call "weighty" applications for high definition technology, but the examples above do show that India has access to it and that the image resolution and picture quality are truly cutting edge.

Information on the use of high definition imaging and display technologies in Pakistan was in short supply. A thorough search turned up only cursory information about some televisions sold in Pakistan that are capable of receiving high definition signals, but nothing related to the proliferation of broadcasting in HD or other HD equipment or applications was evident.

The limited availability of data on Pakistan's capabilities in those areas of information and communications technologies deemed crucial to national power by the Tellis framework does not allow one to assess Pakistan's level of achievement. The areas for which there was some information available; networking, software, and data storage and peripherals, paint a picture of a nation with serious communications infrastructure problems, one that is struggling to compete in the international market with its inferior software, and one tat has a relatively small

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[69] "Handbook," Tellis, p. 2.
[70] "Philips Launches World's First 32" High Definition TV," from
http://www.prdomain.com/companies/P/Philips/news_releases/pr_20011030.htm, October 3, 2003, downloaded April 13, 2004.
[71] "Real Image launches advanced digital cinema system, *Cyber News Service*,
fromhttp://www.dqchannelsindia.com/content/news/103080508.asp, downloaded August 6, 2003.

number of computers in use at all. None of the above lead one to believe that Pakistan is faring well in its development, use, or export of information and communications technologies.

Information and Communications - India

Variables	Indicators	Score*
High Performance Computing	computational power (# of calculations/time)	0
	large input/output bandwidth	0
	high capacity to accommodate different kinds of software	0
	large storage capacity	.5
Networking	high bandwidth	2
	quality of transmission	0
	speed at which signals are processed and transmitted	1
	security of transmissions	2
Software	level of sophistication (# of tasks it can easily take on)	0
	diversity (range of tasks)	0
	flexibility of program design (ability to accommodate unanticipated tasks	0
	can also be assessed negatively by # of flaws	.5
Data Storage and Peripherals	CD-ROMs, floppy disks, keyboards, mice, printers, scanners, etc.	.5
Computer Simulation and Modeling	adaptability, accuracy, and realism of simulations and models	1
Micro- and Opto-electronics	accuracy, reliability, responsiveness of sensors	1
	ability to discern between false and true signals	2
	eliminate irrelevant noise, produce accurate readings	2
High Definition Imaging and Displays	image resolution	1
	picture quality	1
	speed and efficiency of imaging transmission	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Information and Communications - Pakistan

Variables	Indicators	Score*
High Performance Computing	computational power (# of calculations/time)	0
	large input/output bandwidth	0
	high capacity to accommodate different kinds of software	0
	large storage capacity	0
Networking	high bandwidth	2
	quality of transmission	0
	speed at which signals are processed and transmitted	1
	security of transmissions	0
Software	level of sophistication (# of tasks it can easily take on)	0
	diversity (range of tasks)	0
	flexibility of program design (ability to accommodate unanticipated tasks	0
	can also be assessed negatively by # of flaws	2
Data Storage and Peripherals	CD-ROMs, floppy disks, keyboards, mice, printers, scanners, etc.	.5
Computer Simulation and Modeling	adaptability, accuracy, and realism of simulations and models	0
		0
Sensors and Signal Processing	accuracy, reliability, responsiveness of sensors	0
	ability to discern between false and true signals	0
	eliminate irrelevant noise, produce accurate readings	0
High Definition Imaging and Displays	image resolution	0
	picture quality	0
	speed and efficiency of imaging transmission	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Materials

The second area for analysis when determining the quality of the technology base in a particular nation according to Tellis, et al. is materials. This entails surveying materials synthesis/processing capabilities, electronic and photonic materials, ceramics, composites, and high-performance metals and alloys.[72]

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[72] Tellis, p. 60.

Materials Synthesis/Processing

Materials synthesis and processing is singled out in the Tellis framework as being separate from the variables below, but it appears to be more of an overarching category in the area of materials. India, by default, and due to the fact that it has the capability to manufacture as well as use composites as well as high performance metals, has materials synthesis/processing capabilities. These capabilities will be discussed further as the other variables in this area are fleshed out.

Photonic and Electronic Materials

The key applications for photonic materials as outlined in the framework are lasers and fiber optic communications. India uses laser technology in a variety of ways including medical procedures and high tech military weapons. India has used laser technology in its weapons program since 1994 and is in the process of developing miniature laser weaponry for use on fighter-sized aircraft.[73] Looking through the Indian Yellow Pages, one will find a number of companies devoted to the manufacture, and export of fiber optic technologies as well as a number of companies that are considered service providers in this area.

Tellis points out that the key electronic material today is semiconductors and that silicon has been the dominant material in the manufacture of semiconductors.[74] What we find is that India has several internet industrial parks, a well-developed semiconductor design industry, and an "international cadre" of chip makers including Motorola, Texas Instruments, and National Semiconductor.[75] One can assume that if a country has the capability to make semiconductors, that it must also have access to silicon, but I could find no conclusive information on domestic processing, production, or importation data.

Pakistan, too, uses laser technology for a broad range of applications from military to medicine. Furthermore, the Pakistani government considered using laser technology to melt some of the glaciers in its northern territory in an effort to meet water demand in the country.[76] While that idea has not come to fruition, the Agriculture Minister is making framers aware that

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[73] Mazumdar, Sayan, "India's Laser Technology Status," from http://www.indiadefence.com/Laser.htm, December 10, 2002, downloaded April 13, 2004.
[74] Tellis, p. 60.
[75] "Silicon influx puts India on world electronics map," *Electronic Engineering Times*, no. 948, April 7, 1997, p. 27.
[76] Mughul, G.N., "Pakistan may use laser technology to melt glaciers," from http://lists.isb.sdnpk.org/pipermail/eco-list/2001-April/001215.html, December 3, 2001, downloaded April 13, 2004.

precision laser land leveling can improve agricultural productivity.[77] The above examples demonstrate the fact that laser technology has been integrated into many aspects of Pakistani life and that there is at least a realization by the government that lasers can be useful in a number of non-traditional applications.

Pakistan also has fiber optic capabilities. In fact, in 2002, the Pakistan Telecommunication Company finished the second phase of a project to upgrade an under water fiber optic cable system at a cost of $48 million. This move greatly benefited internet service providers and internet users in Pakistan.[78]

We do not, however, see the same access to silicon in Pakistan that India enjoys. As mentioned earlier, silicon has been the main component used in the production of semiconductors. I could find nothing to indicate that Pakistan has either large domestic supplies of the material or is importing the material in quantities sufficient to produce semiconductors. Given this fact, it is not surprising to find that we do not see the same level of chip manufacturing in Pakistan as we do in India.

Ceramics

In addition, while there was no hard data available on the use of ceramics in India, we do find that there is an entire research institute devoted to glass and ceramics applications. The Central Glass and ceramic Research Institute in Calcutta, India conducts research in glass and ceramics and provides testing, analysis, and evaluation of applications that use glass and ceramics.[79] The fact that there is a specialized institution devoted to glass and ceramics research shows that there is an understanding of the importance of these materials and will likely lead India to technological advancements in this area.

Ceramics technology in Pakistan, it appears, is reserved for household use items which are part of Pakistan's rich heritage. The production of ceramics for high tech applications such as heat resistant tiles, etc., does not appear to have taken root in Pakistan.

Composites

The Centre for Mathematical Modelling and Computer Simulation, a division of India's Council of Scientific and Industrial Research, is involved in processing composite ceramic parts

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[77] "Irrigation Shortage: Agri Yield Target Unlikely This Year," *Frontier Post*, March 23, 2002.

[78] "Pakistan Telecom Spends US $13 Million on Optic Fiber System," *AsiaPulse News*, October 31, 2002.

[79] "Engineering Research Laboratories in India," from http://www.indiaonestop.com/engineering.htm, downloaded June 18, 2003.

with aerospace and industrial applications.[80] In addition, India has a successful polymer matrix/plastics industry. India both exports and manufactures plastics for a variety of applications from household goods to automobiles to communications technologies.[81] Finally, a recent article reported that India had developed the "world's first" carbon composite re-entry shield for a rocket.[82] While the U.S. uses carbon-carbon composite heat shields on the space shuttle thus making the claim of "world's first" perhaps not exactly accurate, this at least provides evidence that India is currently developing and using carbon-carbon composite materials.

Pakistan appears to have experience in manufacturing composites, mainly in the form of polymers for plastics production. A PVC plant opened in 1999 which has made Pakistan self-sufficient in PVC production.[83] Furthermore, in 2001, U.S. firms invested $150 million in Pakistan's plastics industry to set up a project to manufacture polyethylene chips, an essential raw material in polymer plastics production.[84] So while it appears that Pakistan uses composite materials for various military applications, it is unclear whether Pakistan is engaging in the large scale production of composite materials other than the plastics polymers discussed above.

High performance metals

A quick glance through the Indian Yellow Pages reveals that there are several companies in India that are in the business of manufacturing, importing, and exporting so called "high performance metals" and alloys. One large corporation called Industrial Metal India deals in high-speed steel, tool and alloy steel, and stainless steel. The metals that they stock can be used to make high performance cutting tools, machining tools for nickel and titanium alloys, and high grade rods, sheets, plates and pipes. This particular company takes orders for deliver exclusively in India which shows that these products are not only produced domestically, but are also widely used.

There is no evidence that Pakistan has broad access to high performance metals and alloys. In fact, the U.S. export control laws prohibit the exportation of certain types of dual use

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[80] "Centre for Mathematical Modelling and Computer Simulation," from http://www.cmmacs.ernet.in/cmmacs/About_cm/aboutcmm.html, downloaded April 18, 2004.
[81] www.123plastics.com, downloaded October 2, 2003.
[82] "All Composite Re-Entry Heat Shield," from http://composite.about.com/b/a/2003_08_12.htm, downloaded October 2, 2003.
[83] "PVC Startup in Pakistan," *Chemical Week Asia*, v. 4, i. 6, November 24, 1999, p. 5.
[84] "US, Pakistan Firms Sign 150 mln Plastics Manufacturing Deal," *AsiaPulse News*, July 27, 2001, p. 557.

technologies, including high performance metals, to Pakistan. This limits the amount of these materials in Pakistan.

Materials - India

Variables	Indicators	Score*
Electronic and Photonic Materials	use of semiconductors	2
	access to silicon	1
	use of lasers	2
	use of fiber optic communications	2
Ceramics	use of ceramics high tech applications	.5
Composites	use of polymer matrix, ceramic matrix, metal matrix, and carbon-carbon composites	1
High Performance Metals	use of high performance metals, including alloys	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Materials - Pakistan

Variables	Indicators	Score*
Electronic and Photonic Materials	use of semiconductors	0
	access to silicon	0
	use of lasers	2
	use of fiber optic communications	2
Ceramics	use of ceramics high tech applications	1
Composites	use of polymer matrix, ceramic matrix, metal matrix, and carbon-carbon composites	2
High Performance Metals	use of high performance metals, including alloys	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Manufacturing

Tellis identifies manufacturing technologies as the third area for consideration under the broader technology heading. It is important to determine if a country has manufacturing

capabilities in the areas of flexible computer integrated manufacturing, intelligent processing equipment, micro-and nanofabrication, and systems management technologies.[85]

Data for India were in very short supply in this area, so I am not inclined to break this section down into its variables as none was explicitly outlined in the literature that I was able to find. Below is a snapshot of manufacturing in India. The framework is looking more at how India manufactures goods rather than what it is actually manufacturing, but as mentioned earlier, information on manufacturing processes proved elusive.

Manufacturing in India has generally decreased over the last ten years. There was, however, a 9.3 percent increase in manufacturing in 1999-2000.[86] It now accounts for only twenty-four percent of the overall economy of the nation.[87] It appears that while the possibility of using India as a manufacturing hub has attracted the attention of several large global companies over the past year, India does not have manufacturing capabilities in line with what the Tellis framework deems necessary and important to national power. Companies such as Hyundai, Proctor and Gamble, Cadbury Schweppes, and Matsoshita have all recently announced plans to attempt to make India their global manufacturing outsourcing hub,[88] but this type of manufacturing (i.e. automobiles, textiles, and food) is a far cry from micro- and nano-fabrication. In addition, several companies that have invested in manufacturing in India have had problems with quality control thus making others skeptical of the "made in India" designation.[89] This would hardly seem the environment to encourage investment in India as a country with the skilled labor and quality standards to deliver precision machining and nanofabrication.

Pakistan's manufacturing sector is extremely important to its economy. It is behind only agriculture as the second largest contributor to GDP.[90] Major exports from the manufacturing sector include automobiles, textiles, and fertilizers, among other items. Manufacturing in Pakistan, however, is currently considered to be inefficient and the goods produced are generally considered to be of poor quality. Data of the nature required by Tellis, et al. were equally difficult to find for Pakistan. There have been some developments that point to an understanding of the importance of upgrading manufacturing processes in Pakistan, especially in the area of

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[85] Tellis, p. 61.
[86] World of Information Business Intelligence Report: India, Walden Publishing, Ltd., Essex, UK, 2001, p. 36.
[87] Lancaster, John, " 'Very Rich' in, Yes, Calcutta," *Washington Post Foreign Service*, September 24, 2003, p. A18.
[88] "India's manufacturing on the rise," *United Press International*, June 11, 2003, p. 1008162w5870.
[89] "India's manufacturing on the rise."
[90] Memon, Noor Ahmed, "55 Years of Manufacturing Sector," *Business Recorder*, August 22, 2002.

systems management. Pakistan will likely become a World Trade Organization member in the near future. This means that the country will have to open itself up to free trade and will therefore have to increase productivity, quality, and efficiency in order to compete. In an effort to address concerns surrounding this issue, the Pakistani Software Export Board has initiated a project to proliferate the use of information technology to maximize output in the manufacturing industry. The PSEB would like for companies to integrate software that would automate the business process as well as interface computers, machines, and tools.[91]

Further recognizing the need to prepare its industries for the future of competition, over 80 representatives from of Pakistan's manufacturing sector attended a seminar held by Oracle and Intel to highlight the critical role that technology plays in manufacturing. These technologies allow companies to forecast demand, streamline the supply chain, and collaborate on some aspects of production.[92]

Finally, there is one other aspect of the Tellis framework as it pertains to manufacturing that was addressed at least on some level by the available literature. That is nanofabrication. In February 2003, the PTCL announced that it would finance Rs14 million worth of research for the COMSTECH Frontier Technologies Research Center. Some of the focus of that research is to be nanotechnology.[93] So while nanofabrication may be in the very early stages of development in Pakistan, we do see at least a movement in the direction of recognizing nanotechnology as an important application.

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[91] "Automation of Domestic Manufacturing Industry," from www.pseb.org.pk/projects/bridge, downloaded August 26, 2003.

[92] "Threats predicted after dismantle of textile quota system in 2005," *The Pakistan Newswire*, May 9, 2003.

[93] "Communication-COMSTECH_PTLL Frontier Technologies Research Center Set," *The Pakistan Newswire*, February 25, 2003.

Manufacturing - India

Variables	Indicators	Score*
Flexible Computer Integrated Manufacturing	integration of product, process, and manufacturing into a single network	0
Intelligent Processing	use of robotics, sensors, and controls	0
Micro-and Nanofabrication	use of lithography, etching, disposition, diffusion, implantation, and packaging	0
Systems Management	use of product exchange tools, databases, data-driven MIS and interoperability	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Manufacturing - Pakistan

Variables	Indicators	Score*
Flexible Computer Integrated Manufacturing	integration of product, process, and manufacturing into a single network	0
Intelligent Processing	use of robotics, sensors, and controls	0
Micro-and Nanofabrication	use of lithography, etching, disposition, diffusion, implantation, and packaging	0
Systems Management	use of product exchange tools, databases, data-driven MIS and interoperability	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Biotechnology and Life Sciences

The next area of concern in assessing a country's technology base is biotechnology and life sciences. Tellis, et al. argue that applied molecular biology and medical technology that can help a country provide "unconventional solutions" to major problems in a number of important sectors such as agriculture and the environment are essential to a country's technological base and thus to its national power. The authors suggests looking at a country's abilities in the areas of applied molecular biology, which includes recombinant DNA technology, protein engineering, monoclonal antibody production, and bioprocessing, which includes assessing the link between

biology and production of things such as drugs, food enzymes, and specialty products for industry and agriculture, in order to round out this category.[94]

Applied Molecular Biology

India has several research institutions devoted to various areas of biotechnology. The Central Drug Research Institute conducts research in drugs, pharmaceuticals, biological activity, fermentation and reagents as well as provides testing, analysis, and bioevaluation services. The Center for Biochemical Technology conducts research in immunology (monoclonal antibodies) as well as diagnostics and reagents. The Center for Cellular and Molecular Biology conducts research in biotechnology, molecular biology, and mathematical modeling. In fact, this organization has set up several DNA research facilities.[95] Lastly, the Indian Institute of Chemical Biology conducts research in molecular biology, biochemicals, chemicals, enzymology, and drugs.[96]

India appears to excel in the area of biotechnology and life sciences, if not already fulfilling all of the necessary components outlined in the Tellis framework, then certainly moving in the direction of developing those technologies through the research and development that is currently underway.

Pakistan, on the other hand, is lagging behind in the areas of biotechnology and life sciences. This is the case in most developing countries, India being one of a very few exceptions. Biotechnology is so underdeveloped in Pakistan that information was sparse. Some generalizations about biotechnology and life science in Pakistan, however, can be made. There appears to be a number of factors causing Pakistan to miss out on the opportunities presented by this growing sector. They include, but are not limited to, a lack of quality scientific manpower, a lack of access to biotechnology literature, and the expense of biotechnology related programs.[97] The government of Pakistan is taking some steps to alleviate some of these problems and create a viable biotechnology industry. For example, the Higher Education Commission is sending students abroad to destinations such as China, Germany, Austria, and France so that they can earn their doctorates in biotechnology related fields. To further its efforts, the government is

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[94] "Handbook," Tellis, p. 9.
[95] "Significant Accomplishments of CCMB," from http://www.ccmb.res.in/achiv/achieve.htm, downloaded July 15, 2003.
[96] "Biotechnology and Toxicology Research Laboratories in India," from www.indiaonestop.com, downloaded June 18, 2003.
[97] "HEC to send students abroad for Ph.D in Biotechnology," *The Pakistan Newswire*, August 20, 2003.

working to insure that ten thousand journals relating to biotechnology will make their way into national universities and is attempting to forge relationships with other countries such as the U.S. to collaborate on biotechnology projects.[98]

Bioprocessing

In July 2003, the Secretary of the Department of Biotechnology in India estimated that demand for biotechnology products from within the country should grow to $1.5 billion by the year 2007 with agricultural biotechnology accounting for about fifteen percent of that market (44). In addition, the Department of Biotechnology has allocated three acres of land for use as a biotechnology incubator in Hyderabad,[99] thus bringing India into a small family of nations undertaking such an endeavor.

India also has a shining star in the area of biotechnology in a company called Biocon India. This company began in 1978 with the goal of manufacturing fermentation products and grew to include its own research and development programs, establishing it as a contender in biotechnology worldwide. The company made significant contributions to fermentation platforms and enzymes and it manufactured and supplied these enzymes to U.S. as well as European markets, thus having an effect on technologies from food processing to textiles. In addition, Biocon India has made contributions to pharmaceutical research.[100] The U.S. recently embraced another Indian biotech-related company. A Massachusetts based firm called Microbia has signed a contract with Ranbaxy, a new Delhi based firm, to improve drug and fine chemicals manufacturing with the hope that they can use bioprocessing to make drugs and chemicals that have traditionally been made using "conventional chemistry."[101]

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[98] "Pakistan and the United States will Cooperate…," *Food Chemical News*, v. 44, i. 40, November 18, 2002, p. 11.
[99] "India's First Biotechnology Incubator to be Set Up in Hyderabad," *Asia Africa Intelligence Wire*, August 23, 2003.
[100] Juma, Calestous, and Victor Konde, "Industrial applications for biotechnology: opportunities for developing countries," *Environment*, v. 44, i. 6, p. 9.
[101] Wood, Andrew," Microbia Technology Revs Up Bioprocessing," Chemical Week, v. 165, i. III, March 19, 2003, p. 42.

Biotechnology and Life Sciences - India

Variables	Indicators	Score*
Applied Molecular Biology	recombinant DNA technology	1
	protein engineering	0
	monoclonal antibody production	1
Bioprocessing	visible link between biotechnologicial science and the production of drugs, food enzymes, and ingredients, and specialty products for industry and agriculture	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Biotechnology and Life Sciences - Pakistan

Variables	Indicators	Score*
Applied Molecular Biology	recombinant DNA technology	0
	protein engineering	0
	monoclonal antibody production	0
Bioprocessing	visible link between biotechnologicial science and the production of drugs, food enzymes, and ingredients, and specialty products for industry and agriculture	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Aeronautics and Surface Transportation

Aeronautics and surface transportation technologies have obvious implications for national power. The Tellis framework suggests that the key indicators of aeronautics technologies are large subsonic transports, supersonic and hypersonic aircraft, research in propulsion, aviation materials and structures, aerodynamics, human factors engineering, aircraft manufacturing, and aeronautical testing. The key indicators for surface transportation technologies are attempts to create intelligent vehicle and highway systems, increase driver safety, increase system capacity and to reduce emissions, fuel consumption, and congestion. In addition, one should consider attempts to develop more energy-efficient vehicles and vehicles that rely on energy sources other than fossil fuels.[102]

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[102] Tellis, p. 63.

Aeronautics

The framework sets "high performance military aircraft" as a separate variable from supersonic, hypersonic and subsonic transport aircraft, however, I believe that it is appropriate to group them all together as supersonic and hypersonic jets can be considered to be high performance aircraft in and of themselves.

While not necessarily a front-runner in domestic production of aeronautics technologies, India has taken advantage of what those technologies have to offer in that they have equipped their Air Force quite well with a combination of limited domestic production of aeronautics technology applications and the importation of equipment. In 2001, India tested a Light Combat Aircraft that was both engineered and manufactured in India. This brought India into the small circle of only eight countries capable of making supersonic fighters. While a full fleet will not be completed for several more years,[103] the fact that the project came to fruition is significant in terms of assessing India's capabilities in this area.

In addition, the Indian Air Force imports supersonic aircraft and uses those aircraft in its current fleet. Some examples include the MiG-29M, the Mirage 2000H, and the MiG-21 Bison. India does not have hypersonic aircraft at present, but the Indian Defence Research and Development Laboratory is in the process of developing the necessary technology and hopes to launch one by 2007.[104] The Indian Air Force also utilizes large subsonic transport aircraft such as the Il-76, the An-32, and the HS-748.[105]

India is currently conducting research in to some of the key technology areas outlined in the Tellis framework. National Aerospace Laboratories conducts research in aerodynamics, propulsion, materials and structures,[106] all of which are mentioned in the framework.

India fares well in the area of aeronautics technologies when held against the Tellis framework as it has large subsonic transport aircraft and high performance supersonic military aircraft. In addition, the government is conducting research in a number of the areas deemed critical to aeronautics technologies in the Tellis framework.

Pakistan also has both supersonic air defense and large subsonic transport capabilities, nearly all of which are imported from other countries such as France, China, and the U.S. Its

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[103] "Significant Accomplishments of CCMB," from www.ccmb.res.in/achiv/achieve.htm, downloaded April 18, 2004.

[104] "India aims to fly hypersonic plane in 2007," *Press Trust of India*, January 1, 2004.

[105] "Air Force Fleet," from http://www.bharat-rakshak.com/IAF/Info/Fleet.html, downloaded July 23, 2003.

[106] "Engineering and Research Laboratories in India."

supersonic fleet already includes the F-16, the FANTAN Q5, and the F-7. In addition, Pakistan is working with China to develop and import the FC-1 "Superseven Project" jet. Pakistan's subsonic transport capabilities come in the form of the C-130, the preferred transport aircraft for many U.S. government services as well as over 60 other countries.

In 2002, the Pakistan Aeronautical Complex, a defense aviation manufacturing and overhaul facility, signed a $517 million in export contracts. These mostly involve rebuilt Chinese aircraft, but the facility is geared toward the indigenous production of the Super Mushshak which is a training aircraft.[107] This facility may pave the way for indigenous development and production of more advanced aircraft in the future.

Specific information concerning Pakistan's research into the areas of aeronautics outlined in the framework was lacking. It appears that there is no one facility that dominates the field and that aviation research occurs in a number of facilities, mostly defense oriented.

Surface Transportation

India also fares well in the area of surface transportation technologies. Available information shows that India is not currently in the process of developing intelligent vehicle and highway systems, but it fits into the framework in almost every other area. Various entities in India have been involved in efforts to increase driver safety, increase system capacity, and reduce emissions, fuel consumption and congestion as well as efforts to develop more energy efficient vehicles.

The Bangalore agenda Task Force, in conjunction with the Global Road Safety partnership, is working to improve road safety in Bangalore. India is one of only eleven countries participating in this particular program. The desired outcome of participation in the GRSP program is to tighten helmet and safety belt laws, improve driver testing, and improve the road system.[108] The success of this program remains to be seen, but the fact that India's road infrastructure was poorly developed and in disrepair[109]will undoubtedly present challenges to the initiative. At least there is an awareness of some key steps in improving roads and driver safety.

In an extremely bold move in 1999, the Supreme Court of India required all cars sold in the Delhi region to be compliant with the stringent Euro emissions standards. This move cut the

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[107] "Pakistan Aeronautical Complex Signs US $517 mln in Exports," *AsiaPulse News*, September 23, 2002.

[108] Colella, Joe, et al., "Road Safety in Banglaore," *Injury prevention*, v. 9, i. 1, March 2003, p. 6.

[109] World of Information Business Intelligence Report: India.

car market in Delhi by ninety percent,[110] and is a testament to the Indian government's commitment to reducing emissions from automobiles. India was also one of six countries named in a 2002 Pew Center for Global Climate Change Report as having made an effort to develop alternative fuels, reduce energy imports, utilize natural gas as an alternative to coal and to reduce air pollution.[111]

In an effort to reduce fuel consumption as well as emissions, Indian Railways is redoubling its work to electrify more of its rail lines. Approximately forty-eight percent of passenger traffic moves with the use of electric traction, and the government is fully aware of the long-term cost savings as well as the environmental implications of moving all of its rail to electric traction. The project is expensive in the short-term, however, and is therefore not being funded as appropriately as some feel that it should. This is adding to the time that it will take to ultimately finish the project, yet it is clear that the vision remains in tact.[112]

As far as energy efficient vehicles are concerned, two items that stand out are the development of a hydrogen-powered motorbike,[113] and the Reva, an impressive battery powered electric vehicle developed and manufactured by the Bangalore based Miani group.[114]

Steps toward reducing emissions and fuel consumption, resolving congestion and driver safety issues, improving roads, increasing capacity and developing energy efficient vehicles show that India is aware of the coming issues in surface transportation technologies and has done much to address and correct the weaknesses that it has in this area.

Surface transportation in Pakistan is currently in fairly poor condition, but the government appears to be making strides to correct this. I could find no reference to any projects, planned or under way, that would create intelligent vehicle or highway systems in Pakistan. There is, however, evidence that Pakistan is taking steps to increase system capacity, reduce emissions, reduce congestion, and produce viable research in the area of energy efficient vehicles and, to some extent, to increase driver safety and reduce fuel consumption.

In 2002, President General Pervez Musharraf cut loose the Pakistan National Highway Authority, giving it complete autonomy. This move was largely made in order to take advantage

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[110] Bursa Mark,"India Emissions Law Stuns Automakers," *Automotive Industries*, v. 179, i. 2, July 1999, p. 17.
[111] "Developing Countries Cutting Emissions," *The Oil Daily*, v. 52, i. 206, p. ITEM02298015.
[112] "India recognizes the Benefits of Electrification…," *International Railway Journal*, v. 42, i. 1, p. 28(2).
[113] "India's Hydrogen Energy Program," Asian Technology Information Program, July 22, 1998, from www.cs.arizona.edu/japan/atip/public/atip.reports.98/atip98.060.html, downloaded October 1, 2003.
[114] "Electric Vehicles Need Government Support," from www.revaindia.com/2001_28.htm, December 4, 2001, downloaded October 1, 2003.

of available World Bank funds that can be used to modernize and rehabilitate Paksitan's highway system. With autonomy comes positive changes in the way that highway projects are approved, making that process more transparent so that World Bank observers can be confident that their money is being used wisely and efficiently and it has also served to make a slow process much faster.[115]

The World Bank financing and an autonomous NHA has allowed for the formulation of a ten year plan for Pakistan's highway system. There are components of rehabilitation, maintenance, and construction/expansion included in the plan, some of which have already been completed. Furthermore, the HNA and World Bank plan includes axle load controls in the form of weigh stations to preserve highways once they are updated or newly constructed as well as the installation of tolls which will provide the necessary revenue for future maintenance.[116] All of these measures have combined to increase the surface transportation system capacity in Pakistan.

In order to reduce one major cause of pollution, namely emissions, the Pakistani government has begun several initiatives including the promotion of compressed natural gas as a viable fuel alternative to petrol and diesel and the improvement of liquid fuel (gas) specifications to improve efficiency and reduce harmful agents found in exhaust emissions such as lead. Lead free gasoline is the only type available now in Pakistan whereas 80 octane had been available and widely used as recently as 2001.[117] Promotion of CNG has included the construction of 200 CNG stations and the exemption of all equipment for CNG station and vehicle conversion from import duty and sales tax until 2007. There are approximately 200,000 CNG vehicles operating in Pakistan and the government expects that number to double over the course of the next two years.[118] Despite these efforts, pollution continues to rise in Pakistan due to the fact that there are still so many diesel engines in use including buses, mini buses, and trucks. Diesel is preferable from the standpoint of the vehicle operator because it is cheaper than other fuels. In order to combat this problem, the government has begun importing Chinese-made CNG buses.[119]

The improvement of Pakistan's highway system and the concomitant increased capacity will likely result in some reduction of congestion. In order to further reduce congestion, the

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[115] "Musharraf gives autonomy to NHA," *The Pakistan Newswire*, March 8, 2002.
[116] "Government launching 10-year programme for improvement of highways," *The Pakistan Newswire*, December 14, 2002.
[117] Raza, Hilal A., "Environmentally friendly initiatives in oil and gas sector," *Global News Wire*, February 6, 2002.
[118] "Pakistan to cooperate with Iran in developing CNG industry," *The Pakistan News Wire*, March 31, 2002.
[119] Yagub, Nadeem, "Use of Green-Friendly Fuel Picks Up," *Inter Press Service*, October 22, 2002.

Pakistani government has created a national Mass Transit Authority and charged it with overhauling the mass transit system. The NMTA initiatives will begin in Karachi and then branch out into other large urban areas of Pakistan. Karachi is to get monorail or light rail style trains and large modern buses under the NMTA plan.[120] These efforts at modernizing mass transit have the potential to reduce fuel consumption as well.

While there does not appear to be either a culture of safe driving practices or a consorted effort on the part of the government to address the extremely dangerous road conditions in Pakistan (some say that it is the second most common form of death in the country), several non governmental organizations have stepped in and will begin educating commercial drivers in Pakistan about the importance of following traffic rules and regulations and the importance and value of human life.[121] This is at least a step, however small, in addressing driver safely issues.

In the area of research and development in energy efficient vehicles, we have seen an interest on the part of the government in creating vehicles that use cleaner, more efficiently burning fuels, but nothing substantial in the development of vehicles that actually use fuel, whether it be liquid or gas, in a more efficient manner.

Aeronautics and Surface Transportation - India

Variables	Indicators	Score*
Subsonic Transports	use of large subsonic transports	2
Supersonic and Hypersonic Aircraft	use of supersonic and hypersonic aircraft	2
Research and Development	research and development in propulsion,	1
Surface Transportation	create intelligent highway systems	0
	increase driver safety	2
	increase system capacity	2
	reduce emissions	2
	reduce fuel consumption	2
	reduce congestion	2
	research and development in energy efficient	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[120] "Karachi badly needs rail-based mass transit system," *The Pakistan Newswire*, August 28, 2003.
[121] "Karachi badly needs rail-based mass transit system."

Aeronautics and Surface Transportation - Pakistan

Variables	Indicators	Score*
Subsonic Transports	use of large subsonic transports	2
Supersonic and Hypersonic Aircraft	use of supersonic and hypersonic aircraft	2
Research and Development	research and development in propulsion,	0
Surface Transportation	create intelligent highway systems	0
	increase driver safety	2
	increase system capacity	2
	reduce emissions	2
	reduce fuel consumption	2
	reduce congestion	2
	research and development in energy efficient	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Energy and Environmental

Energy and environmental technologies are vital to state power. Too heavy a reliance on fossil fuels could be complicated for a nation for both environmental and political reasons, depending on how the country uses fossil fuels and whether it produces or refines the fuel domestically or must go elsewhere to acquire it. In order to mitigate the circumstances under which problems might arise, Tellis argues that countries need to be developing ways to better or more broadly use renewable energy sources such as solar, wind, photovoltaics, and biomass or alternative fuels. In addition, it would be advisable to find ways to use fossil fuels that make them less harmful to the environment.[122]

Research and Development in Renewable Energy

India, as it turns out, is a country to be looked up to in regards to its development and use of renewable energy resources. In fact, India may be the only country in the world to have a cabinet-level agency solely devoted to the development and promotion of renewable energy technologies. It is called the Ministry of Non-Conventional Energy Sources. In addition, India is home to the internationally acclaimed TATA energy Research Institute and the Renewable Energy Development Agency. India's universities also have technology support centers to

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[122] Tellis, p. 64.

certify the quality of government produced renewable technology as well as to provide technology support to manufacturers who use the technologies.

The results of India's efforts in this area are truly noteworthy. Nationwide, India has

> "cumulative installations of 3.02 million family-size biogas plants, 32 modern cook stoves (including 485,000 solar cookers), 500,000 solar hot water systems, 57 megawatts of photovoltaic installations (including 3371 water pumps, 1920 kilowatts of electric power systems, 40,000 community and street lighting units, 100,000 home electric systems, and 250,000 home and community lighting systems), 34.36 megawatts of biomass gasifier electric systems, 222 megawatts of bagasse cogeneration units, 1167 megawatts of wind farms, and 217 megawatts of mini- and micro-hydroelectric generating units."[123]

India, however, it should be noted, still gets most of its energy from large hydroelectric facilities and coal burning.

Pakistan, with its small natural resources base and its heavy reliance on the importation of foreign oil, has come to recognize the importance of the development and use of renewable energy resources. Most of the renewable energy research and development has been conducted in the use of wind and solar power. Beginning in 2001 with the first wind energy project launch, Pakistan has sought out ways to use wind power to help meet the country's growing energy demands and to reduce present shortages. With the help of China, Pakistan installed fourteen wind power turbines in two coastal regions in 2002. These turbines were produced in China but installed by Pakistanis who were trained on the equipment. In 2004, Pakistan will install an additional one hundred wind power turbines, this time with mostly indigenous parts. The government hopes to replicate these successes in other coastal regions of Pakistan where creating the infrastructure for electricity supply is expensive and difficult due to the remoteness of the areas.[124] Furthermore, the first ever wind power plant will be operating in Karachi "very soon."[125]

Pakistan is also attempting to use solar power to its advantage. The fact that Pakistan is a nation with hot, sunny skies makes solar power an even more feasible option as a renewable

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[123] Ottinger, Richard L., and Rebecca Williams, "Renewable Energy Sources for Development," *Environmental Law*, v. 32, i. 2, Spring 2002, p. 331 (8).

[124] "Pakistan's Coastal Areas to have 100 Wind Power Turbines Next Year," *AsiaPulse*, May 28, 2003.

[125] "Pakistan to Have First Wind Power Plant Shortly," *AsiaPulse*, August 19, 2003.

energy resource with true potential. Pakistan's Alternative Energy Development Board has embarked on a project initially funded with Rs 200 million that will include the introduction of 1000 solar cookers in a number of provinces as well as the introduction of 6000 solar geysers. The program would also include the establishment of 5000 solar homes in each province.[126] Photovoltaic cell technology was installed commercially for the first time in Pakistan in 2002 when it was installed at the Natha Khan Bridge in Karachi. The Pakistan Council of Scientific Research has been conducting testing and analysis on the system since its installation but has yet to publish its results.[127] In addition, many companies in Pakistan are trading in photovoltaic products and appliances and selling PV lamps, garden lights and batteries, among other things.[128]

Pakistan already meets much of its energy needs with traditional biomass fuels in the form of wood. Deforestation and pollution have become problems in recent years, however, and this fact has caused some to look in a different direction on the issue of biomass as fuel. A failed attempt by the government to complete a biogas initiative started in 1974 has left biomass/biogas energy research somewhat in the lurch but at least one firm is attempting to take advantage of the available technologies that allow the conversion of agricultural waste in the form of bagasse from sugar cane and rice husks to be converted to gas which can then be used for electricity, heating, and cooking. Business Associates International is importing and selling the Chinese-produced biomass gassifier and generation system.[129]

Research and Development in Fossil Fuels

It is unclear wether either the Indian government or the private sector has been significantly involved in efforts to address issues surrounding the use of fossil fuels such as using them in a more environmentally friendly fashion. There are, however, several research centers involved in the conservation of fossil fuels such as the Petroleum Conservation Research Association, the Central Fuel Research Institute, and the Indian Institute of Petroleum. All of

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[126] Ibid.

[127] "Solar energy center PCSIR installs first commercial photovoltaic system in Karachi," *The Pakistan Newswire*, August 5, 2002.

[128] "Photovoltaic System Businesses in Pakistan," from http://energy.sourceguides.com/businesses/byP/solar/pvS/byGeo/byC/Pakistan/Pakistan.shtml, downloaded April 18, 2004.

[129] "Technology developed to get energy from agricultural residues," from www.pakissan.com/english/news/2003/jan/technology.developed.shtml, January 24, 2003, downloaded April 13, 2004.

these research institutes conduct some research into energy conservation and environmental impact.[130]

It is important to remember, however, that the Tellis framework requires only advancements in one area or the other of the development and promotion of renewable energy sources or the conservation and reduction of environmental impact of the use of fossil fuels. It is clear that India has made significant strides in the area of developing and utilizing renewable energy sources if not necessarily in fossil fuel conservation and environmental impact reduction, which is all that is necessary to determine according to the framework.

I could not find much to indicate that Pakistan has been engaged in any significant research in the use of fossil fuels in such a way that they would be conserved or have less impact on the environment. Again, the framework only requires research and development in one of the two areas to allow for the assessment of capabilities in the energy and environmental sector.

Energy and Environmental - India

Variables	Indicators	Score*
Research and Development in Renewable Energy	solarthermal power	2
	wind turbines	2
	photovoltaics	2
	biomass/alternative fuels	2
Research and Development in Fossil Fuels	how to use with out harming the environment	.5

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[130] "Energy Research Laboratories in India," from http://www.indiaonestop.com/energyresearch.htm, downloaded June 18, 2003.

Energy and Environmental - Pakistan

Variables	Indicators	Score*
Research and Development in Renewable Energy	solarthermal power	2
	wind turbines	2
	photovoltaics	2
	biomass/alternative fuels	2
Research and Development in Fossil Fuels	how to use with out harming the environment	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Having discussed the success and failure of attempts to gather data in all of the areas deemed important by Tellis, et al. to a nation's technology base, it is time to move into a discussion of whether or not, based on the available information, answers to the questions that Tellis, et al. ask concerning these technology areas are obtainable. As mentioned earlier, gathering information concerning the critical technology areas is only part of the assessment according to the parameters of the framework. One must then use the information to determine whether a country has indigenous production capabilities in the technology area, has transplanted production capabilities deriving from its status as a host for foreign-owned facilities, has trade access to foreign capabilities in a given technology area, and engages in research and development work even if not in commercial production.[131] Because so many of the indicators for the components of India's technology base could not be found, it is clear that there are no definitive answers to the above questions. It is possible, however, to make some general comments in this vein.

India is a technological dichotomy it seems. On the one hand, it has established itself as a leader in the design of cheap, quality software and in fact exports a large quantity of software to a number of international destinations. On the other hand, telecommunications infrastructure issues make even connecting to the internet difficult in some areas of India and the number of people who actually have personal computers is lower that one might expect from a country that gets so much media attention for possibly becoming a technology hub. In addition, there are a number of large international technology companies operating within India with what appears to

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[131] "Handbook," Tellis, pp. 9-10.

be mixed success. Quality control issues seem to be the major concern, yet there are also a number of companies interested in outsourcing their technology needs to India.

India seems to have indigenous access to all of the right raw materials it would need to support future technological initiatives. It seems to be strong domestically in the areas of bioprocessing and surface transportation and is moving in the right direction to address the severe energy and environmental concerns that it is currently facing. It imports much of its aeronautics technologies, but is also in the process of designing and producing its own capabilities in that area. Finally, the number of research institutions connected to the above technology areas indicates that there is a significant amount of research being conducted which may lead to future developments, but speaks nothing to the quality of those efforts.

Overall, the literature indicates that India has a fair amount of indigenous production capabilities in some of the technology areas and access to what it cannot produce on its own. It is working with international companies as well as other countries' governments to make up for its own shortcomings. The literature also indicates that India is at least aware of most of the technology related problems that it has and those it is likely to encounter in the future, and the government seems willing to address these issues.

The same difficulties in gathering the necessary data that were present in the discussion of India are present to an even greater degree in examining Pakistan's capabilities in critical technology areas. Again, one is unable to answer all of the questions relating to technology posed by Tellis, et al., but one can make some generalizations concerning Pakistan as well.

In Pakistan, we see a situation where high performance computing and networking capabilities are hampered by low bandwidth, domestically produced software is considered by even those with in the country of origin to be of poor quality, where there are relatively few computers in operation in the country at all, and advanced technological applications appear to be fledgling experiments if they exist at all. Its manufacturing sector, while essential to its economy, is fraught with inefficiencies and often produces goods that are of poor quality. There is a notable lack of scientific manpower within Pakistan's borders, causing it to fail to advance its capabilities in the area of biotechnology. Its current surface transportation system is in disrepair and cannot handle the capacity necessary to move people from point A to point B without a great deal of difficulty and even danger. Its aeronautics capabilities at present are almost solely dependent on foreign goods and technologies, and finally, while advances are

being made to help Pakistan meet its energy demands through alternative measures, there exists at present a system that is highly dependent on foreign fuel for energy and even that is not currently meeting demand. The only promising news in the area of technology as it is outlined in the Tellis text is the fact that the government seems to be working closely with international organizations in some cases to obtain financing for projects that will help alleviate some of the aforementioned problems.

Enterprise

The second component that Tellis, et al. identify as critical to measuring a country's national resources is enterprise. It is defined for the purposes of the framework as "a collective expression for the level of invention, innovation, and the diffusion of innovation within a given society."[132] The purpose of defining it in this fashion is to highlight the fact that technology is a product of state choice rather than an autonomous entity and to provide for the explanation of those factors that ultimately allow technological capabilities to develop and thus allow a country to avoid stagnation.

Capacity for Invention

A country's capacity for invention can be measured by assessing the level of public and private research and development expenditures, the research and development expenditure in the "leading sectors" (those areas discussed above such as information and communications and biotechnology), as well as the level of patenting at home and abroad.[133]

Public and Private Research and Development Expenditures

Collecting information on the first two variables for India was more difficult than would seem warranted. India's Ministry of Finance keeps a fair amount of statistical data, but not necessarily of the quality required for the framework, and other sources proved to be too generalized to provide the necessary information. It does appear, that India spends less on research and development than other countries in similar positions as developing nations.[134] According to the International Bank for Reconstruction and Development's World Development Indicators Report, India's government spent, on average, .62 percent of its GNP in research and

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[132] Tellis, p. 65.
[133] Ibid.
[134] Bowonder, B., and N.G. Satish, "Is Economic Liberalisation Stimulating Innovation in India?" *Interdisciplinary Science Reviews*, v. 28, no. 1., 2003, p. 46.

development in 2001.[135] This represents a decrease when compared to the data gathered by the same group for the years 1987-1997. The percent of public expenditure for that period was, on average, .73 of GNP.[136] Private sector industries have traditionally invested very little of their funds into research and development. In 2001-02, the top twenty public companies in India invested, on average, less than four percent of their sales revenues on research and development.[137] Pakistan is currently spending only .25 percent of GNP on research and development. These figures are miniscule when compared to developed countries such as the U.S. and South Korea at 2.5 percent each.[138]

Leading Sector Research and Development

As far as how the money that was invested in research and development from both the public and private sectors was allocated, it appears that scientific research in areas such as space, atomic energy, and defense has become more of a priority.[139] According to the framework, these are all areas to which a country's government should be devoting resources. The major investor in industrial research and development in India was the Indian government, with the private sector investing very little in this area. R & D is highest in the pharmaceuticals and lowest in automobiles[140] which is actually a good sign according to the framework because it means that resources are being spent in sectors of the economy that can provide the most return and the most potential for growth. A disaggregated figure for Pakistan was not available.

Patent Activity

The third variable, patenting activity, was much more easily determined. According to the International Bank for Reconstruction and Development, in 1999, only 14 patent applications were filed by Indian residents. This is a shocking decline from 1998 when 2,111 patents applications were filed by Indian residents.[141] The numbers are much higher for non-residents who applied to India for patents in the name of foreign agencies and individuals at 38, 348 in 1999.[142] Information on how many patents were actually sealed was elusive, but it is clear that the number won by Indians must be far lower than the number won by foreign entities.

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[135] <u>World Development Indicators, 2002</u>, International Bank for Reconstruction and Development, 2002.
[136] <u>World Development Indicators, 2001</u>, International Bank for Reconstruction and Development, 2001.
[137] Bowonder, p. 47.
[138] "Government must spend more on scientific research," *The Pakistan Newswire*, May 18, 2003.
[139] Bowonder, p. 48.
[140] Bowonder, p. 46.
[141] <u>World Development Indicators, 2001</u>.
[142] <u>World Development Indicators, 2002</u>.

It is also interesting to note that Indian residents were awarded 96 patents in the US in 2002 and just 16 patents in 2003. The patents issued to Indians by the U.S. were awarded in such areas as applied molecular biology, human factors engineering, and pharmaceuticals,[143] some of the very areas deemed necessary for the advancement of a country's technology base by the Tellis framework.

It appears that patent activity on the part of Indians is actually on the decline in general. In fact, based on the above information, it seems that patent activity by Indian citizens living in India is extremely low considering a country like Madagascar had similar patent activity levels. This is an indication that perhaps India's capacity for invention is on the decline.

The Ministry of Industries and Production houses the Pakistan Department of Patent and Design. This office, however, does not publish statistics related to patent activity within the country. Recent statistics from the International Bank for Reconstruction and Development put domestic patent activity at a very low level, with fewer than twenty patents filed in Pakistan by residents of Pakistan. More than 700 patent applications were filed in Pakistan by non-residents. Pakistanis were awarded just three patents in the U.S. in 2003, down from 15 in the year prior.[144] These numbers are extremely low and indicate that it is unlikely that Pakistan has a high capacity for invention.

Capacity for Invention - India

Variables	Indicators	Score*
Public and Private R&D expenditure	N/A	1
R&D expenditure in leading sectors	N/A	0
Level of patenting at home and abroad	number of patents issued	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[143] http://patft.uspto.gov/netahtml/search-bool.html, database search using the terms "India"and "2002," and "India" and "2003."

[144] http://patft.uspto.gov/netahtml/search-bool.html, database search using the terms "Pakistan"and "2002," and "Pakistan" and "2003."

Capacity for Invention - Pakistan

Variables	Indicators	Score*
Public and Private R&D expenditure	N/A	1
R&D expenditure in leading sectors	N/A	0
Level of patenting at home and abroad	number of patents issued	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Capacity for Innovation

The next measure of enterprise is a country's capacity for innovation. Tellis, et al. warn that this is difficult to measure, and with good reason. They argue that one way to measure this would be to determine the number of patents actually adopted for manufacture and another would be the percentage of prototypes actually line produced.[145] Tellis, et al. suggest that either or both of these statistics would be sufficient, however, an exhaustive search turned up no concrete numbers for either India or Pakistan.

Capacity for Innovation - India

Variables	Indicators	Score*
Number of patents adopted for manufacture	N/A	0
Number of prototypes line produced	N/A	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Capacity for Innovation - Pakistan

Variables	Indicators	Score*
Number of patents adopted for manufacture	N/A	0
Number of prototypes line produced	N/A	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[145] Tellis, pp. 70-71.

Diffusion of Innovation

The last dimension of entrepreneurship is a country's ability to diffuse innovation. Again, Tellis, et al. warn that this could be difficult to trace, but that one should try to gather information on the degree of business e-connectivity and the number of specialized research institutions devoted to technology.[146]

Business E-Connectivity

The level of business e-connectivity can be determined by assessing the number of businesses that use e-mail, have their own web pages, and advertise on the World Wide Web. In addition, one should try to find out the volume of e-business as a percent of total business. Currently, e-commerce in India accounts for a "negligible portion" of the economy.[147] Using two sources, one can put the total dollar amount of e-business at between $100,080,062.23 and $66,484,721.55 (converted to U.S. dollars from Indian Rupees). The main reason e-business is so low in India is cited as a lackluster Internet infrastructure, including a lack of bandwidth.[148] Despite this, a number of companies have set up websites to inform people about their products and services, and a simple Internet search reveals that even if businesses are not necessarily conducting monetary transactions on their websites, they are taking advantage of the Internet to advertise. I was unable to find any information on the use of e-mail, but several of the companies with websites offered a place where the customer could e-mail the company directly, so clearly it is being used at least on a limited basis.

So while I could find no hard numbers, the available information tells us that companies are using the Internet to connect to one another (ninety percent of the e-business conducted in India over the course of 1999-2000 was in business to business transactions),[149]advertise, and inform customers about goods and services, but that the number is less than it could be due to a lack of Internet infrastructure in India.

It is clear that e-business is still in the very early stages of development in Pakistan. The lack of infrastructure, poor quality of the network, and attempts by the government to tax and

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[146] Tellis, p. 72.
[147] Rao, N.H., "Electronic Commerce and Opportunities for Agribusiness in India," *Outlook On Agriculture*, v. 32, no.1, 2003, p. 31.
[148] Rao, p. 30.
[149]"E-Business," India Business Opportunities, from http://meadev.nic.in/economy/bus-ind-p/ch16-pg2.htm, downloaded April 18, 2004.

regulate e-commerce while it is still in its infancy have all played a role in stifling the e-commerce environment.

One company has overcome these obstacles and has created Pakistan's first and only one of its kind in Pakistan online shopping mall at http://mallpk.com.[150] I could not find statistics relevant to how much e-business was being conducted in Pakistan either in dollar amounts or in number of transactions. The same type of simple Internet search as was conducted on India, when conducted on Pakistan, reveals that at least some businesses are advertising online and that e-mail is being used, but in general, it cannot be determined whether Pakistan has a high level of diffusion of innovation using the measure put forth in the framework.

Specialized Research Organizations

Another measure of diffusive capacity is the number of specialized national or industry-wide research institutes that are directly connected to creating technological advancements. I could not find a specific number of institutions, but it is clear, based on the earlier discussion of the critical components of technology, that there are a number of organizations in India engaged in technological research and advancement.

Many organizations in Pakistan are devoted to the advancement of technology within its borders. The Pakistan Council for Scientific and Industrial Research, the National Institute of Electronics, the Pakistan Council for Science and Technology, the Pakistan Science Foundation, and the IT Commission of Pakistan are among the most well recognized among them. There is no exact number of institutions available, however, and it is unclear whether the quality of the research being performed at these institutions meets international standards.

Business E-Connectivity – Alternative Measure

As an alternative to the above measure, the Tellis framework suggests that measuring the number of computers, Internet connections, bandwidth, and communication devices per one thousand individuals could help one to assess a country's ability to diffuse innovation.[151] This measure was much more easily accessible. As mentioned in the discussion on data storage and peripherals, India was home to 6 million personal computers in 2001.[152] Industry Standard Magazine ranked per capita Internet use and found 5 Internet users per 1000 people in India in 2001. In a Chart listing the five countries with the lowest per capita Internet usage, India was

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[150] "Pakistan;s most prestigious e-commerce project," *Economic Review*, October-November 2001, p. 52.
[151] Tellis, p. 72.
[152] "Personal Computers ITU Estimates"

first ahead of Indonesia, Ukraine, the Philippines, and Saudi Arabia.[153] As mentioned in the earlier discussion concerning India's bandwidth, India has far less bandwidth than it actually needs at just 324 mbits,[154] and as far as other communications devices are concerned, the CIA estimates that there were 27.7 million telephone lines in use in India (2000), 2.93 million cellular phones (2000).[155] Despite India's booming software industry and large technological pool, the diffusion of innovation is likely slow and difficult considering the number and nature of those with computers and those who are online.

Recent statistics put the number of personal computers per 1000 people in Pakistan at just 4.4.[156] We have already discussed the poor bandwidth capacity within Pakistan, and Internet use was at just 3.4 users per 1000 people in 2001. Other communications devices including telephones and cellular phones were listed at twenty-three and six per 1000 respectively in 2001.[157]

Diffusion of Innovation - India

Variables	Indicators	Score*
Level of business e-connectivity	number of companies that use e-mail	0
	number of businesses that have their own web pages and advertise on the World Wide Web	1
	volume of e-business as a percent of total business	1
Trade/industry research organizations		1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[153] "Per Capita Usage is Highest Up North," *Industry Standard*, March 2001, p. 97.
[154] "Bandwidth Bottleneck."
[155] "World Factbook, 2002 - India," Central Intelligence Agency, from www.cia.gov/cia/publications/factbook/geos/in.html, downloaded June 19, 2003.
[156] "Personal Computers Per Capita," from http://www.nationmaster.com/red/graph-T/med_per_com_cap&int=-1, downloaded April 18, 2004.
[157] "Human Development Indicators," *Human Development Report, 2003*, United Nations Development Programme, 2003, p. 276.

Diffusion of Innovation - Pakistan

Variables	Indicators	Score*
Level of business e-connectivity	number of companies that use e-mail	0
	number of businesses that have their own web pages and advertise on the World Wide Web	1
	volume of e-business as a percent of total business	0
Trade/industry research organizations		1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Diffusion of Innovation: Alternate measure - India

Variables	Indicators	Score*
Level of business e-connectivity	Number of computers	2
	Number of Internet connections	2
	Bandwidth	2
	Communications devices per 1000 individuals	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Diffusion of Innovation: Alternate measure - Pakistan

Variables	Indicators	Score*
Level of business e-connectivity	Number of computers	2
	Number of Internet connections	2
	Bandwidth	2
	Communications devices per 1000 individuals	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Human Resources

The third component that must be measured in order to assess a country's national resources is human resources. When examining a country's human resource base, Tellis, et al. argue that one should be looking at both formal and informal education within a country.

Formal Education

Formal education refers to gross expenditure on education, the number of educational institutions by level, the level and composition of specialization, and the overall quality of education. This examination, to be complete, must also reveal information about enrollment at all levels, with a special emphasis on higher education.[158]

Gross Expenditure, Number of Institutions, and Specialization by Level

India, as in many other areas under consideration in this paper, seems to be a bit of a contradiction in the area of education. It has had significant education development since it gained independence in 1947, and yet forty-four percent of its adult population in 2000 was considered illiterate. India spent approximately 4.11 percent of its GDP on education in 2000-2001[159] and is home to a number of educational institutions. There are 845,000 institutions at the primary level, 126, 047 institutions at the secondary level, and 10,406 at the tertiary level.[160] Pakistan spends about 2.4 percent of its GNP on education. There are approximately 164,235 schools at the primary level, 19,088 at the secondary level, and 12,966 at the tertiary level.[161]

Enrollment

Information on enrollment on these levels comes in the form of the Gross Enrollment Ratio. It is defined as the percentage of enrollment in the level of education (primary, secondary, or tertiary) to the total number of people in the requisite age level that could be attending a particular educational institution. The percent may be more than one hundred due to the fact that the statistics include both under- and over-aged children. Gross enrollment in India at the primary level in 2001 for males was 107 percent and for females it was ninety-three percent. At the secondary level, the numbers were fifty-nine and thirty-nine percent respectively.[162] This represents a significant decline between levels. In that same year, the gross enrollment rate for the tertiary level of education was only six percent.[163] It was difficult to find recent information

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[158] Tellis, p. 75
[159] "Selected Educational Statistics," Ministry of Human Resource, Government of India, from
http://www.education.nic.in/htmlweb/edusta.htm, p. 1, downloaded April 13, 2004.
[160] "Selected Educational Statistics, p. 3.
[161] "Education," Pakistan Statistical Yearbook, 2003, from
http://www.statpak.gov.pk/depts/fbs/publications/yearbook_2003/yearbook2003.html, downloaded April 13, 2004.
[162] "India: Country Profile," from www.tulane.edu/~internut/Countries/India/indiaxx.html, downloaded April 13, 2004.
[163] Chintis, Suma, "Higher Education in INDIA," Black Issues in Higher Education, v. 16, i. 25, February 3, 2000, p. 28.

related to the specialization of these students, but the following statistics were available: enrollment in engineering/technology/architecture was 86,105 in 1998, enrollment in medicine was 139,874 in 1987, enrollment in agriculture and forestry was 45,100 in 1987, and enrollment in education was 113, 273 in 1998.[164]

Tellis, et al. argue further that in order to truly assess enrollment, one must also look at enrollment in foreign countries, especially the United States, and especially at the tertiary level. The Chronicle of Higher Education estimates that there were 546,640 students from India studying in the United States in 2001, second on the list of countries with the largest number of students studying in the U.S. only to China.[165] As for other countries as destinations for study abroad, I could not find any recent data. Data from 1996-1997 shows that 3404 students left India for destinations other than the U.S. during that time. In order to fully flesh out the framework in this area, one would also need to know the specialization of the students who study abroad. Again, I could not track down recent statistics, but information from 1996-1997 shows that there were 1473 engineering/architectural students, 631 science students, 381 technology and industry students, 1777 commerce and business students, eighty students of agriculture and forestry, and 907 students in the medical field during that time period.[166]

Gross enrollment ratios for Pakistan at the primary and secondary levels are eighty-six and thirty-seven percent respectively.[167] The gross enrollment ratio for the tertiary level of education was more difficult to track down, but one estimate puts it at less than three percent.[168] Specialization for these students is as follows: arts and sciences 770,286 students, medical 377,730 students, law 20,419 students, engineering, 10,140 students, education 8284 students, commerce 55,931 students, and agriculture 1065 students. Furthermore, recent estimates put the number of Pakistani students studying in the U.S. at just 6107.[169] This is significantly lower than the number of students from other developed countries, perhaps due to the fact that post-911

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[164] "Educational Statistics Compiled by IAMR," Government of India, Department of Education, from http://education.nic.in/htmlweb/iamrstat.htm, downloaded June 16, 2003.

[165] "Top Places of Origin of Foreign Students in the U.S., 2000-01," *Chronicle of Higher Education*, November 2001, p. A46.

[166] Sahni, P., Reddy, P.O., et al., "Indian Medical Journals," *The Lancet*, v. 339, no. 8809, June 27, 1992., p. 1589 (3).

[167] "Participation in Education," World Development Indicators, 2002, International Bank for Reconstruction and development, 2002, p. 91.

[168] Iqbal, Nadeem, "Liberalisation Drive Raises Teachers' Ire," South Asia Tribune, i. 15, October 28-November3, 2002.

[169] "Foreign Students Enrolled in Institutes of Higher Education in the U.S.," Digest of Educational Statistics, 2001, Office of Educational Research and Improvement, February 2002.

requirements for student and other visas for people of Pakistani origin may have caused this number to decrease, at least temporarily.

As for other destinations for Pakistanis interested in completing their higher education abroad, I could find no concrete data, but there was an indication that France has become more popular in recent years. No breakdown for the specialization of Pakistani students studying abroad was available.

Quality of Education

With all of the above information about the infrastructure and enrollment in place, the next element is the examination of the quality of a country's formal education system. Tellis, et al., argue that quality cannot be measured across the education system as a whole, but only by discipline. It is therefore necessary to look at those disciplines that most critical to national power such as science and technology. It is best to look at the number of published articles, the estimated influence of those articles, the number of international grants awarded to Indian researchers, the number of awards and honors earned by Indian researchers, and the quality and number of advanced research institutes focusing on science and technology.[170]

The National Science Foundation estimated that India published 9,217 scientific articles in 1999. These articles were in fields such as biomedical research, earth and space, engineering, and technology[171] among others. These are some of the very areas deemed critical to the creation of national power. As for the influence of these articles, the National Science Foundation uses a system to measure the prominence (and thus influence) of the scientific literature in a country based on the relative citation index of the region. In this system, a score of 1.00 would indicate that a country's share of cited literature is equal to the region's overall world share of scientific literature. Anything greater or less than 1.00 would indicate that literature from a particular country was cited more or less than that country's share of scientific literature. In the areas of engineering and technology, India earned a score of .68, in the area of physics, a .51, and in the area of mathematics, a .50.[172] These numbers indicate that the prominence of the literature is average to low, and thus probably not very influential on the global scene.

I could not locate any general figures related to the number of grants and awards given to Indian researchers, but I was able to find a listing of about 150 research institutes in India, the

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[170] Tellis, p. 78.
[171] Science and Engineering Indicators, 2002, National Science Foundation, 2002, p. A5-93.
[172] Science and Engineering Indicators, 2002, National Science Foundation, 2002, p. A5-93.

bulk of which are related to technological and military research.[173] While this is by no means a definitive listing, it does point to the fact that there are a great deal of research institutes in India. The Tellis framework does not suggest a way to measure the quality of research institutes, and I was unable to locate any literature testifying as to the quality of Indian research institutes either in general or specific terms.

Statistics for the same year for Pakistan indicate that only 277 articles were published in advanced areas of science and technology. The National Science Foundation gives Pakistan a score of .40 for the relative prominence of its scientific literature using the same prominence index outlined above.[174]

Again, I could not find a definitive, official government listing of research institutes, nor could I find any information relating to grants or awards given to Pakistani researchers, but I did find one listing which contains eighty-two research institutes in areas ranging from agriculture to labor and unemployment and electronics.[175] The quality of these research institutes will be briefly addressed in a later section on instrumental rationality.

Formal Education - India

Variables	Indicators	Score*
Gross expenditure on education	N/A	2
Number of educational institutions by level	N/A	2
Composition of specialization by category	number of students specializing in areas critical to	1
Quality of education	number of published articles	2
	estimated influence of published articles	2
	number of national and international grants	0
	number of recognized honors and awards earned by	0
	number and quality of advanced research institutes	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[173] "National Institutes of India," from http://www.cyberjournalist.org.in/linksi.html, downloaded April 18, 2004.
[174] Science and Engineering Indicators, 2002, National Science Foundation, 2002, p. A5-93.
[175] "Research Institutes in Pakistan," from http://www.geocities.com/Tokyo/Garden/4404/in, downloaded April 13, 2004.

Formal Education - Pakistan

Variables	Indicators	Score*
Gross expenditure on education	N/A	2
Number of educational institutions by level	N/A	2
Composition of specialization by category	number of students specializing in areas critical to	1
Quality of education	number of published articles	2
	estimated influence of published articles	2
	number of national and international grants	0
	number of recognized honors and awards earned by	0
	number and quality of advanced research institutes	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Informal Education

The Tellis framework also touches on the importance of informal education in assessing a country's human capital resources. Tellis, et al. submit that one can measure the level of a country's informal education by considering the extent of Internet connectivity, the per capita distribution of radios and televisions, newspaper readership, and the number of books sold per capita.[176]

As aforementioned, Internet connectivity in India stood at 5 Internet users per one thousand people in 2001.[177] In 2000 there were seventy-eight television sets per 1000 people and 121 radios. In addition, newspaper readership was sixty per 1000 inhabitants in 1998.[178] The last component of informal education, the number of books sold per capita, was troublesome. I was not able to find a number of books sold, but I was able to find the total number of titles published in India in 1998, broken out by category. This at least gives us an indication of the access that Indians have to literature and could be a reasonable substitute for the requested

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[176] Tellis, p. 75.

[177] "Per Capita Usage is Highest Up North", p. 97.

[178] "Human Development Indicators," *Human Development Report, 2003*, United Nations Development Programme, 2003, p. 276.

variable. There were 14,085 titles printed in that year, most of them being general literature, with about 1330 of those titles being in the sciences.[179]

Data indicate that there are about 3.4 Internet users per 1000 people in Pakistan. There are about thirty newspapers per 1000 people, 105 radios, and 131 televisions.[180] I could find neither an actual number nor a reasonable substitute for number of books sold per capita in Pakistan.

Informal Education - India

Variables	Indicators	Score*
Extent of Internet connectivity	N/A	2
Per capita distribution of radio/TV	N/A	2
Newspaper readership	N/A	2
Number of books sold per capita	NA/	.5

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Informal Education - Pakistan

Variables	Indicators	Score*
Extent of Internet connectivity	N/A	2
Per capita distribution of radio/TV	N/A	2
Newspaper readership	N/A	2
Number of books sold per capita	NA/	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

The reason for examining education in a country is that investments in human capital tend to provide significant returns in terms of a country's ability to produce national power. One thing that the framework does not address in this area is the fact that many of the best-educated

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[179] "Gross Domestic Savings," Economic Survey 2003-2003, Ministry of Finance and Company Affairs, Government of India, from http://indiabudget.nic.in/es2002-03/chapt2003/tab15.pdf, downloaded April 18, 2004.

[180] "The Information Age," World development Indicators, 2002, International Bank for Reconstruction and Development, 2002.

individuals take their knowledge and move abroad, living and working in other countries.[181] This so-called brain drain could mean that India's investments in education are not providing the type of returns that they might under circumstances where the country was able to retain its best and brightest in its domestic workforce.

Financial/Capital Resources

The fourth component making up a country's national resources is its financial/capital resources. This component tells the tale of whether or not a country is in a position to make the necessary investments in all of the above-mentioned areas that can contribute to a nation's power. Tellis, et al. believe that in order to properly assess a country's capabilities in this area, one must find information about the extent of savings, the aggregate growth of the economy, and sectoral growth in a country.[182]

Extent of Savings

The extent of savings in a country can best be measured by assessing the overall rates of saving in the economy, the ratio of taxes to GNP, and the level of official development assistance and foreign direct investment.[183]

Savings and Ratio of Taxes to GNP

The Indian Finance Ministry estimated that in 2001-02, savings in India was 549, 963 Rs crore and could be broken out as follows: household sector savings was at 515, 565 Rs crore, private sector savings was 92,060 Rs crore, and public sector savings came in at –57,662 Rs crore.[184] In addition, the Indian Budget for 2001-02 showed the tax revenue of the central government to be 165,030.74 Rs crore.[185] This was approximately 3.3 % of the GNP at that time.

In Pakistan, savings grew to 18.5 percent of GNP in FY03, up from 16.8 percent in FY02, with private savings growing faster than public savings equaled 1.5 percent of GNP and private savings were at seventeen percent. A breakdown of savings between corporate and household was unavailable.[186]

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[181] Chintis, Suma, "Higher Education in INDIA," *Black Issues in Higher Education*, v. 16, i. 25, February 3, 2000, p. 28.

[182] Tellis, p. 83.

[183] Ibid.

[184] "Gross Domestic Savings."

[185] "Budgetary Transactions of the Central and State Governments and Union Territories," Ministry of Finance and Company Affairs, Government of India, from http://indiabudget.nic.in/es2002-03/chapt2003/tab22.pdf, downloaded April 18, 2004.

[186] "Economic Growth, Savings, and Investment," State Bank of Pakistan from www.sbp.org.pk/reports/annual/arFY03/index.htm, downloaded February 18, 2004.

Official Development Assistance and Foreign Direct Investment

India appears to have access to a fair amount of foreign development assistance. The Department of Economic Affairs, a division of the Ministry of Finance, estimated that in 2002-03, India received a grand total of 12192.91 Rs crore in external assistance. 11333.82 Rs crore of that assistance came in the form of loans, and 824.36 Rs crore were in the form of grants to the Indian government.[187] During that same time period, foreign direct investment was at approximately 1089 million.[188] In Pakistan in 2002, foreign direct investment was at $684 million.[189] In FY03, it rose to $798 million.[190] Official development assistance was $1.589 billion in 2002/03 and is expected to rise to $1.719 billion for 2003/04.[191]

These numbers may seem high on first inspection, but when compared to numbers from China, (47 billion in FDI in 2001), one quickly realizes that the amounts these two countries are receiving is not on par with other countries, possibly due to poor government infrastructure and the resulting unwillingness of foreign countries to enter that environment.[192]

Extent of Savings - India

Variables	Indicators	Score*
Overall rates of savings	N/A	2
Ratio of taxes to GNP	N/A	2
Official development assistance	N/A	2
Foreign direct investment	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[187] "External Assistance," Union Budget 2002-03, Ministry of Finance and Company Affairs, Government of India, from http://indiabudget.nic.in/ub2003-04/rec/annex2.pdf, downloaded April 18, 2004.

[188] Foreign Investment Inflows," from www.rbi.org.in, downloaded April 13, 2004.

[189] "Pakistan's economic performance appreciated worldwide," *The Pakistan Newswire*, September 16, 2003.

[190] "Pakistan's economic performance appreciate worldwide."

[191] "Pakistani Government Estimates GDP Growth at 5.3% for 03/04," *AsiaPulse,* May 26, 2003.

[192] Lancaster, p. A18.

Extent of Savings - Pakistan

Variables	Indicators	Score*
Overall rates of savings	N/A	2
Ratio of taxes to GNP	N/A	2
Official development assistance	N/A	2
Foreign direct investment	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Aggregate Growth

According to Tellis, et al., the best way to measure a country's aggregate economic growth is to examine its annual growth rate as well as the absolute size of GNP and per capita GNP.[193] The Indian Finance Ministry estimated that in the period from 2001-02 India's GNP grew by 5.4 percent. Furthermore, it estimated the absolute size of the GNP for 2000-01 at 1,878,429 Rs crore.[194] The CIA estimated that in 2002, the per capita GNP was $2540.[195] The State Bank of Pakistan estimated that GNP growth in 01-02 was at 3.49 percent.[196] The absolute size of GNP for that time period was Rs 3428318 million.[197] The CIA estimated that in 2002 the per capita GNP in Pakistan was $2000.[198]

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[193] Tellis, p. 83.

[194] "General Review," Economic Survey 2001-2002, Government of India, Ministry of Finance, from
    http://indiabudget.nic.in/es2001-02/general.htm, downloaded April 19, 2004.

[195] "World Factbook 2002 - India."

[196] "Economic Growth, Savings, and Investment," State Bank of Pakistan from
www.sbp.org.pk/reports/annual/arFY03/index.htm, downloaded February 18, 2004.

[197] "National Accounts," Pakistan Statistical Yearbook, 2003, from
    http://www.statpak.gov.pk/depts/fbs/publications/yearbook_2003/yearbook2003.html, downloaded April
    13, 2004.

[198] "World Factbook, 2002 - Pakistan."

Aggregate Growth - India

Variables	Indicators	Score*
Annual growth rate of GNP	N/A	2
Absolute size of GNP	N/A	2
Per capita GNP	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Aggregate Growth - Pakistan

Variables	Indicators	Score*
Annual growth rate of GNP	N/A	2
Absolute size of GNP	N/A	2
Per capita GNP	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Sectoral Growth

In order to further refine the aggregate numbers above and therefore determine where income production lies in a country, one must examine sector growth. The more income generation from "leading edge" sectors rather than "sunset" sectors, the better.[199] Leading edge sectors are those created by technological breakthroughs and are typically found in what is traditionally referred to as the tertiary sector of the overall economy. Sunset sectors are considered to be those found in the primary, and to some extent, the secondary sectors of the economy.

The growth rates between the three major economic sectors in India are as follows: 5.7 percent in agriculture and related sectors (primary), 3.3 percent in industry, manufacturing, etc. (secondary), and 6.5 percent in the services sector (tertiary).[200] The tertiary sector in India, it seems, is in a position to drive India's GDP growth over the next several years. What is

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[199] Tellis, p. 85.
[200] "Macroeconomic Overview for 2001-2002," Economic Survey 2001-2002, Ministry of Finance and Company Affairs, Government of India, from http://indiabudget.nic.in/es2001-02/general.htm#chap11, downloaded October 22, 2003.

significant about this growth, other than the fact that it is occurring in the tertiary sector of the economy, is that it has come about due to India's willingness and ability to create and use new technologies that allow for faster, more efficient delivery. Growth in this sector has remained strong despite the global economic downturn, contributing forty-nine percent of the GDP over the last five years.[201] Given that the tertiary sector of the economy is maturing, India, if it stays on its current path, will create a safe environment for business in the service sector and perhaps attract more of the much-needed foreign direct investment which will put it on par with other developing countries.

Economic growth for Pakistan in the primary sector is at approximately 4.8 percent, in the secondary sector it is 5.4 percent and in the tertiary sector, growth is estimated at 5.3 percent. With Pakistan we also see a trend toward greater growth in the secondary and tertiary sectors which is a positive trend for a developing country. It is possible, however, that recent droughts have caused the primary sector to lag behind, causing advancements in the secondary and tertiary sectors to appear to excel beyond the primary sector.

Sectoral Growth - India

Variables	Indicators	Score*
Distribution of sectoral growth	distribution of growth among primary, secondary and tertiary sectors	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Sectoral Growth - Pakistan

Variables	Indicators	Score*
Distribution of sectoral growth	distribution of growth among primary, secondary and tertiary sectors	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[201] Chand, Fakir, "Service sector to drive India's GDP growth," from www.rediff.com/money/2002/jul/13it.htm, July 2002, downloaded October 23, 2003.

Physical Resources

In the postindustrial age, knowledge-driven growth has made the natural endowment of physical resources in a country less imperative to national power than it once was. New technologies have allowed us to more creatively and efficiently use our natural resources and have therefore decreased the level of insecurity surrounding whether or not and how much of a particular resource is at a country's disposal. The fact that the global market and trading systems have developed so as to make the procurement of raw materials relatively easy has decreased that level of insecurity as well.[202] Only the prospect of an interruption in the supply of these items is cause for concern. Notable exceptions to the above concept are energy and food resources, and perhaps over the long term, water. In addition, the postindustrial age will require different materials of a nation in order to develop and succeed. These materials include non-fuel resources such as critical minerals and rare metals. Examples of these resources include light but strong and flexible metals such as titanium as well as metals critical to the information age such as the platinum group metals used in circuit boards and other high-tech applications. Tellis, et al. therefore submit that it is necessary to evaluate a country's food stocks, energy sources, critical minerals, and rare metals to determine a country's level of domestic production, the size of its secured stockpiles, and the sources for/security of foreign access to these physical resources.[203]

Food Stocks

Since the 1960's, the Indian government has pursued an agricultural policy with the aim or creating self-sufficiency in foodgrains. The goal of this policy remains unmet as a number of factors hinder India's ability to domestically produce its grain needs including poor irrigation, land ceiling regulations, and poor storage facilities. Riche is India's largest crop, but it also produces wheat, maize, millet, and pulses. Production of all of these crops was estimated at 200.8 million tons in 1999.[204] Also, India produced 6,038,390 metric tons of meat in 2003.[205]

Most of what is produced agriculturally in India is consumed domestically. Production is generally not enough to meet consumption demands and India also has serious corruption problems in its distribution system for food. India has, however, achieved self-sufficiency in

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[202] Tellis, p. 88.
[203] Tellis, p. 89.
[204] World of Information Business Intelligence Report: India.
[205] "Agricultural Data," from
http://faostat.fao.org/faostat/form?collection=Production.Livestock.Primary&Domain=Production&servlet=1&hasbulk=0&version=ext&language=EN, choosing "Livestock Primary," then choosing "India," "MEAT TOTAL+," and "2003," downloaded April 14, 2004.

dairy production as well as in freshwater fish. Due to the discrepancy between production and demand, India must import some of its foodgrains from other countries in order to meet its needs. In 2001, the Indian Finance Ministry estimated that India had to import 2.9 million tons, or almost two percent of its total food available for distribution.[206] What is unclear is from where India imported the foodgrain. The fact that India only needed to import two percent of its foodgrain needs from abroad leads one to believe that if the Indian government were to upgrade the storage facilities for these grains and cut down on corruption in the distribution system, it could meet demand domestically and finally reach the goal of self-sufficiency set in the 1960's.

As for food stockpiles in India, a long drought in 2002 as well as a large-scale export initiative caused India's food stocks to dramatically decline in 2003. Food stocks fell to 41.3 million tons in 2003 (as of May 1) from 62.4 million tons in 2002 (figure on May 1).[207]

The Pakistani government announced recently that it is pursuing a policy to become self-sufficient in the agricultural sector and is looking for ways to profit from the international sale of surplus crops. Pakistan is currently self-sufficient in four major crops: cotton, sugarcane, wheat, and rice. In addition, grain production in Pakistan was at 24,830 thousand tons in 1999 and 27,599 tons in 2000.[208] Pakistan imported 3107 thousand and 2060 thousand tons of grain respectively in those years, and produced 1,891,580 metric tons of meat in 2003.[209]

Despite the fact that Pakistan imports and produced enough food to meet the requirements for every person in the country, economic and social access constraints prohibit many poverty-stricken citizens from obtaining food.[210] The above represents a sketch of food production in Pakistan, but I was unable to find any statistics related to stockpiles of food within the country, nor anything related to how secure those stockpiles might be.

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[206] "Net Availability, Procurement and Public Distribution of Foodgrains," Economic Survey 2002-03, Ministry of Finance and Company Affairs, Government of India, from http://indiabudget.nic.in/es2002-03/chapt2003/tab118.pdf , downloaded April 18, 2004.

[207] "India to dismantle current foodgrains export regime," Organization of Asia –Pacific News Agencies, May 28, 2003.

[208] "Food Security Assessment," Economic Research Service, March 2002, p. 54.

[209] "Agricultural Data," from http://faostat.fao.org/faostat/form?collection=Production.Livestock.Primary&Domain=Production&servlet=1&hasbulk=0&version=ext&language=EN, choosing "Livestock Primary," then choosing "Pakistan," "MEAT TOTAL+," and "2003," downloaded April 14, 2004.

[210] "World Hunger – Pakistan, from www.wfp.org/country_brief/index.asp?region=5, choosing Pakistan, downloaded April 13, 2004.

Food Stocks - India

Variables	Indicators	Score*
Level of domestic production	N/A	2
Level of secured stockpiles	N/A	2
Sources for/security of foreign access	N/A	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Food Stocks - Pakistan

Variables	Indicators	Score*
Level of domestic production	N/A	2
Level of secured stockpiles	N/A	0
Sources for/security of foreign access	N/A	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Energy Stocks

The framework tells us that fossil fuel resources such as oil, coal, and natural gas will remain important to national power as will nuclear power.[211] India meets about seventy percent of its demand for oil thorough importation. Its reserves were estimated at 4.7 billion barrels in 2001[212] and are projected to be 6.24 billion, on average, for 2000-2025.[213] While India is heavily dependent on other countries for oil, it has been working to develop oil found in the western part of the country in an effort to reduce that dependence and to help meet the rapidly rising demand for oil.

Coal provides sixty-five percent of total energy requirements in India.[214] India produced 327.79 million tons of coal in 2001-02,[215] and its proven coal reserves were 74.73 billion tons .[216]

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[211] Tellis, p. 89.

[212] "World Crude Oil and Natural Gas Resources," *International Energy Annual*, Energy Information Administration, May 2002.

[213] "Estimated World Oil Resources," International Energy Outlook, 2002, Energy Information Administration, p. 32.

[214] World of Information Business Intelligence Report: India, p. 32.

[215] "Production of Coal and Lignite," Economic Survey 2002-2003, Government of India, Ministry of Finance, from http://indiabudget.nic.in/es2002-03/chapt2003/tab122.pdf, downloaded April 14, 2004.

The Indian government predicts that it will need to import twenty-one million megatons of coal in 2003 in order to meet demand.[217]

In 2001, India produced .80 trillion cubic feet of dry natural gas,[218] and reserves were estimated at 22.8 trillion cubic feet.[219] Demand for natural gas has been increasing thus India has had to begin importing l32iquefied natural gas. The government has already made deals with Oman and Iran to help it meet demand. Iran especially could prove a volatile ally in procuring this resource. A discovery of a gas field in southern India, however, could yield a significant amount of natural gas if developed.[220]

There are approximately fourteen thermal nuclear reactors currently in operation in India and 2550 electrical reactors. India's total nuclear power generation is 17.8 terawatts.[221] It is clear at present that India is having trouble meeting its energy needs. Most of its energy generation capacity comes from coal and oil, and production in these areas has been somewhat stagnant over the last several years.[222] What is worse is that India's demand for energy is expected to more than double by 2020 at an annual growth rate of 3.8 percent per year.[223] India is already having trouble with blackouts, etc. in some areas of the country so the situation there stands to get much worse if improvements in the production, procurement, and distribution of energy resources are not made.

Pakistani oil reserves in 2001 were estimated at .2 billion barrels.[224] Production is estimated at 66,000 barrels per day . Most of Pakistan's oil needs are met through importation from Gulf states such as Kuwait, but there is great potential for a vibrant oil sector if potential reserves are explored and ultimately exploited. To date, Pakistan has only discovered fifteen percent of its total reserves, but the government is aggressively issuing exploration licenses in hopes of developing its potential. The fact remains, however, that the bulk of Pakistan's fuel needs come from a region that is historically volatile and therefore supply could potentially be

[216] World of Information Business Intelligence Report: India, p. 33.
[217] "India predicts limiting imports to 21 million mt in FY03," *Coal Week International*, i. 620, July 7, 2003, p. 4.
[218] Annual Energy Review 2002, Energy Information Agency, from
    http://www.eia.doe.gov/aer/pdf/pages/sec11_23.pdf, downloaded April 28, 2004.
[219] "World Crude Oil and Natural Gas Resources."
[220] World of Information Business Intelligence Report: India, p. 33.
[221] "Energy," from www.nationmaster.com/country/in/Energy, downloaded April 14, 2004.
[222] "Energy in India: An Overview," *CSIS South Asia Monitor*, no. 14, October 1, 1999, from
    www.csis.org/saprog/sam14.html, downloaded April 14, 2004.
[223] "Energy in India: An Overview."
[224] "World Crude Oil and Natural Gas Reserves."

interrupted. The problem with domestic development to this point has centered around political and economic uncertainties in the country.[225] Coal reserves are estimated at 186 billion tons. Currently, Pakistan meets less than twenty percent of its energy demand from coal[226] with production at 3.6 million tons annually,[227] but as it is one of the world's largest coal producers, it does not need to depend on foreign sources for this energy source which is a plus.

Pakistan has the same enormous potential for natural gas exploration and exploitation as it does for oil; however, it also has the same barriers to the potential use of this resource, and the fact remains that Pakistan is one of the most gas dependent nations in the world and relies on importation to meet its demands. Importation mainly comes from Gulf states. Pakistan produces 23.4 billion cubic meters of natural gas annually[228] and has reserves estimated at 21.6 trillion cubic feet.[229]   In the area of nuclear energy, Pakistan has two thermal nuclear reactors and approximately 425 electrical reactors. It produces 1.8 terawatts of electricity at its nuclear plants.[230]

Pakistan has not faced the severe outages and rolling blackouts as has India, but there are still many remote areas in the country without access to electricity generated by coal, nuclear, or some other means. Its staggering population growth and the resulting strains on critical infrastructures will continue to be a barrier to development for Pakistan on into the future.

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[225] Usmani, Faizan, "Opportunities in Oil and Gas Sector," *Economic Review*, v. 34, i. 2, February 2003, p. 40(2).
[226] Aslam, Syed A., " Coal Reserves in Pakistan," *Pakistan Gulf Economist*, February 23-29, 2004 from http://www.pakistaneconomist.com/pagesearch/Search-Engine2004/S.E63.asp, downloaded April 14, 2004.
[227] "Energy," from www.nationmaster.com/country/pk/Energy, downloaded April 14, 2004.
[228] Usmani, p. 40(2).
[229] "World Crude Oil and Natural Gas Reserves."
[230] "Energy."

Energy Stocks - India

Variables	Indicators	Score*
Oil	level of domestic production	2
	level of secured stockpiles	2
	sources for/security of foreign access to	1
Coal	level of domestic production	2
	level of secured stockpiles	2
	sources for/security of foreign access to	2
Natural gas	level of domestic production	2
	level of secured stockpiles	2
	sources for/security of foreign access to	2
Nuclear	level of domestic production	2
	level of secured stockpiles	0
	sources for/security of foreign access to	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Energy Stocks - Pakistan

Variables	Indicators	Score*
Oil	level of domestic production	2
	level of secured stockpiles	2
	sources for/security of foreign access to	1
Coal	level of domestic production	2
	level of secured stockpiles	2
	sources for/security of foreign access to	2
Natural gas	level of domestic production	2
	level of secured stockpiles	2
	sources for/security of foreign access to	2
Nuclear	level of domestic production	2
	level of secured stockpiles	0
	sources for/security of foreign access to	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Critical Minerals and Rare Metals

Tellis, et al. identify the following substances as critical minerals and rare metals: copper, titanium, vanadium, chromium, cobalt, aluminum, and columbium, as well as platinum group metals such as iridium palladium, platinum; gallium arsenide, graphite, carbon, and asbestos. All of these materials are essential to the creation of sophisticated machinery and high-tech information and communications technologies.[231]

India produced 328,000 metric tons of copper in 2001.[232] In addition, it produced 449 metric tons of titanium, 1,677,924 metric tons of chromium, 250 metric tons of cobalt, 624,000 tons of primary aluminum, 140,000 of graphite and 21,000 of asbestos.[233] As discussed earlier, India produced 327.29 million tons of carbon in the form of coal in 2001.[234] I could not find any information on the domestic production of vanadium, gallium, or germanium arsenide. It is clear however, that India is a very mineral rich state. The exploitation of its natural endowment in this area contributed two percent to the nation's GDP. In addition, minerals made up twenty percent of Indian exports in 2001 and foreign direct investment is heavy in this area.[235] I could find no specific numbers for stockpiles of these critical minerals and rare metals, but the fact that India is exporting many of them leads one to believe that it has plenty to cover its domestic needs. Thus, it can be further surmised that India would have a secure supply in a time of crisis.

It is extremely difficult to get a clear picture of Pakistan's strengths and weaknesses in the area of critical minerals and rare metals due primarily to a lack of data relative to what is required by the framework. Pakistan is not currently a large copper producing state, but recent discoveries show the potential for future copper production. The same can be said of Pakistan's production of titanium. In 2001, Pakistan produced 26,000 tons of chromium, 9000 tons of aluminum,[236] and 3.6 million tons of coal.[237] There was no information available on Pakistan's production of the platinum group metals, vanadium, cobalt, columbium, gallium arsenide, graphite, or asbestos. Furthermore, there was nothing to indicate what stockpiles, if any,

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[231] Tellis, pp. 89-90.
[232] "Nuclear Power in India," from www.dae.gov.in/power.htm, downloaded April 14, 2004.
[233] Kuo, Chin, "The Mineral Industry of India," Minerals Yearbook, 2001, U.S. Geological Survey, table 1.
[234] World of Information Business Intelligence Report: India, p. 33.
[235] Kuo, p. 11.1.
[236] Lyday, Travis Q., "The Mineral Industries of Afghanistan and Pakistan," from
        http://minerals.er.usgs.gov/minerals/pubs/country/2000/afpkmyb00.pdf, downloaded April 14, 2004.
[237] "Energy."

Pakistan has of these materials, nor whether the country might be exporting these materials, indicating whether there might be stockpiles or other sources for procuring these resources.

Critical Minerals and Rare Metals - India

Variables	Indicators	Score*
Level of domestic production	N/A	1
Level of secured stockpiles	N/A	.5
Sources for/security of foreign access	N/A	.5

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Critical Minerals and Rare Metals - Pakistan

Variables	Indicators	Score*
Level of domestic production	N/A	1
Level of secured stockpiles	N/A	0
Sources for/security of foreign access	N/A	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

NATIONAL PERFORMANCE

Measuring national performance, according to the Tellis framework, requires determining what factors may be working either for or against a country's pursuit of the goal of becoming an effective state. This means looking at those mechanisms that allow a state to produce and then convert those inputs outlined in the section on national resources into final goods. Final goods in the context of the framework come in the form of effective military capabilities. In order to determine whether a country has the capacity to convert resources into final goods, one must look at the external constraints that a country faces from the international system, the infrastructural capacity of its governing structures, and the ideational resources a country has at its disposal.[238]

External Constraints

The external pressures placed on a country can constrain its ability to acquire effective military capabilities. The constant shifts in power inherent in the international system will cause a country to attempt to increase its military capabilities to a level that is beyond that of its competitors.[239] In other words, states will not attempt to balance power, but rather, will try to escalate their own power to a level that is above other countries. Tellis, et al. argue that one can measure the concept of external pressure, at least in an estimative way, by looking at the nature of the external threats facing a country, the nature of a country's state interests, and the nature of its political aims.[240]

External Threats

Fear provides strong motivation for a country to increase its national power. The extent of a country's external threat, or fear, can be measured by assessing the number and size of its most immediate challengers or rivals, any transnational issues such as ideological or territorial disputes, the extent to which external groups are supporting or promoting challenges already present within the country, and the extent to which a country is participating in competitive arms racing.[241]

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[238] Tellis, p. 92.
[239] Tellis, p. 94.
[240] Tellis, p. 100.
[241] Tellis, p. 101.

Number and Size of Challengers and Transnational Issues

It is impossible to predict exactly where threats against India may come from in the future; however, there are two countries that present themselves as probable challengers when considering India's security environment. They are Pakistan and China. India has had conflicts with these two countries in the past and has unresolved issues with them at present. The border between China and India as well as a land agreement with Pakistan concerning the border of what India considers to be a part of Kashmir are the basis for the current dispute although the India's 1962 defeat at the hands of China has kept India wary of its neighbor to the northeast regardless of inroads being made on more current issues. In addition, several wars and skirmishes between India and Pakistan over the course of the last fifty years as well as the current armed standoff over the Jammu and Kashmir region and disputes over Indus River water put Pakistan as a forerunner on the list of direct challengers.[242] So we see a situation where India has one very large and well-equipped challenger in China and one challenger that is similarly situated to itself in the developing world in Pakistan. Both of India's major challengers are geographically close, well-armed, sizable nuclear powers with which India has both past and present disputes, thus making India's situation volatile.

Pakistan's most obvious direct challengers are India, Russia, and to a lesser extent, Afghanistan. Pakistan has impetus to consider India a threat for the same reasons outlined in the discussion on Pakistan as a threat to India. The long history of armed conflict, the nuclear status, the close proximity, and the enormous size of India's army make India Pakistan's chief rival.

While relations between the two nations are improving, Russia still presents a very real threat to Pakistan. The Soviet Union sided with India in the 1971 Indo-Pak war and therefore relations between Russia and Pakistan became strained. Tensions increased when the Pakistani government chose to support Afghan rebel forces against the Soviets in the 1980's,[243] and the close relationship between Russia and India has made the Pakistani government untrusting of the Russian government.

The nature of the Pakistani conflict with Afghanistan can be traced to the division of the Pashtuns along the border between the two countries and followed to the present uneasiness over

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[242] "World Factbook, 2002 - India."

[243] "Foreign Relations of Pakistan," Wikipedia, from http://en.wikipedia.org/wiki/Foreign_relations_of_Pakistan, downloaded February 23, 2004.

the ultimate outcome of the displacement of the Taliban with a new government. Afghanistan, however, does not pose a great a threat to Pakistan as either India or Russia do.

Pakistan's transnational issues, not surprisingly, coincide largely with those of India. The armed standoff between India and Pakistan over the Kashmir region as well as India's objections to the cessation of land to China which India believes to be part of Kashmir, and disputes over Indus River water can be considered transnational issues for Pakistan just as they can be for India.[244]

External-Internal Nexus

The external-internal nexus in India is, as one would imagine, linked to its direct challengers. Ethnic, caste, and religious differences within India have been exploited by outside entities who arm the estranged groups thus encouraging and enabling low intensity conflicts.[245] In addition, widespread corruption, organized crime, and drug trafficking have created weak spots within India that area easily exploited by interested parties. Government corruption allows organized crime and drug trafficking to occur, and the money made from drug trafficking, in turn, finances foreign sponsored low intensity conflicts.

Perhaps the most striking examples of external groups allegedly supporting insurgents within India come with an examination of the disputed Kashmir region. India has long insisted that Islamabad has pursued a policy of supplying militant Islamist insurgents with funds and weapons. There are approximately five major insurgent groups operating in Kashmir with Pakistani support. This support comes in the form of training, financing, political and ideological support, and military aid.[246] One high profile arrest that has come about as a result of allegations of the support of insurgents by Pakistan was of a senior Pakistani diplomat in New Delhi named Zaleed Abbas Geelani in February of 2003.[247]

Pakistani support for insurgents causes a great degree of instability in India. In some instances, this affects India's standing in the international community. For example, when India mobilizes troops in response to events in Kashmir, it can be seen as an escalation in the broader

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[244] "World Factbook, 2002 – Pakistan", Central Intelligence Agency, from www.cia.gov/cia/publications/factbook/geos/pk.html, downloaded April 14, 2004.

[245] Subrahmanyam, K., "Self-Reliant Defence and Indian Industry," *Strategic Analysis: A Monthly Journal of the ISDA*, v. xxiv, no. 7, October 2000.

[246] Chalk, Peter, "Pakistan's Role in the Kashmir Insurgency," Jane's Intelligence Review, September 1, 2001, from www.rand.org/hot/op-eds/090101JIR.html, downloaded April 14, 2004.

[247] "India accuses Pakistan of financing subversive activities in Kashmir," *The Canadian Press*, February 7, 2003.

conflict between India and Pakistan and therefore cuts India's stock as a nation that is trying to progress and become a true superpower.

One does not find the same type of claims by the Pakistani government that there are Indian groups operating within its borders attempting to exacerbate the situation in Kashmir that one finds emanating from the Indian Government. The most pressing problem for Pakistan in this area appears to be terrorist organizations operating along the Afghan-Pakistani border. These cells not only attack Pakistanis, but the mere existence of these groups serves to somewhat undermine Pakistan's standing in the international community as it then appears that the government cannot even manage its own borders. Most of the disruption and undermining of government in Pakistan, it appears, comes from within the country and from Pakistanis themselves.

Competitive Arms Racing

Practically since the very moment that India "formally announced" its nuclear program in 1998 by conducting a series of five nuclear test, it has been engaged in competitive arms racing with Pakistan. In recent months, India has made efforts to better marry its nuclear capabilities with effective delivery methods and is in the process of constructing the command structure necessary to for nuclear deployment.[248] In addition, India has been busily buying the needed hardware to help it to that end from Israel.[249]

As the counterpart in the above paragraph, we must also say that Pakistan is engaged in competitive arms racing with India. Pakistan, too, held nuclear tests in 1998, making tensions between the two countries palpable in the international community. Pakistan has openly chastised India for pursuing a conventional and non-conventional arms build-up that could ultimately further destabilize an already volatile region. Ironically, the Pakistani government has deemed it necessary to purchase items "necessary for the armed forces in order to keep strategic balance in the region," but does not see this as engaging in competitive arms racing.[250] India's overwhelming advantage has caused Pakistan to more frantically balance power. In other words, small changes in India's posture seem large to Pakistan because it is at such a relative disadvantage and therefore Pakistan feels that it needs to counter every move from India whether

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[248] Bidwai, Praful, " Politics: India moves closer to nuclear deployment," *Inter Press Service*, September 2, 2003.
[249] "Musharraf says India triggering South Asia arms race," *Agence France Presse*, September 24, 2003.
[250] "Pakistan not to indulge in arms race," *Pakistan Press International*, September 4, 2003.

large in actuality or large only in perception.[251] It seems that in their efforts to create credible nuclear deterrence, India and Pakistan are creating an unstable environment considered by some to be one of the most volatile in the international community.

External Threats - India

Variables	Indicators	Score*
Number and size of challengers and transnational issues	N/A	2
External-internal nexus	N/A	2
Competitive Arms Racing	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

External Threats - Pakistan

Variables	Indicators	Score*
Number and size of challengers and transnational issues	N/A	2
External-internal nexus	N/A	2
Competitive arms racing	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Nature of State Interests

In addition to assessing the nature of the external threats facing a country, it is also necessary to examine the nature of state interests to round out an analysis of a country's external constraints. To accomplish this, one must look at the extent of a country's defensive perimeter, the extent of its strategic natural resources, the extent of the commitment to its "national diaspora," [252] as well as the economic dependence on that diaspora.

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[251] Rajagolpalan, Rajesh, "Neorealist Theory and the India-Pakistan Conflict – II," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxii, no. 10.
[252] Tellis, p.101.

Defensive Perimeter

An examination of a country's defensive perimeter reveals both its geopolitical value as well as the areas that it must actively defend.[253] India's land mass shares borders with seven other countries. They are Pakistan, China, Bangladesh, Myanmar, Nepal, Bhutan, and Afghanistan. Its longest border is with Bangladesh, but its most volatile is with Pakistan. The total length of its defensive perimeter is 15,851 km. In addition, India has over 7600 km in coastline and two island neighbors on either side of the peninsular portion of the country. India's geographic closeness to Afghanistan has made it geopolitically integral in the U.S. war on terrorism, but its closeness to both China and Pakistan has often led to turmoil.

Pakistan's land mass shares borders with Afghanistan, China, India, and Iran. Its longest and most volatile border is with India. The total length of its defensive perimeter is 6774 km and it has 1046 km of coastline. Pakistan has become integral in the U.S. led war on terrorism for the same reasons as India, but it has the additional dubious distinction of being a place of refuge for those terrorists fleeing Afghanistan because of military operations there. The eye of the international community is therefore focused on the Pakistani government and would like to see it crack down on those individuals associated with terrorist groups that it finds within its borders.

Strategic Natural Resources

The fact that India is geographically located so as to allow for great access to sea-borne trade and other benefits of maritime life also contributes to India's already complicated security environment. Much of India's maritime activity is dependent on the North Arabian Sea for success. India imports the majority of its oil needs, a resource critical to India's daily operation, from the Persian Gulf region via the North Arabian Sea. The fact that the region is home to five nuclear states as well as the fact that there is a presence of nuclear fleets in these waters gives India some unique and pressing security concerns related to natural resource procurement.[254]

The above speaks to India's security vis-à-vis its external dependence on a strategic natural resource, however, it is also important to point out that a possible area for conflict to arise may be associated with an internal strategic natural resource: water. Controlling access to water is vital to national security and yet India finds itself in the position of being dependent on shared water sources, namely the Ganges and Indus rivers. India has been forced to negotiate waters

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[253] Ibid.
[254] "Salient features of national security environment," Ministry of Defence, Government of India, from
http://mod.nic.in/aforces/body.htm, downloaded April 14, 2004.

treaties with both Bangladesh and Pakistan. As we know that India has had a less than friendly relationship with Pakistan to this point, and it is of note that they are dependent upon one another for the security of their shared water supply.

Pakistan is in a similar position to India concerning its dependence on the importation of strategic natural resources. Pakistan also imports much of its energy needs from volatile Gulf States and, as mentioned above, is a party to a water treaty with India. Pakistan also has large natural gas reserves which, depending on their location, might be strategically attractive to a country such as China or India when placing claims on territory that is already disputed.

Diaspora

The Indian diaspora is a vast one. As mentioned in the earlier discussion on education, many Indians choose to go abroad for their higher education needs and then go on to live in those countries in which they have studied. In addition, other more developed countries place a high value on Indian trained technology workers. These countries therefore attempt to attract Indians from their native country and have had a great measure of success. Many Indians find themselves in the U.S. or Australia, but the Indian government will likely need to assess the security situation regarding those Indians who have temporary work permits in the Gulf countries[255] as that region has proven problematic for Indians living there in the past. During the first Gulf War, over 100,000 Indians had to be evacuated from Iraq. In addition, already tense relations between India and Pakistan stand to be further strained with the increasing persecution of Indian ethnic minorities living in Pakistan. One further example of how the diaspora may contribute to tensions comes in the form of a coup in Fiji where the Indian minority living there was directly targeted. This type of incident, if it becomes more widespread with the increase in the number of Indians living abroad, could give the armed forces cause to intervene in situations in ways not previously considered.[256]

As far as economic dependence on its diaspora is concerned, the so-called brain drain points to the fact that Indians living abroad are more a detriment to the economy than a benefit. Indians living abroad do not seem to be contributing to or investing in their homeland in any significant way.

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[255] Kanwal, Gurmeet, "India's National Security Strategy in a Nuclear Environment," Strategic Analysis: A Monthly Journal of the IDSA, v. xxiv, no. 9, December 2000.
[256] Kanwal.

There are over four million Pakistanis living abroad,[257] most of them in the Middle East. This presents the same problem concerning instability in that region and potential dangers for Pakistanis living there as was presented with India. In the post 911 environment, many Pakistanis living abroad have begun to think it prudent to send some of their savings back home through legitimate channels. As a result, the Pakistani government has seen a dramatic increase in dollars coming from its diaspora.[258] In addition, the government is aggressively seeking the assistance of Pakistanis living abroad in the form of financial and volunteer support for development projects in some of the poorest areas of the country. The Pakistani diaspora can be said to be both large and essential to the overall Pakistani economy.

Nature of State Interests - India

Variables	Indicators	Score*
Defensive perimeter	area state must actively defend	2
Strategic natural resources	any resource that another state may covet	2
Diaspora	potential danger to this group abroad	2
	economic dependence	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Nature of State Interests - Pakistan

Variables	Indicators	Score*
Defensive perimeter	area state must actively defend	2
Strategic natural resources	any resource that another state may covet	2
Diaspora	potential danger to this group abroad	2
	economic dependence	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[257] "The Pakistani Diaspora," The Global Council of Pakistan from www.gcpak.org/Base/index.cfm, downloaded February 25, 2004.

[258] Bhagat, Rasheeda, "Feel-good in Pakistan , too," *The Hindu*, February 23, 2004.

Nature of Political Interests

The final area of observation necessary to the evaluation of a country's external constraints is the nature of its political aims. One must discern whether a country is pursuing policies with the aim of changing the current international order by way of force, recovering "irredentist claims," or spreading its own brand of ideology.[259]

Pursuit of Radical Change

While it is clear that India has unresolved issues with some of its neighbors, it is generally not considered to be an international maverick. One could construe the shocking nuclear tests in 1998 as a somewhat radical move, and one could also construe the current conflict in the Kashmir region to be a use of force with the aim of changing the international order. In reality, India is using force in the Kashmir situation in an effort to restore the international order and has been open to talks with the aim of normalizing its relationship with Pakistan. Furthermore, after the initial shock in 1998, India has managed to legitimize its nuclear program with some in the international community, namely the U.S. Security concerns remain high in the region, but the disputes are considered to have a degree of legitimacy and thus not considered radical.

On the other hand, Pakistan has not had as much luck gaining legitimacy in the eyes of the international community. The environment has certainly improved given Pakistan's cooperation and new found strategic importance in the post 911 situation, but the fact that the country is ruled by a military leader who took control in a coup, and that there are questions surrounding whether or not the Pakistani army retains sympathy for the Taliban and is committed to fighting terrorism, coupled with questions surrounding Pakistan's role in global nuclear proliferation, and allegations that the government continues to support insurgents in India thus exacerbating the already problematic Kashmir conflict and most likely causing it to last longer that it would without that additional strain all lend to the perception of Pakistan as somewhat untrustworthy.

Pursuit of Irredentist Goals

The term irredentist is defined as "one who advocates the recovery of territory culturally or historically related to one's nation, but now subject to a foreign government."[260] This

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[259] Tellis, p. 102.
[260] Definition from www.dictionary.com

definition makes the task of determining whether a country is pursuing irredentist goals a tricky one when discussing India and Pakistan specifically. The main conflict between the two countries centers over the Kashmir region. Kashmir was acceded to India following the partition and subsequent independence of India and Pakistan in 1947. Pakistanis believe that the majority Muslim region bears more in common with Pakistan than it does with India and has, as mentioned before, been involved in several wars with India over the area. There has been, over the course of the decades long dispute, established a line of control in the region. We can therefore say that both countries are pursuing irredentist goals. India believes that any part of the territory, including that on the "Pakistani" side of the LOC is part of its territory that is not subject to a foreign government. Pakistan on the other hand, feels that the Kashmir region belongs to Pakistan, and many in the country believe that, if given the choice, Kashmiris would prefer to be part of Pakistan and is therefore willing to fight to the end to see that this territory, one which it sees as culturally and historically related to Pakistan, will again be part of that nation. This is also considered an irredentist goal. So we see a situation where two countries are pursuing irredentist goals. It is broadly recognized in the international (non-Muslim) community, however, that India has the more legitimate claim on the territory.

Spread of Ideology

India is considered to be the world's largest democracy and is majority Hindu. It is a secular nation with some major obstacles that it must overcome in order to secure its place as a major player on the international scene. It has not, however, attempted to accomplish its goals through the spread of any particular political or religious ideology, unless one counts its commitment to democracy. Even so, the Indian government is not attempting to bring democracy to any unwilling states or trying to alter the ideology of any nation through the spread of its own brand of ideology.

The same can largely be said of Pakistan. The country is an Islamic republic considered to be a democracy at least on the surface, although questionable constitutional wrangling by Musharraf in the recent past has led some to question the legitimacy of that democracy. Its latest face is more of a hybrid system where the country is governed by civilians but ultimately overseen by the military. It is also not seen as a country that is attempting to export its brand of democracy or its religion or other ideology to other countries through the use of force.

Assessing the external constraints helps to develop a picture of a state's incentives to mobilize its military. The nature of India and Pakistan's individual external threats appears to be the most pressing external constraint faced by these countries as they develop their national security strategy and as they attempt to move past their current difficulties toward major power status. The pursuit of irredentist goals seems to be more of an issue in the eyes of the international community for Pakistan rather than for India, but both of the above issues could cause either or both countries to mobilize their armies.

Nature of Political Interests - India

Variables	Indicators	Score*
Pursuit of radical change	N/A	2
Pursuit of irredentist goals	N/A	2
Spread of ideology	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Nature of Political Interests - Pakistan

Variables	Indicators	Score*
Pursuit of radical change	N/A	2
Pursuit of irredentist goals	N/A	2
Spread of ideology	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Infrastructural Capacity

In addition to examining the external constraints facing a country in order to measure its national performance, one must also assess a state's infrastructural capacity. This is an assessment of whether or not a country has the political capacity to extract the wealth that it needs from society in pursuit of its external goals.[261] An inability to do this puts a state in a

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[261] Tellis, p. 103.

position of having unrealized power. An analysis of whether a state can extract wealth must include knowledge of the distribution of power between the state and society.[262] In doing this, however, one must realize that this relationship is not a static one and that state power may vary widely from one policy area to another. It is for this reason that Tellis, et al. suggest that concentration should remain on whether or not a state is "minimally effective" in the area of national security as that is the key area of concern to the framework in that it relates specifically to military power.[263] Infrastructural capacity will therefore need to be examined on two levels: self-control, or the capacity of a state to set goals, and social control, or the capacity of a state to attain those goals that it sets.

Self-Control

A country's level of self-control can be determined by looking at the extent of elite cohesion and the relative power of societal groups within that country.

Elite Cohesion

The extent of elite cohesion is indicated by the coherence of ideology between leaders and societal elites, the political, social, and economic links between leaders and elites, and the overall robstness of governing institutions.[264] The rhetoric issued from the political elites in India appears not to be based in reality. Rhetoric from Nehru down to that coming from the current Bharatiya Janata Party (BJP) is one of great vision for India. This rhetoric attempts to portray India as a nation with vast resources, a large population, and burgeoning status as a world player when in reality India, while it does have a huge population, is still a relatively poor country that has numerous cross cutting cleavages as well as severe economic and energy problems.[265] Furthermore, the leader of the BJP, Vajpayee, is head of a fragile government coalition.

One area where the many problems faced by India and its government becomes glaringly obvious is in India's attempts at privatization of its state-owned companies. This is a feat well documented by domestic as well as foreign media, as meeting the conditions for privatization are necessary for securing further economic aid from the international community. From almost the moment that the BJP was voted into power, the government has been working towards

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[262] Tellis, p. 106.
[263] Tellis, p. 107.
[264] Tellis, p. 109.
[265] Malhotra, Paren, "Bytes, Bombs, and Bombshells," *Harvard International Review*, v. 23, i. 3, Fall 2001, p. 32.

privatization in sectors ranging from industry to agriculture, but has had difficulty delivering on its pledges. It appears that the problem, however is not one of a lack of commitment on the part of Mr. Vajpayee, but rather, a difficulty in convincing others in government as well as the general public that this is a necessary step in India's economic recovery.[266] Much of the resistance comes from within government. There is little cohesion between Vajpayee and his Ministers. The Ministers do not want to sell companies that they control. In fact, the Ministers can be said to act like feudal lords, reigning power over the people and property under the purview of their Ministries. Others in the "rank and file" of government see privatization as a threat to their jobs and the general public is suspicious that the organizations will be sold to foreign interests.[267] So in this one example of the state's attempt at privatization, we see where not only is there dissent between leaders and other political elites, but there is also a disconnect between leaders and the general public that they serve. Additionally, this example illustrates a discrepancy between the rhetoric issued by the state and what ideas the state has actually been capable of delivering on. On the other hand, one must recognize that Vajpayee has managed to hold together a fragile coalition of many smaller political parties and continues to be able to function at least on a basic level. Some would say that the reason for this, however, is simply that there is no viable alternative to Vajpayee at this time and therefore he shall remain the head of the BJP-led coalition government by default.[268]

We see that India has conflicting political linkages between its leaders and other elites as the coalition government is dependent on meeting regional and state party interests for its survival. The disparate nature of these coalition parties also means that there are a number of social differences among influential Indians. Political power in the states has moved into the hands of the lower caste groups.[269] This has caused some frustration in that this is not necessarily true at the national level, therefore the power and status associated with political office has not necessarily translated into economic gains.

As far as the robustness of governing institutions is concerned, it appears that India, to some degree, is seeing a shift in the locus of power rather than an overall decline. The move

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[266] Donald, Angus, "Process remains high on rhetoric, low on action: privatization," *The Financial Times*, November 6, 2000, p. 3.

[267] Donald, p. 3.

[268] Rudolph, Lloyd I., and Susanne H., "New Dimensions of Indian Democracy," Journal of Democracy, v. 13, no.1, January 2002, p. 57.

[269] Rudolph, p. 103

from one party dominance to coalition government has caused the decline of the Ministers, cabinets, and legislatures, but the central government still manages to function. Power has shifted somewhat to the regulatory institutions such as the Supreme Court, the presidency, and the Election Commission.[270] Furthermore, the traditional "interventionist" institutions such as national prime ministers and legislators have become less relevant due to numerous scandals over the last decade. The public does not feel that it can fully trust leaders and political elites with their money, etc.[271]

There is a decided lack of elite cohesion in Pakistan. While Pervez Musharraf attempts to portray Pakistan as a nation on its way to becoming more prosperous and tolerant, the reality is that Pakistan is a nation wrought with problems. There are tensions between those in Pakistani society, namely the religious elites, who still support the same brand of Islamic extremism that brought us the Taliban and those in government who have abandoned that type of extremism in favor of more moderate views. Those on the religious right have become increasingly assertive and have formed a coalition opposition party to Musharraf's government. This organization called the Muttahida Majlis-e-Amal Pakistan (MMA), made a strong showing in the 2002 national elections. Some argue that the emergence of this contingent is due to the fact that Musharraf banned outright his two more mainstream political rivals, the Pakistan Muslim League and the Pakistan People's Party, thus paving the way for the void to be filled by party extremists.[272] So we see in Pakistan a situation where the country is run by the military and the opposition is run by the clerics. This creates weak political and social linkages as well as differing ideological goals between government leaders and elites, in this case, religious elites.

Furthermore, Pakistan's governing institutions are weak. Years of military rule coupled with a hostile security environment have caused the military in Pakistan to become the most powerful, stable, and cohesive governing institution. The tumultuous nature of constant change between weak and ineffective civilian rule and military rule has meant that virtually nothing but the military has become institutionalized in Pakistan. Because nothing is institutionalized, nothing endures.[273] What few democratic institutions there are remain weak due to the fact that the politicians in Pakistan kowtow to the military leaders so that they will be allowed to remain

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[270] Rudolph, p. 60.
[271] Rudolph, p. 61.
[272] Kennedy, Miranda, "Campus Takeover: Pakistan's Fundamentalists are on the Rise – Even at its Top University," *The Boston Globe*, October 5, 2003.
[273] Vatikiotis, Michael, "Dictating Democracy," *Far Eastern Economic Review*, December 20, 2001.

in power and manipulate democratic institutions such as the constitution and thus perpetuate their own position in leadership. There is no real democratic culture in Pakistan because after independence, the government was highly centralized in nature and remains so today.[274] The cycle of corrupt civilian rule followed by military take-over has left a public weary of internal conflict and oblivious to the ways of a true democracy. As long as the structure of government remains such that it is dominated by the military and electoral democracy amounts to mere tokenism, the people of Pakistan will continue to be disengaged and the weak governing institutions will continue to be so.

Relative Power of Societal Groups

To assess the relative power of societal groups, one must attain a feel for the structural cleavages faced by a country, the relative power of state supporters versus others, and the potential for mobilizing latent groups.[275] Cleavages are troublesome to a government attempting to realize self-control in that a lack of cohesion may cause the government to divert resources to internal security from national security, lose legitimacy, and be unable to project power externally.[276]

India has class, religious, linguistic, regional, and ethnic fissures, some being more pronounced than others, but all affecting the "Indian State." Additionally, because India is so heterogeneous and because there is an abundance of identities to which one might lay claim in under any given circumstance, there is a certain fluidity of identity among Indians that further complicates the picture of the potential ramifications of these cleavages.

For the most part, class in India is linked to caste. Lower classes are also lower castes, and higher classes are generally higher castes, with the exception of the ex-untouchables who are outside of the caste system altogether. As in most class-based systems, there is a tendency toward exploitation of the lower classes/castes by the higher classes/castes. The nature of the caste system can both help and hurt mobilization in the class struggle. Lower classes will often unite and mobilize politically for a common cause, but sometimes caste will divide the lower classes. For example, some lower caste workers might refuse to unite with ex-untouchable

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[274] Patanaik, Smruti, "Governing a 'Security State,'" *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxv, no. 3, June 2001.
[275] Tellis, p. 109.
[276] Tellis, p. 111.

workers in a wage strike situation because of their respective statuses.[277] For the state, the mobilization of the lower classes, when it is not impeded by caste division, has had dramatic consequences. These lower classes represent a large and often powerful electorate. Free and fair elections in India have, over time, brought power (at least at the state level) into the hands of lower class/caste individuals.[278] The fact remains, however, that the status gained in certain circumstances by the lower classes/castes has not always translated into economic gains and is therefore a source of frustration. The higher classes/castes still enjoy both status and wealth which continues to be a point of contention between the various levels of society.

Religious differences in India also contribute to social cleavages. About eighty-one percent of the country is Hindu, twelve percent is Muslim, about two percent is Christian, and about two percent are considered Sikh.[279] Despite the fact that secularism is explicitly outlined in India's constitution, Muslims and Christians face widespread discrimination and targeted violence in India, partly as a result of state rhetoric. The government, in an attempt to find a common thread in India's extremely heterogeneous population, has clung to nationalism as a platform. Nationalism in the eyes of the Indian state means Hindu Nationalism. The state naturally wants to survive in its current form and therefore has often catered to the Hindu majority simply because it is the majority. The fact that coalition in government is now the rule of the day, however, makes secularism and religious tolerance crucial to the function of the state.

Less divisive socially and politically, but still notable, are the linguistic differences in India. Hindi is the national language and is spoken by thirty percent of the population. English is the most important language in terms of national, political, and commercial dialogue, but there are fourteen other official languages in India. One other unofficial language, Hindustani, is used widely in northern India.[280] The multitude of languages spoken in India carries with it all of the problems that it does in other countries, however, the high rate of illiteracy and the relatively low level of educational attainment in India exacerbates these difficulties. Broad based national communication is challenging and political leaders may have difficulty promoting their platforms in areas where tribal languages dominate.

[277] Das, R.J., "The Social and Spatial Character of the Indian State," *Political Geography*, v. 17, no.7, p. 794.
[278] Rudolph, p. 63.
[279] "World Factbook, 2002 – India."
[280] "World Factbook, 2002 – India."

In addition, there are regional divisions within India. The most striking of these in the Kashmir region, but there are also regional "counter-elites" that have grown in power in the Punjab and Assam regions.[281] These regional differences, when coupled with the others, contribute to the already difficult task of governing, making it even more difficult.

Finally, we see ethnic differences in India. There are two major ethnic groups in India as defined by the CIA. They are Indo-Aryan, which seventy-two percent of the population can be said to be, and Dravidian, which twenty-five percent can be said to be. The other three percent is considered "mongoloid and other."[282] Ethnicity, however, is a difficult concept in India. Ethnic identity does not necessarily translate into ethnic nationalism. So complicated is the term as applied to India that one researcher devoted an entire study to it. James Manor, in his piece entitled "Ethnicity and Politics in India" has outlined five different ethnic groups in India related to various "identities." There are identities grounded in religion, identities grounded in language, tribal identities, regional identities, and the more traditional Aryan and Dravidian identities.[283] He argues that ethnic identities can run counter to other cleavages. So we see that ethnicity in India can be related to other social cleavages already present. Without a firm definition outlined in the framework, ethnicity in the context of this composition will be considered to be more of an overarching category that organizes the other cleavages mentioned.

We see that India has many societal divisions. These divisions pose great challenges to already tenuous relationships between parties in the coalition government currently in place. According to the Tellis analysis, this does not bode well for the Indian state's ability to set goals and achieve them. The many obstacles created by a lack of cohesion have already derailed a government initiative toward economic reforms and will likely continue to exacerbate problems within the leadership and elite circles in India. Furthermore, these cleavages do not allow India to project stability and national power beyond its borders as well as it would like to.

These divisions, coupled with the many corruption scandals that have plagued the Indian government, make the power of state supporters versus others who may not support the government difficult to ascertain. Coalition-style government does not give a clear mandate to the "state" per se, and corruption has caused many Indians to become disillusioned with their

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[281] Ahmad, Ahrar, "The State, Participation, and Constitutionalism: Political Crises and Democracy in India," Asian Affairs, p. 123.
[282] "World Factbook, 2002 – India."
[283] Monor, James, "Ethnicity and Politics in India," *International Affairs*, v. 72, i. 3, July 1996, pp. 461-462.

government. For example, forty-six percent of respondents to a poll regarding politicians in India said that they think politicians in India are dishonest.[284] The BJP has support now, but it is anyone's guess what the government will look like after the 2004 national elections.

The state's ability to mobilize latent groups is also called into question because of the many competing interests within India. One trend, however, has been the mobilization of India's lower castes and minorities. Efforts by the state to educate voters and to promote turnout have had a major effect on the enfranchisement of India's lower classes. These classes have an acute understanding of the power of the ballot box. What is unclear is whether the government will be able to capitalize on this trend or whether the lower classes will demand a change from the current government to one that more closely represents its interests.

India's overall self-control, as defined by the framework, is lacking. A dearth of elite cohesion and the competition among social and political groups for state attention puts the state in a position where it must indeed divert resources from important external national needs to pressing internal needs including resolving class and regional conflict issues and unifying the diverse populous.

Pakistan is less of a nation in the traditional sense and is more of a state without those aspects of nation that lend to societal cohesiveness. Perhaps the only unifying factor remains the state's animosity toward India. There are ethnic, religious, political, regional, linguistic, tribal, and class cleavages throughout Pakistan, some emerging from the partition of the subcontinent in 1947, some that have arisen for other reasons since then. Ethnic groups such as the Baloch and Sindhi have been marginalized throughout history and have a sense of nationalism, not toward Pakistan, but within themselves as separate entities.[285] Furthermore, the dominance of the Punjabis has lead to resentment from other, smaller ethnic groups.

Perhaps the most enduring, deepest, and ultimately most dangerous cleavage in Pakistan is the religious one. While ninety-seven percent of the population is Muslim, there is a divide between the seventy-seven percent Sunni Muslim population and the twenty percent Shi'a Muslim population. Christians, Hindus, and other smaller religious groups make up the remaining three percent.[286] So while Islam unites Pakistan to a certain extent, Islamisation causes rifts. The historical divide between these two sects of Islam that have created tensions in

[284] Ahmad, p. 124.
[285] Khan, Adeel, "Pakistan's Sindhi Ethnic Nationalism," *Asian Survey*, v. 42, i. 2, March-April 2002, p. 213(17).
[286] "World Factbook, 2002 – Pakistan."

other countries such as Iraq are the same as those found in Pakistan. The other religious groups are largely left alone and do not attempt to disturb the Islamic nature of the state of Pakistan.

The political cleavages are due in large part to the religious cleavages. Political parties based on Islamic (sometimes extremist) principles are beginning to dominate the political landscape to the extent that they are allowed by the military style government to operate. This creates tension due to the differing domestic and international agendas that each side wishes to pursue, one a reformist, the other a fundamentalist.

Regional divide in Pakistan can be linked to ethnic divide. The Punjab region so dominates other regions from an economic, a political, a demographic, and a linguistic perspective, that some of the smaller regions resent the status and concomitant influence that the Punjab region enjoys. [287]

There are no fewer than ten languages spoken in Pakistan. Urdu is the national language but is spoken by just eight percent of the population. Forty-eight percent of the population speaks Punjabi, twelve percent Sindhi, ten percent Siraiki, eight percent Pashtu, three percent Balochi, two percent Hindko, one percent Brahwi, and just under eight percent speaks English .[288] These linguistic differences further exacerbate regional and ethnic divisions.

Class cleavage stems from the fact that the political or ruling class, because it is essentially the military itself, comes from the wealthy landed class.[289] Pakistan's poor, who constitute most of the population, are largely left out of the political process. This creates a sense of apathy and furthers the general lack of societal cohesiveness necessary to national survival.

Tribal cleavages, while not as pronounced as they once were, also exist in Pakistan. Those regional tribal leaders in the more remote regions of the country are largely left to their own devices and often institute tribal policies that differ in direction and general goal from the broader national agenda. These cleavages have become somewhat more visible recently as the U.S.-led war on terrorism has required the Pakistani government to exert more control in those areas as forces conduct searches for terrorists, etc.

The above-outlined cleavages coupled with the military style government that decapitates political parties by exiling their leaders, and the weaknesses of political leaders and democratic

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[287] Aiyar, Mani Shankar, "Pakistan's Internal Dynamics," *Frontline*, v. 20, i. 10, May 10-23, 2003.
[288] "World Factbook, 2002 – Pakistan."
[289] Aiyar.

institutions in Pakistan all make for a disillusioned electorate. State support is weak overall, but those who generally support the state in Pakistan tend to be wealthier, landed citizens who have more power than poorer individuals. Those who do not support the state are generally poor disenfranchised citizens without the power or the impetus to attempt to make changes in the current system of government. As mentioned before, however, the tide is beginning to change somewhat in that the religious right has made a strong showing in recent elections. This contingent is a relatively well-organized if not necessarily cohesive group with a fair amount of power.

It appears that Musharraf is adept at using what is often referred to as the "state machinery" to mobilize various groups during times crucial to his political agenda. For example, the machinery was used to bring crowds to rallies designed to garner support for the April 2002 referendum that extended the Musharraf presidency by five years and formalized the military's role in government. This is not necessarily an example of the government's ability to mobilize latent groups per se, but it does show that the government has the power to mobilize voters when necessary. What we also know is that Musharraf uses the powers of the constitution to squelch opposition parties, thus making the act of voting less meaningful than it might be in a more open democratic system.

Like in India, self-control in Pakistan is mostly lacking when set against the framework. We see a lack of cohesion between societal and political elites, we see weak political institutions, a society with many cross cutting cleavages, and an apathetic electorate that is willing to give power over without much ado. What is interesting about this situation in Pakistan, however, is that the fact that those in political positions are dependent on those in the military (those ultimately in power) for their job security, and additionally, we see a constitution that allows for broad power in the area of detention of political opponents on the part of the president and a constituency that is apathetic toward those in power. These three factors, however, allow for a large amount of government control over political events and thus an enhanced ability to set goals. What is problematic in this situation is that the power is not gained in an open forum, but rather through somewhat oppressive means.

Self-Control - India

Variables	Indicators	Score*
Elite cohesion	coherence of ideology	2
	social, political, and economic links between leaders and elites	2
	robustness of political institutions	2
Relative power of societal groups	structural cleavages	2
	relative power of state supporters versus others	1
	potential for mobilizing latent groups	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Self-Control - Pakistan

Variables	Indicators	Score*
Elite cohesion	coherence of ideology	1
	social, political, and economic links between leaders and elites	2
	robustness of political institutions	2
Relative power of societal groups	structural cleavages	2
	relative power of state supporters versus others	1
	potential for mobilizing latent groups	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Social Control

The second component of a state's infrastructural capacity set forth in the Tellis framework is social control. Social Control refers to a state's ability to fulfill the goals that it sets. The power that allows for strong social control comes from penetration, extraction, and the regulation of social relations.

Penetration

Penetration refers to the state's ability to assert power throughout society in a nonrepressive way. Efficient mobilization of state resources depends greatly upon societal cooperation. Legitimacy translates into authority given to the state by the people.[290] Penetration is a good measure of social control because it shows the degree to which the people accept the

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[290] Tellis, pp. 113-114.

state's authority.[291] In order to assess penetration, one must learn the ratio of direct taxes (the more difficult for a government to collect because they are domestic and affect the people directly), and indirect taxes on international trade (the easier of the two because they are not levied against the state's own population). In addition, one must learn the ratio of non-tax government revenues to direct taxes.[292]

According to India's Ministry of Finance, direct tax revenues were 91585 Rs. crore and indirect tax revenues were 142652 Rs. crore in 2003-03,[293] making indirect tax collection roughly 1.5 times that of direct tax collection. The total for non-tax revenues for India in 2002-03 was 60764.95 Rs crore. That includes 41660.01 Rs crore in interest receipts from states and union territories, as well as dividends and profits.[294] This makes the ratio of non-tax revenue to direct taxes 1:1.5.

So we see a case where government revenues are dependent upon tax revenues and that at least some of the people of India see the state as at least legitimate enough to pay their domestic direct taxes. What this does not reveal is the number of people in India that do not pay the taxes that they owe. This would perhaps be a better measure of state legitimacy and is addressed to some extent in the next section.

Direct taxes in Pakistan in 2002-03 were estimated by the Ministry of Finance to be 14840 Rs crore. Indirect taxes were 31220 Rs crore. Indirect taxes, therefore, were collected at a rate 2.1 times greater than direct taxes. Non-tax revenue was at 15379.3 Rs crore in 2002-03, making the ratio of non-tax revenues to direct taxes 1:.96.[295] In Pakistan, it appears that the government is much more willing to and capable of collecting tax revenues from indirect sources than from its own population, a sign of weakness in the framework.

Extraction

Another element of social control is extraction. The Tellis framework suggests that one should determine the actual tax revenue versus the taxable capacity of a country, compared

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[291] Tellis, p. 115.
[292] Tellis, p. 117.
[293] "Budgetary Developments in 2002-03," <u>Economic Survey 2002-2003</u>, Government of India, Ministry of Finance, from http://indibudgeta.nic.in/es2002-03/chapt2003/chap23.pdf, downloaded April 14, 2004.
[294] "Receipt Budget, Non-Tax Revenue, Union Budget 2003-04, from http://indiabudget.nic.in/ub2003-04/rec/ntaxrev.pdf, downloaded April 14, 2004.
[295] Pakistan 2003 Statistical Pocketbook, Federal Bureau of Statistics, Government of Pakistan, from http://www.statpak.gov.pk/depts/fbs/publications/pocket_book2003/pocket_book.html, downloaded April 19, 2004.

internationally. This is a difficult, if not impossible variable to measure. India is in a position in the world that is quite unlike any other. It has an enormous population from which to extract wealth, but it also has one of the highest illiteracy and poverty rates in the world, thus complicating wealth extraction. It would be difficult to find another country in a similar enough situation in terms of level of development, population size, and governing style to accurately and fairly compare or even create a decent sketch of the government's ability to extract wealth from society. That being said, one source does put the number of people in India who pay taxes at approximately thirty million and indicates that up to one hundred million ought to be paying taxes.[296] This fact coupled with the fact that India's tax revenues are among the lowest in the world at fourteen percent of GDP indicates that extraction as outlined in the framework is low in India.

Tax revenues in Pakistan were just 12.8 percent of GDP in 2002.[297] This is lower than most of its neighbors, including Malaysia, Sri Lanka, and Kyrgyzstan. The IMF has admonished the Pakistani government for the poor design and operation of the tax system there, but there is some evidence that the numbers may get better. The 12.8 percent represents an increase of 16.6 percent over last year's revenue collections.[298] This could point to an upward trend that might help to improve Pakistan's reputation in this area, especially in the eyes of the IMF. Slowing this improvement, however, is the fact that there is rampant tax evasion in Pakistan. In 1999, the government began to crack down on tax evasion in the country, however it has met with limited success. At that time, less than one percent of the population eligible to pay income tax was actually paying it.[299] Currently, the government is in the process of trying anew to reform the tax system. Beginning in January of 2004, the government set deadlines for tax officials to eliminate tax evasion and fraud in their areas. It appears that some of the problem in collecting taxes is the fact that the tax officials themselves are bribed by members of the business community to book their companies as having paid taxes when, in fact, they had not. Punitive measures were also worked out by the government for those who fail to comply.[300] The hope is that this will further

[296] Luce, Edward, "India turns to the net in bid to boost tax collection," *The Financial Times*, August 8, 2003, p. 10.
[297] Safraz, Sohail, "Pakistan's tax collection efforts not enough: IMF," *Business Recorder*, April 3, 2003.
[298] "Economic Performance During July-September 2002," Finance Division, Government of Pakistan, from www.finance.gov.pk/summary/jul_sep_02.pdf, p. 1, downloaded April 14, 2004.
[299] Bokhari, Farhan, "Pakistan moves on tax evasion," *The Financial Times*, July 13, 1999.
[300] "Pakistan's CBR to eliminate tax fraud," *AsiaPulse*, January 23, 2004.

boost lagging tax revenues within the country. It is clear, however, that Pakistan has a long way to go toward making this particular situation better.

Regulation of Social Relations

The final component of social control is the regulation of social relations. In terms of the framework, this refers to the "ability of the state to control the agenda once goal-oriented action has been implemented."[301] The point is to determine if a state sets the financial goal (remembering that the goal is the extraction of wealth from society) but has difficulty meeting that goal and is forced to compromise with society by allowing certain tax breaks and subsidies. Measuring penalties helps to determine how often the government's goals are at odds with what society is willing to allow.

The Indian government does allow tax breaks to both individuals and companies for a myriad of reasons. The key here is to recognize that it is providing these breaks despite its soaring budget deficits and despite the fact that tax revenues are only a small portion of overall government revenues thus leading one to believe that the government attempted social control through the implementation of taxation but was derailed by society. The government provides tax breaks on housing and savings, tax breaks for individuals earning less than Rs 100,000, for senior citizens, and tax breaks on dividends from mutual fund investments among other areas. It is crucial to note that the coalition government did attempt to do away with some of these tax breaks but retreated due to concerns over the advisability of potentially alienating the urban middle class, the primary support base of the BJP.[302]

The Indian government also provides subsidies to various social groups as well as companies. India subsidizes its agricultural industry its private power distribution companies, and its software industry among others. A World Bank economist described the Indian government's subsidies to individuals as poorly targeted and non-merit based. This fact renders the subsidies effectiveless as they do not reach targeted beneficiaries and therefore represent only a drain on the Indian economy.[303]

As mentioned earlier, the Indian government is likely not collecting taxes from tens of millions of Indians who should rightfully be paying them. The government has attempted to raise collection rates by making it easier to file through the use of electronic filing and by

[301] Tellis, p. 120.
[302] "Politics of Economic Liberalisation," *The Financial Times*, July 23, 2003.
[303] Srinivasan, S., "World Bank Economist Rues India's Poor Public Finances," *The Associated Press*, May 22, 2003.

simplifying some of the tax laws. An additional option has been the use of penalties. The government, however, has not had much success in enforcing these penalties and has, in some cases, even lessened penalties. Fines have been reduced for failure to deduct or pay income taxes, willful tax evasion, and failure to furnish returns of income.[304] The ability to collect on even these lessened penalties is hindered further by the widespread government corruption in India. In November of 2003, a high profile senior official in the tax department was brought up on charges by the Central Bureau of Investigations for soliciting and accepting bribes in return for the reduction of a penalty.[305] With practices such as the one described above occurring frequently, the Indian government is hard pressed to increase collections through both the collection of penalties and the threat of penalties. The government cannot collect on money that is being funneled to crooked tax agents and the threat of penalties is not a viable one when said penalties can be reduced by bribing the right person.

Pakistan also has a number of tax breaks and subsidies for individuals, companies, and specific goods, however, it appears that Pakistan is working to repeal or limit some of these. The Pakistani government provides exemptions related to pensions, non-profit charitable religious and welfare activities and educational institutions, exemptions relating to electric power generation, and certain tax holidays for those undertaking industrial development within Pakistan. Furthermore, the government allows exemptions and subsidies on sales tax for food items, fertilizer, information technology equipment, and pharmaceutical products. These exemptions resulted in a 21.89 percent expenditure on taxes by the central government in 2002-03. The good news is that overall, the exemptions and subsidies totaled 11.4 percent less of an expenditure in 2002-03 than they did in 2001-02.[306]

As mentioned earlier, the government is trying to crack down on non-payment of taxes and is attempting to reduce its expenditure on various tax exemptions and subsidies in an effort to increase government revenues overall. This shows that the government realizes the necessity of revenue for its survival and prosperity. It appears, however, that the government attempting to transition into a position where it can better extract wealth from society, but that it has not yet arrived at that position.

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[304] "Get your tax penalties reduced, without hassle," *The Financial Times*, August 2, 2003.
[305] "Tax official charged for demanding bribe to relax penalty," Indo-Asian News Service, November 5, 2003, from http://in.news.yahoo.com/031105/43/293pj.html, downloaded April 14, 2004.
[306] "Tax Expenditures," Economic Survey, 2002-03, Ministry of Finance, Government of Pakistan, from http://www.finance.gov.pk/survey/chapters/expenditure.pdf, downloaded April 14, 2004.

Based on the above observations on social control in India, we get the picture of a situation in which the Indian government appears to have legitimacy as an institution but has difficulties following through on those goals that it is able to set due to the lack of government cohesion, the challenges presented in working with a fragile government coalition, and an inability to garner public cooperation for the purposes of setting and reaching state goals. Social control in Pakistan is plagued by many of the same problems faced by India. The fact that it collects more than double the indirect taxes as it does direct taxes, the lack of societal compliance with direct tax collection, and the broad tax breaks that it currently offers point to a government in need of a higher degree of social control for its improved existence.

Social Control - India

Variables	Indicators	Score*
Penetration	ratio of direct to indirect taxes	2
	ratio of non-tax government revenues to direct	2
Extraction	Tax revenue versus taxable capacity in a	1
Regulation of social relations	Use of tax breaks and subsidies	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Social Control - Pakistan

Variables	Indicators	Score*
Penetration	ratio of direct to indirect taxes	2
	ratio of non-tax government revenues to direct	2
Extraction	Tax revenue versus taxable capacity in a	1
Regulation of social relations	Use of tax breaks and subsidies	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Ideational Resources

Another important component of national performance is a country's ideational resources. An examination of infrastructural capacity allows us to determine whether a country can respond to international pressures as well as, to a certain extent, internal or domestic pressures. Examining ideational resources, according to Tellis, et al. allows us to determine whether a country can convert its control over society into the intermediate goods that will allow for effective military capabilities, the "ultimate manifestations of national power."[307] In order to understand a country's use of ideational resources, one must gain insight into a country's level of instrumental rationality, defined in terms of the Tellis framework as "the ability to adequately relate means to ends," and the level of substantive rationality, defined by Tellis, et al. to be a "national commitment to the pursuit of wealth and the acquisition of power."[308]

Instrumental Rationality

Tellis, et al. submit that the best indicators of "embedded" instrumental rationality can be found in the school system, focusing on the secondary level of education. It is first necessary to obtain information on enrollment and attainment at the secondary level. This information has been obtained and discussed earlier in this composition. Next one must gather information around a nation's teaching methodologies, division of curriculum time, and the nature of national examinations.[309]

Teaching Methodologies

As far as indicators for this variable are concerned, the framework is fairly vague. It simply states that one should strive to find out whether instruction methods emphasize the rote memorization of facts or focus on the development of problem solving skills and the encouragement of creativity.[310] According to UNESCO, there appears to be a discrepancy between the goals of national education policies and the teaching methodologies in India. India's national education policy includes a national curricular framework that contains a "common core." The common core includes, among other items, "the inculcation of the scientific approach" as well as the development of students' creative potential.[311] While these

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[307] Tellis, p. 122.
[308] Tellis, p. 123.
[309] Tellis, p. 125.
[310] Tellis, p. 127.
[311] "India: education policies and curriculum at the upper primary and secondary education levels," <u>Unesco Statistical Yarbook</u>, Paris, 1998, p. 78.

goals are in line with what the Tellis framework would deem necessary for quality education, it appears that the teaching methodologies in the country do not allow these goals to be met. The primary mode of curriculum transaction is "verbal exposition" by the teacher.[312] This one-way style of teaching creates a student that is merely a passive recipient of information and is therefore not in line with the goal of turning out students who are creative in their thinking and who fully grasp the critical and analytical thinking skills that are essential both to scientific methodologies and higher education.

Teaching methodologies in Pakistan are widely considered to be poor. Students studying in the critical areas outlined by the framework are often taught by teachers with little or no special training in the subjects. In fact, no formal education is required for teachers to sit for the B.Ed. examination which qualifies them to teach at the secondary level. I could find no indication that teachers emphasize critical thinking over rote memorization, but according to the Pakistani Ministry of Education, the reforms that the educational system needs to undertake include the introduction of a system of evaluation that "emphasizes learning of concepts and discourages rote memorization."[313] This goal indicates that the emphasis now lies with the latter of the two teaching methodologies and should change, which points to a weakness in Pakistan when held against the Tellis framework.

Curriculum Time

Tellis, et al. suggest that an examination of curriculum time in secondary education should focus on the time spent on mathematics and science relative to other subjects, the point being that these two subjects are more closely related to critical thinking and problem solving than are the others.[314] In India, the students' curriculum time in mathematics and science constitutes a total of twenty-six percent of total instruction time at thirteen percent each. This thirteen percent each for mathematics and science is the same amount of classroom time devoted to social science and work experience and is just three percent more than the amount of time given to both health and physical education and the arts. Language gets the most instruction time at thirty percent of total instruction time. Clearly mathematics and science are considered at least as important as most of the other core subjects and are therefore not neglected, but there

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[312] "India: education policies…, p. 79.
[313] "Secondary Education," Ministry of Education, Government of Pakistan, from www.pakistan.gov.pk/education-ministry/highlights/NEP-secondary-edu.jsp, downloaded April 14, 2004.
[314] Tellis, p. 127.

does not seem to be any particular emphasis on them. This fact, coupled with the fact that the education system in India is wrought with problems, leads one to believe that it does not have a great deal of embedded rationality in this area.

In Pakistan, more curriculum time is given to physics, chemistry, and biology/computer science at seven hours per week of instruction time devoted to each area. Approximately five hours each week are devoted to the study of Urdu, six to the study of English, three each are devoted to Pakistani studies and Islamic education. Four hours each week are devoted to general science and electives, and mathematics. Very little instruction time is given to physical or health education, equaling just fifteen to twenty minutes per week.[315] So while more instruction time is given to the sciences than any other one subject, it is important to remember that education in general in Pakistan is considered to be very poor, so the quality of that instruction comes in to question and thus points to a lack of embedded instrumental rationality.

National Examination System

The final area under observation when considering a country's instrumental rationality is its national examination system. The focus should be on whether these exams are oriented towards the regurgitation of information or towards critical thinking and creativity. National exams in India are conducted at the end of the lower and higher secondary stages. While there was no apparent quantitative data concerning the style of the examination, the Department of Education in India itself acknowledges flaws in the current examination system. The secondary exams represent a "one shot" approach to evaluation rather than an approach that would allow for more continuous and therefore comprehensive evaluation. The Department of Education admits that teachers gear their teaching toward exam requirements rather than toward student development and student need. [316] This could point to the fact that the emphasis is on memorization and regurgitation at exam time rather than analysis and creativity because if a student understands a concept and the theories, etc. behind it, he or she does not necessarily need to memorize outcomes as he or she will be able to follow the theory and logic necessary to the development of the outcome.

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[315] "Secondary Education Outline," World Education Services, from www.wes.org/ca/wedb/pakistan/pksecond.htm, downloaded April 14, 2004.

[316] "Evaluation and Examination Reform," Department of Education, Government of India, from http://shikshanic.nic.in/cd50years/q/91/HL/91HL0501.htm, downloaded April 14, 2004.

The national examination system in Pakistan is currently in the process of being rehabilitated, as are many other aspects of the Pakistani education system. In our focus on secondary education we currently see an examination system that is unreliable. The Secondary School Certificate is taken at the lower secondary level and students must pass this examination in order to progress to the higher secondary education level. Most of the students who do not pass this examination simply drop out of school and begin looking for employment. The examination is largely believed to assess recall abilities rather than critical thinking or even the broader goals of the curriculum. This type of assessment leads to the poor teaching methodologies discussed above. Furthermore, the fact that if a student fails this examination he or she cannot progress to the next level of educational attainment encourages corruption and cheating.[317] This can hardly be considered an examination system that works toward the goal of assessing either the teachers on their ability to teach the state-developed curriculum or the students in their ability to think critically and apply the learned curriculum in a variety of ways.

It appears that both India and Pakistan, with their low enrollment and attainment rates, non-interactive teaching methodologies, and lackluster examination systems would have what one would consider to be a low level of instrumental rationality as outlined in the Tellis reading.

<u>Instrumental Rationality - India</u>

Variables	**Indicators**	**Score***
Enrollment and attainment rates at the secondary level	N/A	2
Teaching methodologies	rote memorization versus critical thinking skills	2
Curriculum time	time devoted to study of mathematics and science	2
National examinations	rote memorization versus critical thinking skills	.5

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[317] "High Quality Examination Board Based on National Curriculum…," AGA Khan University, Newsletter Online, v. 5, no. 1, January 2004, from www.aku.edu/university/publications/Newsletter5.1/akueb.shtml, downloaded April 14, 2004.

Instrumental Rationality - Pakistan

Variables	Indicators	Score*
Enrollment and attainment rates at the secondary level	N/A	2
Teaching methodologies	rote memorization versus critical thinking skills	1
Curriculum time	time devoted to study of mathematics and science	2
National examinations	rote memorization versus critical thinking skills	.5

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Substantive Rationality

The second component of a nation's ideational resources is the level of its substantive rationality. Tellis, et al. argue that the state's bureaucracy and legal system hold the key to the development of substantively rational policies that will ultimately aid the state in its pursuit of national power.[318] Therefore, one must examine state ideology, state structure and incentives and private organization in order to assess whether they are all working toward making/cooperating with substantively rational policies.[319]

State Ideology

In the examination of state ideology, it is essential to find evidence of "a deliberate, public commitment to the production of wealth and power, particularly in the form of acquiring modern science and technology."[320] While India may be publicly committed to the development of wealth, its actual commitment seems to be something different. Since India's independence, the government has made radical changes to the state's economic structure, but the pace of change has slowed in the decade or so since it became recognizable as a market economy in 1991. The growth rate of the Indian economy is such that India is considered to be one of the fastest growing developing economies. It is partly due to this fact that the government has been slow to make the necessary changes to further improve the state's economy. The difficulties in progressing India's movement toward the privatization of the many state owned companies have

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[318] Tellis, p. 131.
[319] Tellis, p. 128.
[320] Tellis, p. 131.

already been discussed and are in large part related to an unwillingness of the state to divert money from subsidies and salaries and to ask bureaucrats, labor and industry to make sacrifices that might jeopardize its own political standing. In order to progress, the state will likely need to look inward for areas of further reform.

In addition, the public deficit in India shows that the priority has not been placed on the generation of wealth. It is at about ten percent of GDP currently. This is a reflection of poor spending priorities and serves to reduce state income generation potential in that it discourages private investment, pre-empts public investment, and decreases India's stock in the international community as a state with good potential for investors. [321]

We have also already investigated India's technology base. While it appears that India has a long way to go in this area, the government seems to at least recognize the need to acquire the latest technologies and the advisability of advancing the sciences. India is recognized by the international community for its strides in the development of inexpensive, quality software and its many advances in the area of biotechnology and life sciences. We see, however, that some attempts by the government to create or obtain cutting edge technology are hindered by a variety of factors including the lack of a commitment to the pursuit of wealth discussed above.

It is clear that the Pakistani government does not have a stellar history of success in the area of wealth generation for the country. Beginning at Pakistan's independence in 1947, the problems with the development of the economy had to do with a dearth of personnel and solid institutions with which to begin the process of wealth generation. Most of the large industries in the country were under government control and there was little interest on the part of the private sector in what industries were left, and to make matters worse, the government used subversive tactics to insure that private sector activities meshed with the interests of the government's agenda. It was not until after 1977 that the government began to focus more on the fact that economic development should be driven by private enterprise, and policies emphasizing this realization continued through the early 1990's. Various public industrial enterprises were denationalized and private investment policy was revised. The government seemed to be on the right track in instituting these changes, but it did not deal with a growing budget deficit which

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[321] "Unlocking the potential; India's struggle to reform its economy," *The Economist*, June 2, 2001, p. 3.

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began to scare off foreign investors.[322] The military coup in 1999 that brought Pervez Musharraf to power did not help this situation to improve.

The current government has made some significant changes that promise to improve the chances for the development of wealth, however. It has improved its standing in the international community by increasing its revenue collections (although the rate of collection remains low, it is still an improvement over previous years' collections) and attempting with some success to curb the deficit.[323] In addition, the government has been selling assets in the oil and gas industries as well as in banking, telecommunications, and energy industries and is generally trying to make true deregulation of the overall economy possible.[324] It is unclear, however, that these reforms have made more than a nominal difference in the economic situation in the country. Poverty and unemployment are still extremely high and the growth of the Pakistani government is not where some argue that it could be. This fact, coupled with the earlier discussion on the lackluster performance in fostering quality science and technology industries puts Pakistan in a position of weakness in its ability to measure up to the ideals of the framework concerning its commitment to the generation of wealth in the country.

State Structure and Incentives

One must also gain an understanding of a state's structure and incentives in order to develop the picture of the level of its substantive rationality.[325] One is attempting to discover whether the state structure is such that it lends itself to the production of wealth and power through the possession of a bureaucracy that understands the state's goals in this area, routine usage of finance instruments (i.e. a national budget) to "procure, subsidize, or provide incentives for the production of desired capabilities," and the efficiency of public sector instruments.[326]

Corruption has been a recurring theme whenever the topic of government bureaucracy in India has come under examination in this composition. It is no less applicable or undesirable in this situation. Corruption in the bureaucracy clearly runs counter to the national goals of revenue

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[322] "Role of Government," <u>Country Studies – Pakistan</u>, Library of Congress, from
    http://countrystudies.us/pakistan/46.htm, downloaded April 14, 2004.
[323] "Pakistan: Economy," from www.nationmaster.com/country/pk/Economy, downloaded April 14, 2004.
[324] Husain, Israt, "Economy of Pakistan: Past, Present and Future," Keynote address at the conference on
    Islamizaton and the Pakistani economy held at the Woodrow Wilson Center, Washington, D.C., January 27,
    2004, from http://www.sbp.org.pk/about/speech/2004/eco_of_pk(past_present_future).pdf, downloaded
    April14, 2004.
[325] Tellis, p. 128.
[326] Tellis, p. 131.

and power generation. Every bribe accepted by a bureaucrat and each time a bureaucrat looks the other way has the potential to rob the state of both wealth and power. Furthermore, the bureaucracy has a reputation for being difficult to navigate through at all levels at which it exists.

The bureaucracy in India is fairly powerful and yet highly inefficient. There are three levels of jurisdiction over commercial transactions: national, state, and concurrent, which refers to those transactions over which both the central and state governments have control. One can manage the central government's bureaucratic hurdles with a fair amount of ease as it is incented by the slow-growing economy to participate in activities that will generate revenues, but below that it gets extremely complicated. State level bureaucrats are not incented in the same way that bureaucrats are at the national level. The many difficulties at the state level that one may encounter in attempting to do business in India are access to electricity, environmental clearances, developing an understanding of labor laws, and gaining access to land and water.[327] All of the above point to a discrepancy between what the federal government might be attempting to achieve on the one hand and what corruption and inefficiency at the state level from its bureaucracy will allow it to achieve.

India does have a national finance instrument in that it has a national budget plan. It is unclear if this instrument is being used to "procure, subsidize, or provide incentives for the production of desired capabilities"[328] as there is no real explanation from within the Tellis text as to what that phrase might actually mean. We do know that India has a significant budget deficit and therefore is not developing financial planning tactics conducive to the creation of wealth and power, but without a more detailed explanation of what the Tellis framework is attempting to measure, it is impossible to speak to the nature of India's finance instruments.

The final area under consideration in the examination of state structure and incentives is the efficiency of public sector instruments. This is defined by the framework as "public sector undertakings aimed at directly producing capabilities otherwise beyond the capabilities of civil society."[329] Again there is no further explanation as to what this might mean in more explicit terms. If it refers to the ability of the state to provide for its inhabitants, we have seen examples of poor execution in this area. India is a nation of illiteracy, poverty, and starvation. The public

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[327] Ramachandran, Raja, "Understanding the market Environment of India," *Business Horizons*, January-February, 200, p. 47.
[328] Tellis, p. 131.
[329] Tellis, p. 131.

distribution system and storage facilities for food are sub par. The ability to feed one's own population should be a paramount consideration for the state. This represents a role that is being poorly filled by government. However, without a more detailed explanation of what the authors require to flesh out this area of the framework, this example is representative of one situation that may or may not be what the authors are ultimately trying to assess.

Corruption is also a theme when discussing Pakistan's bureaucratic infrastructure. According to the US Agency for International Development, Pakistan has severe democracy and governance problems, some of which manifest themselves in the bureaucracy.[330] It appears the corruption in the bureaucracy touches just about every facet of Pakistani life and creates barriers to economic, social, and political development as well as greatly damages Pakistan's reputation in the international community as a potential location for businesses. There is a culture of promoting and rewarding employees because they are relatives or friends rather than because of merit, and a culture of persecution of those who refuse to give in to the corrupt policies. Public money is misused by bureaucrats in that state issued items such as telephones and vehicles are used for private purposes.[331] Some argue that corruption is so widespread because there is a distinct lack of transparency in government and business in Pakistan. Whatever the cause, it is clear that agency reforms, public sector building projects, banking, freedom of information reforms, and political party reform are being stalled by so-called bureaucratic red tape. Furthermore, private entities must constantly grease the palms of bureaucrats in order to get permits, licenses, infrastructural change approval, or even to get paid by the government for work completed. The bureaucracy is also considered widely to be backwards. It has not modernized to the point that it can incorporate new technologies or other innovations into its operations, despite the efforts of higher-ups in government to try and change that.[332] A major e-government initiative approved by the Pakistani government in 2000 with the goals of creating more transparency and thus eliminating the ability of bureaucrats to operate in a corrupt fashion, increasing government productivity, and standardizing practices across agencies has met with extremely limited success. While a number of the projects included in the e-government

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[330] "Budget Justification to the Congress," U.S. Agency for International Development, FY2004, from http://www.usaid.gov/policy/budget/cbj2004/, downloaded April 14, 2004.

[331] Siddiqui, Anjum, "Institutional Corruption in Pakistani Banks," *South Asia Tribune*, i. 47, June 22-28, 2003.

[332] "Society and Its Environment," from http://reference.allrefer.com/country-guide-study/pakistan/pakistan32.html, downloaded April 14, 2004.

initiative have been completed, there is no evidence that their completion has helped the people of Pakistan to be able to better trust in their bureaucrats.

Pakistan is much like India in the area of corruption among its bureaucrats and it is also in a similar position as far as the possession of a national finance instrument goes. Pakistan does, in fact, have a national budget. There are two main parts to this budget: the ordinary budget, and the development budget. The ordinary budget covers current spending, and the development budget, as one might assume, covers expenditures related to capital development and investment and is set out in a five year plan with adjustments being made each year.[333]

Finally, in keeping with the same assumptions of what efficiency of public sector instruments might mean that were used in the discussion, we can conclude that Pakistan is in a similarly poor situation. Pakistan is also a nation of poverty, illiteracy, and starvation. There is a severe energy problem that is only likely to get worse in the near future, and many of the other critical infrastructures are in disrepair. Government corruption and instability due to the country's cyclical moves between civilian and military style government have prevented the proper channels for providing public services to develop and has kept those that do exist from becoming efficient.

Private Organization

The third and final component for measuring substantive rationality in a country is private organization. For the purposes of the framework, the nature of private organization includes the existence of a competitive socioeconomic system and cultural norms that emphasize achievement. Indicators of a competitive socioeconomic system include institutions that look after the interest of property holders through the preservation of private property rights, institutions that allow individuals to engage in nonviolent dispute resolution, and ample institutions to provide for public safety and political order.[334] No indicators for what might constitute cultural norms that emphasize achievement were outlined it the text.

It was not clear from the available information concerning India's private property rights situation if there are separate institutions devoted solely to the protection of property rights. There are certainly laws in place that protect the property rights of India's citizens. Property rights include claims to land and dwellings as well as to intellectual property. It appears that the

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[333] "Finance," from http://reference.allrefer.com/country-guide-study/pakistan/pakistan71.html, downloaded April 14, 2004.
[334] Tellis, p. 132.

same institution in India is responsible both for maintaining and protecting private property rights as well as for nonviolent dispute resolution in all matters. This institution is the court system.

We have seen that the Supreme Court in India has enjoyed a rise in stature in conjunction with the decline in stature of the legislative branch in the wake of corruption scandals. India's court system overall, however, does have some issues. There are often severe delays in cases being heard. The court's infrastructure is old and in danger of collapse, and there is an overwhelming number of cases pending before the courts.[335]

The courts in India enjoy a high degree of independence form the more highly politicized branches of government and therefore serve as the final resort for many who have tried and failed to change the policymaking process via their elected officials. This also puts the courts in the position of being considered a threat to the legislative and executive branches. It is this perceived threat, some believe, that has caused the legislative branch to withhold adequate funding from the judiciary thus adding to its woes.[336]

Nevertheless, the Indian people do have an institution, although one that is at times slow and inefficient, that allows both for the protection of private property rights and nonviolent resolution of general disputes. The Indian government has also put into place separate family courts to deal specifically with domestic issues and established a program of free legal aid to qualified individuals in order to allow for greater access to the legal system. Despite their problems, the courts appear to function and provide a reasonable outlet for dispute resolution.

The last indicator of a competitive socioeconomic environment is the existence of institutions that provide for public safety and political order. States in India have their own police forces to handle issues of public safety at the state level. In addition, the central government has a national level police force called the Central Reserve Police Force.[337] The role of this armed force is to provide assistance to state police operations, to maintain general law and order, and to contain insurgency. This force seems to enjoy legitimacy from both the individual state police forces as well as the general public. Some of the specific duties performed by the CRPF are crowd control, riot control, protection of VIPs, UN peacekeeping, and

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[335] Moog, Robert S., "Elite-Court Relations in India: An Unsatisfactory Arrangement," *Asian Survey*, v. 38, i. 4, April 1998, p. 410.

[336] Moog, p. 414.

[337] "Central Reserve Police Force," from http://crpf.nic.in/, downloaded April 15, 2004.

countermilitancy/insurgency operations. In recent years, the CRPF has overseen general elections in the turmoil stricken areas of Jammu and Kashmir and provided security for the 1999 parliamentary elections.[338] So it appears that India does have an institution, and an effective one at that, charged with public safety duties and the preservation of political order.

In looking at these same components of private organization for Pakistan, we see a somewhat different picture. Property rights in Pakistan are outlined in the country's Constitution. Part II, Chapter 1 provides that "Every citizen shall have the right to acquire, hold and dispose of property in any part of Pakistan, subject to the Constitution and any reasonable restrictions imposed by law in the public interest," and further that "No person shall be compulsorily deprived of his property save in accordance with law."[339] It goes on to outline certain circumstances under which the government may acquire a person's property for public purposes, but that the owner of the property must be compensated. So we can see that property rights are considered important enough to be included in the state's Constitution which is a sign that they are at least recognized on a theoretical level by the state. What we find in practice, however, are some disturbing instances in which landless peasants have been killed in confrontations with provincial government forces over their tenant status on some state-owned lands. Since coming to power in 1999, Musharraf has been stating publicly that he would work toward the negotiation of contracts with tenant farmers, the ultimate goal being their ownership of lands that they have been farming for a hundred years in some cases but have not been allowed to own outright. In 2002, several tenant farmers were killed in separate incidents."[340] These incidents lead one to believe not only that property rights are held up more in theory than in practice, but that the mechanisms for non-violent dispute resolution, at least over private property rights, are lacking. It is a widely held belief that land reforms can greatly enhance a country's ability to reduce poverty by increasing production, employment, and income. The current land situation in Pakistan is not moving very quickly in the direction of true reform and thus Pakistan is missing an opportunity to improve its situation and therefore displays a lack of substantive rationality in this area.

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[338] "Central Reserve Police Force."

[339] *Constitution of Pakistan* from www.pakistani.org/pakistan/constitution/part2.ch1.html, downloaded April 15, 2004.

[340] "Pakistan:Brutal State Repression Against Landless Peasants in Punjab," *Food First*, July 18, 2002, from http://www.foodfirst.org/action/cgar/pakistanrepression.html, downloaded March 22, 2004.

Conflict resolution in other areas of the law occurs largely within the court system in Pakistan, however, there are tribal areas in which tribal law supercedes federal law. In these areas, tribal leaders work with those in government to maintain order but are not tied to the federal code. The court system overall is not considered to be in good shape. Despite a publicly stated conviction to allow the courts to operate in an independent fashion, the Musharraf government has amended Pakistan's constitution to ban courts from issuing court orders against Musharraf himself or any other person who may occupy his position in the future. Furthermore, upon coming to power, he made each justice swear to uphold the Provisional Constitutional Order that he put in place after the coup that brought him to power, essentially forbidding judicial review of the Constitution which is an essential power of the courts in any healthy judicial system.[341] The court system is also generally considered to be corrupt and inefficient. There is not equal access across Pakistan and among Pakistanis to the system and the capacity of the courts, especially the lower ones, is far too low to meet demand. The government is, however, in the process of reforming its system. There are no plans to change the fact that the President is practically untouchable by the courts according to a Constitution that the courts are not allowed to question, but there are plans to broaden access to the legal system, address the low capacity of the system overall, improve judicial training, and address concerns surrounding quality legal education. All of this is to be accomplished over the next several years with funding provided to the Pakistani government by the Asian Development Bank in 2002.[342] So while there are mechanisms in place allowing for the possibility of non-violent conflict resolution, often times they are not utilized and the government will resort to violence, or they do not meet the needs of the people that they are there to protect because of overcrowding, a lack of independence, or other problem.

For Pakistan, the last indicator of a competitive socioeconomic environment, the existence of institutions that provide for public safety and political order, is a bit of a convoluted entity. While the provisional governments each have their own police forces, the top two positions in each provincial police organization are selected from the Police Service of Pakistan which is not a national police force as one might assume, but rather, it is an organization geared toward individuals interested in careers in internal security. Officers in the PSP are assigned

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[341] "Courts and Judgments," *The Jurist*, from http://jurist.law.pitt.edu/world/pak.htm, downloaded April 15 2004.
[342] "CJ stresses improvement of judicial system," *Pakistan Press International Information Services*, December 21, 2002.

either to provincial forces or to other government entities, according to their skills and abilities. The provincial police forces, however, have their fair share of problems. Officers are often undermined by local politicians to the degree that an officer who arrests a perpetrator may see that individual go free if a politician intervenes on his or her behalf. In addition, the officers do not have the weaponry that they need to fight an often better trained and better equipped adversary, particularly in the outlying areas of Pakistan where insurgents are known to operate. Promotions are based on contacts and reputation rather than on service records, and recruitment standards, while they are outlined in the operating procedures, are rarely followed. Pay is higher than may jobs in Pakistan, but is considered low when compared internationally.

As with the court system, reforms are under way in the area of internal security as well. As recently as February 2004, the federal government allocated Rs 1.5 billion to the provincial governments so that they can begin to address some of the issues outlined above. Police station buildings will be upgraded, pay for those officers with excellent performance will be increased, and equipment and training will be improved over the next several years with the advent of this generous endowment. The hope is that these reforms will help to restore the confidence of the average Pakistani in the police force.[343]

Substantive Rationality - India

Variables	Indicators	Score*
State ideology	public commitment to the production of wealth and power	2
State structure and incentives	expert bureaucracy	2
	finance instruments	.5
	public sector instruments	.5
Private organization	competitive socioeconomic system	1
	cultural norms that emphasize achievement	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[343] "Centre releases Rs1.5 billion for police stations upgradation," *Pakistan Press International Information Services*, February 22, 2004.

Substantive Rationality - Pakistan

Variables	Indicators	Score*
State ideology	public commitment to the production of wealth and power	2
State structure and incentives	expert bureaucracy	2
	finance instruments	.5
	public sector instruments	.5
Private organization	competitive socioeconomic system	1
	cultural norms that emphasize achievement	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

When held up to the Tellis framework, we see in India a nation struggling in the area of national performance. Its external constraints are numerous and pressing, its infrastructural capacity is low in that both its ability to set goals and its ability to carry them out are hindered by social, political, and economic cleavages as well as a lack of cohesion between leaders and other political and societal elites. Finally, its ideational resources are in tact but struggling to be effective in some cases.

We see Pakistan similarly ill equipped in the area of national performance. Its external threats are powerful and numerous, the nature of its interests concerning the Kashmir region have caused a great deal of animosity between Pakistan and its greatest threat, India; its infrastructural capacity is lacking in that societal, political, and religious elites often work against one another; there is a large number of political, social, and economic cleavages hampering development, and its ideational resources are no where near where they need to be to foster the kind of development that Pakistan needs to take it into the future.

MILITARY CAPABILITY

The third and final broad category under which one must organize data for the measurement of national power according to Tellis, et al. is military capabilities. Military capability is the "ultimate yardstick of national power" for the purposes of this framework.[344] One must keep in mind, however, that measuring capabilities in this area will entail assessing those capabilities as resources rather than outcomes and will therefore not include combat analysis in the traditional sense.

The researchers admit from the beginning that the difficulties that one encounters when attempting to measure military capabilities are similar to those faced in measuring national power. One-or two-measure approaches are unlikely to provide a useful picture of overall power and a single measure is often only useful for ranking states and therefore does not capture the true nature of the many components that go into creating effective military capabilities. It is for this reason that the organization of the examination of military capabilities will be similar to the organization of the larger framework for measuring national power. It "seeks to identify the strategic resources a military receives from the government it serves; the variables bearing upon the means by which these resources are converted into effective capabilities; and finally, the capabilities of the combat force itself."[345]

Strategic Resources

Strategic resources include financial, human, physical, and technological resources that a country's government provides to its military organizations.[346] These are all part of the larger picture of a country's national resources which were examined earlier in the framework, but here, those components will be applied directly to the military as opposed to the nation as a whole.

Defense Budget

The defense budget must be analyzed both in terms of its total as a percentage of overall public spending and as a percentage of GDP. Furthermore, one must determine the distribution

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[344] Tellis, p. 133.
[345] Tellis, p. 135.
[346] Tellis, p. 136.

of that budget among the branches of service in order to reveal whether a country understands the nature of its threats.[347]

In India, military spending was at 11.52 billion dollars, or about 2.3 percent of GDP in 2002.[348] Total government expenditure was at 404013 Rs crore and about 56000 Rs crore of that was military spending. This represents about 13.8% of total government expenditure devoted to military spending.[349] I was unable to find any disaggregated data that would indicate how the money was allocated between the three branches of the military.

In Pakistan, military spending was at 2.964 billion, or about 4.6 percent of GDP in 2002.[350] Total government expenditures were at Rs 805.2 billion with about Rs 160.3 billion of that representing government expenditures on defense. This means that roughly 19.9 percent of total expenditure is devoted to the military.[351] I was unable to find disaggregated information on how the armed forces budget was distributed between the services for Pakistan.

Defense Budget - India

Variables	Indicators	Score*
Military spending as a % of total public spending	N/A	2
Military spending as a % of GDP	N/A	2
Distribution of funds between armed services	% of defense budget allocated to Army	0
	% of defense budget allocated to Navy	0
	% of defense budget allocated to Air Force	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[347] Tellis, p. 135.
[348] "World Factbook, 2002 – India."
[349] "Expenditure," Union Budget 2002-03, Ministry of Finance and Company Affairs, Government of India, from http://indiabudget.nic.in/ub2003-04/bag/bag3.htm, downloaded April 19, 2004.
[350] "World Factbook, 2002 – Pakistan."
[351] "Budget at a Glance, 2003-04," Ministry of Finance, Government of Pakistan, from http://www.finance.gov.pk/budget/budgetAtaGlance.pdf, downloaded March 24, 2004..

Defense Budget - Pakistan

Variables	Indicators	Score*
Military spending as a % of total public spending	N/A	2
Military spending as a % of GDP	N/A	2
Distribution of funds between armed services	% of defense budget allocated to Army	0
	% of defense budget allocated to Navy	0
	% of defense budget allocated to Air Force	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Manpower

It is essential to know the size and quality of military manpower in order to assess national power as it relates to military capabilities according to the Tellis framework. One must gather information about the total size of the force, the breakdown between those on active duty and those in reserve, as well as the distribution of personnel across the services. Tellis, et al. suggest it is also helpful to look at some qualitative variables related to military manpower such as the educational levels of both the officer corps and the enlisted ranks, and the minimum attainment level an individual must have to meet recruiting standards. Furthermore, issues such as whether national cleavages such as race, gender, class, or ethnicity are exacerbated or attenuated in the military must be examined.[352]

India's military has an approximate total of 1,954,000 personnel in all of its armed services. The Indian Army has 980,000 active troops, 300,000 first line reserves, and 500,000 second line reserves. The Indian Navy has approximately 54,000 active duty personnel.[353] The Air Force has 120,000 active duty personnel.[354]

The qualitative aspects of the framework, as one might suspect, were difficult to pin down for India. We have already discussed the complex military training system in place in India, but concrete information concerning educational attainment levels of military personnel was elusive. Most of the officer corps, as mentioned earlier, however, comes from the National

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[352] Tellis, p. 138.

[353] "Indian Navy," from http://www.globalsecurity.org/military/world/india/navy.htm, downloaded April 15, 2004.

[354] "Indian Air Force," from http://www.globalsecurity.org/military/world/india/airforce.htm, downloaded April 15, 2004.

Defence Academy, and in order to gain entry into that competitive program, one must have already earned a bachelor's degree. In addition, we find that educational standards for the purposes of recruitment vary from service to service and from skill category to skill category. Army requirements range from basic literacy to higher secondary education while the Navy and Air Force require higher levels of attainment due to the more technical nature of those services. The Air Force requires a minimum of higher secondary education and the Navy requires graduation from a secondary educational institution with the exception of cooks and stewards. Navy officers have to have higher secondary education and have to pass a "competitive" exam to meet standards. If one has a university degree in an area such as engineering, physics, or medicine, one can gain direct entry into the officer corps.

Recruitment has become complicated in recent years due to the fact that there are so many opportunities in the private sector for individuals with technical education and training. Individuals with this type of background are not seeking employment in the armed services as consistently as in the past.

It does not appear that social cleavages are exacerbated in/by the military. The government has stopped the practice of recruiting for the armed services based on caste, religion, ethnicity, or language, and the armed forces have thus become highly integrated and heterogeneous. The government has strived to keep a well-rounded force by recruiting from each state or union territory based on its share of the national population.[355] In addition, I could find no published reports of abuse or discrimination within the military specifically related to issues surrounding caste, religion, ethnicity or language. Furthermore, women have been admitted to every branch of the armed services. This could either point to a generally tolerant military culture or one that has a tendency toward keeping such incidents close to the vest.

Pakistan's armed services consist of the Army, Navy, Air Force, and the Civil Armed Forces/National Guard, with a total of approximately 827,000 personnel. The Pakistani Army has 520,000 active duty personnel and 500,000 individuals with a reserve obligation to the age of forty-five. The Navy has 22,000 active duty personnel and a reserve force of 5000,[356] and the Air Force has a total of 45,000 active duty personnel with 8,000 reservists. The Civil Armed

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[355] "Recruitment and Training," from http://reference.allrefer.com/country-guide-study/india/india195.html, downloaded April 17, 2004.

[356] "Pakistan Armed Forces," from http://members.tripod.com/israindia/pak_army_orbat.html, downloaded April 15, 2004.

Forces/National Guard consists of 247,000 personnel with no information as to a reserve force.[357]

Individuals enlisted in the Pakistani Army must have at least a sixth grade education, but poor public education in Pakistan means that these individuals often have only basic literacy skills and little or no experience with any of the high-tech implements of today's advanced armed forces. Army officers are recruited from the Pakistan Military Academy and have ten years of schooling plus two years at the Academy where they focus both on military training and academic work. Officer and enlisted training and educational attainment is similar to that of the Army for both the Navy and the Air Force with institutions in and near Karachi.

It is difficult to determine whether there is a culture of exclusion and discrimination within Pakistan's armed forces. Recruitment is nation-wide and there is at least an attempt to maintain ethnic balance, however, most of the recruits come from the Punjab and the North-West Frontier Province.[358] As discussed earlier, a regional/ethnic cleavage exists between the Punjab and the rest of society because that area is so socially, economically, and politically dominant, so there is a possibility that this could translate into resentment among the ranks of the armed services as well. There is no definitive information however that would either support or refute the idea that there might be discrimination in the military.

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[357] Lodi, Sador, F.S. and Jamie Al-Nasir, "An Introduction to the PAF Pakistan Air force," from www.pakaviation.com/PVA/Library/Docs/the_paf.html, downloaded March 30, 2004.

[358] "Personnel and Training," from http://reference.allrefer.com/country-guide-study/pakistan/pakistan153.html, downloaded April 15, 2004.

Manpower - India

Variables	Indicators	Score*
Total size of force	N/A	2
Number of active duty v. number of reserve forces	N/A	2
Distribution of personnel across the services	N/A	2
Educational attainment of officers and enlisted	N/A	2
Effect of national cleavages	evidence that race, gender, class, ethnicity cause problems within the force structure	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Manpower - Pakistan

Variables	Indicators	Score*
Total size of force	N/A	2
Number of active duty v. number of reserve forces	N/A	2
Distribution of personnel across the services	N/A	2
Educational attainment of officers and enlisted	N/A	2
Effect of national cleavages	evidence that race, gender, class, ethnicity cause problems within the force structure	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Military Infrastructure

Military capabilities are further impacted by the extent and quality of a military's infrastructure. In the context of the Tellis framework, military infrastructure refers to military bases and installations, testing and training ranges, medical facilities, and military construction projects. The crux of the analysis here is the number of facilities relative to the size of the force and the level of protection that these installations provide to their personnel and equipment.[359]

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[359] Tellis, p. 139.

The Indian Navy has forty-four of what would be considered major facilities. Of those, four are medical facilities and twelve are testing and training facilities and the rest are traditional bases and installations. The framework is a bit unclear as to what might be construed as military construction projects, but if it refers to the construction of additional facilities on the scale of those mentioned above, the Indian Navy has two such construction projects planned in the near future: one is a base facility and the other is a training facility.[360]

The Indian Air Force has fifty-five major facilities. None are listed as medical facilities and nine are listed as testing and training facilities.[361] I could find no specific reference to Air Force construction projects currently under way or planned in India.

India's Army has a system of cantonments left over form the British era. These cantonments are considered to be the major facilities of the Indian Army. There are a total of sixty-two cantonments and nine ordnance depots. These operate like small, self-sufficient cities, each with its own medical facilities, sanitation divisions, primary education institutions, and training facilities. It appears that the Army is concentrating on repairing and updating those facilities already in existence rather than embarking on major new construction projects.

Information related to the quality of these facilities was lacking. I could find no references to any problems or special protections afforded to personnel and equipment for either the Air Force or the Navy. What is apparent, however, is that the Army has had difficulties with its ordnance depots. The anit-sabbatoge measures involve fencing and patrolling by security forces or soldiers. The problem, however, has not been with protecting the depots from outside forces, bur rather, protecting the depots' contents from fire. There have been at least six major fires at depots since April 2000. In addition, the location of the depots is such that they are near the fighting forces and therefore an attack could severely damage the first line of defense. Part of the money allocated for updates and improvements to Army facilities, however, is earmarked specifically for updates to ordnance depots.

The Pakistani Army is not widely written about which makes assessing it extremely difficult. It is unclear whether the Army operates with a traditional base structure similar to that found in other countries, or whether the nine Corps Headquarters serve as bases. The lines are

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[360] "Indian Naval Bases," from http://www.globalsecurity.org/military/world/india/ports.htm, downloaded April 15, 2004.

[361] "Indian Air Force Stations," from http://www.globalsecurity.org/military/world/india/airbase.htm, downloaded April 15, 2004.

further blurred as the military is also in control of the government at this time. It appears, however, that the infantry and armored divisions are organized under the Corps Headquarters, making those headquarters sound like traditional bases even if they are not referred to as such.[362] I could find no reference to military construction as it relates to the army, but tight resources and poor economic times point to the possibility that construction could be limited.

The Navy has a total of thirteen major facilities. Five of the naval facilities are considered traditional naval bases, the rest are training and testing facilities, none were noted for having medical facilities. There are two bases currently under construction in Gwadar and Ormara.[363] The Air Force has ten Major Operational Bases which are those facilities where military aircraft operate during both peace and wartime, and eleven Forward Operational Bases which are those facilities that are active during peacetime but do not become fully operational until wartime. Four of these facilities are considered training facilities.[364] I could find no reference to any Air Force bases that might be under construction at this time, and none of the bases had information relative to their use as major medical facilities. I could not find any information regarding the level of security that these military installations might provide to their occupants, and there was nothing to indicate that base security had been a problem for Pakistan's armed services in the past.

This entire section was difficult to flesh out, but when the total number of major facilities for each country is tallied and then compared against the total number size of the force, we see a situation where there is roughly one major facility for every 12,000 Indian troops and one major facility for every 19,000 Pakistani troops. These figures give a rough sketch of the infrastructural capacity of each country, even if the framework cannot be fully fleshed out in this particular section.

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[362] "Pakistan – Army," from http://www.globalsecurity.org/military/world/pakistan/army.htm, downloaded April 15, 2004.

[363] "Pakistan Naval Bases," from http://www.globalsecurity.org/military/world/pakistan/ports.htm, downloaded April 15, 2004.

[364] "Pakistan Air Force Bases," from http://www.globalsecurity.org/military/world/pakistan/airbase.htm, downloaded March 31, 2004.

Military Infrastructure - India

Variables	Indicators	Score*
Bases and installations	number relative to total force	2
	extent of protection facilities offer to equipment and personnel	1
Testing and training ranges	number relative to total force	1
Medical facilities	number relative to total force	1
Military construction projects	number relative to total force	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Military Infrastructure - Pakistan

Variables	Indicators	Score*
Bases and installations	number relative to total force	1
	extent of protection facilities offer to equipment and personnel	0
Testing and training ranges	number relative to total force	1
Medical facilities	number relative to total force	0
Military construction projects	number relative to total force	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Combat RDT&E Institutions

The number and quality of institutions that focus on combat research, development, testing, and evaluation are the next component of a nation's strategic resources as they relate to military capabilities.[365] These institutions include academic institutions, those institutions that focus on warfighting skills, technical centers that focus on developing, testing, and/or evaluating new combat equipment or organizations devoted to military research.[366]

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[365] Tellis, p. 139.
[366] Tellis, pp. 139-140.

While I could not find a total number of institutions, it is clear that India has an extensive system of military academies where soldiers receive training.[367] There are institutions that train for all branches of service such as the National Defence Academy, the Indian Military Academy, and the Indian Military College. These academies are designed to foster leadership and combat training and are only for those individuals interested in serving in the military on a permanent commission (until retirement). There is also the Officers Training Academy for those interested in short service commission.[368]

In addition, each military branch has its own individual RDT&E institutions. The Infantry School is the largest and oldest training establishment in the Indian Army and there is also a Combat College for the purposes of honing warfighting skills.[369] Most of the Army's officer corps comes from the National Defence Academy. The Indian Air Force has a number of training institutions as well. Training command is located at Bangalore. The Air Force Academy, the premier training institution of the Air Force, is at Hyderabad. There are operational training schools at various locations throughout the country and advanced training occurs at the Defence Services Staff College. There are two schools for specialized training and numerous technical schools throughout India. The Indian Navy selects its candidates from the National Defence Academy, but there are various training institutions throughout India. Some are located at the Navy Training Command Headquarters on Willingdon Island.[370]

I was unable to find any information directly related to the quality of these institutions. The major cultivator of candidates for the Indian armed forces, however, is the National Defence Academy. Attendees spend three years getting a military education. Entry is allowed only after the completion of a bachelor's degree and is highly competitive.

Finally, there is a national institution devoted to technical development for the armed forces. The Defence Research and Development Organisation is a network of fifty-one laboratories charged with developing defense technologies in areas ranging from aeronautics, arms, electronics, combat vehicles, naval systems, advanced simulation and computing, and

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[367] Fair, Christine, "Military Operations in Urban Areas: The Indian Experience," India Review, v. 2, i. 1, January 2003, p. 49.

[368] "Indian Army," Ministry of Defence, Government of India, from http://mod.nic.in/aforces/army.htm, downloaded April 15, 2004.

[369] "Indian Army."

[370] "India Profile: Military," from www.nationmaster.com/country/in/Military, downloaded April 15, 2004.

agriculture.[371] The length of training and the competitive nature of admission into India's top military academies points to the possibility that India has a solid armed forces training program in place.

A hard number of combat RTD&E institutions is also unavailable for Pakistan, however, it is possible to discuss some of the major institutions. There are a number of academic institutions focusing on honing warfighting skills, and we have seen that each branch of the armed services has its own training facilities. There are also a number of colleges and universities devoted to training officers across the branches. Some examples include the Pakistan Air Force Academy, the Pakistan Military Academy, the Military College in Jhelum, the Army Medical College, the Pakistan Naval Academy, and the Command and Staff College in Quetta. Furthermore, there are a number of technical institutes performing military research.[372]

The Pakistani military also has at its disposal several major non-academic facilities devoted to various aspects of military research and development. The Heavy Industries Taxila or HIT facility develops and produces tanks. The Pakistan Aeronautical complex has recently expanded its role from simply reconditioning Chinese aircraft to include the development of light jet trainer aircraft. The Military Vehicles Research and Development Establishment, as one might imagine, deals with research and development related to military vehicles, just as the Armament Research and Development Establishment deals with ammunition and weapons research, including the development of arms storage facilities. The oldest institution and the one with the broadest mandate is the Defence Science and Technology Organization. This organization performs research and testing in all areas of the military. Innovation is the operative word in this facility, with research R&D being conducted in propulsion, electronics, propellants, and metallurgy, among other things.[373] The quality of these institutions is widely regarded as superior throughout Pakistan, but there is little to indicate that the international community necessarily agrees. The Command and Staff College, however, does train individuals from other countries, and the Pakistani military is generally considered to be a well-trained force.

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[371] "Genesis and Growth," from http://www.drdo.com/genesis.shtml, downloaded April 15, 2004.
[372] "Colleges, Universities, and Research Institutions in Pakistan," from www.pakistanpage.net/education, downloaded March 31, 2004.
[373] "Defence Production Division," from http://www.pakistan.gov.pk/defenceproduction-division/index.jsp, downloaded March 31, 2004.

Combat RTD&E Institutions - India

Variables	Indicators	Score*
Number and quality of institutions	N/A	.5

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Combat RTD&E Institutions - Pakistan

Variables	Indicators	Score*
Number and quality of institutions	N/A	.5

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Defense Industrial Base

The extent and quality of a country's defense industrial base is the next area under consideration in an examination of military effectiveness within the bounds of the Tellis framework. The defense industrial base of a country is centered around those firms and industries that produce military technologies and applications and that depend on national defense spending for their survival. One approach to measuring a country's defense industrial base is to assess both the quality of and the ability to domestically produce large and small weapons, non-lethal but strategic products, and supporting consumables. The framework suggests that this is a relatively generic approach and that a more detailed assessment would entail looking at the quality and proficiency at creating: integrated weapon information systems, major weapons platforms, complete weapon component parts, subsystems, subassemblies, components, and materials.[374] There is not much further description of what exactly these broad categories might include, but it is at least a way to organize information about a country's defense industrial base. Without any expertise in military weapons and weapons technology, it is difficult to flesh out this portion of the framework. Furthermore, beyond the first two major categories: integrated weapon information systems and major weapons platforms, it becomes impossible to count the actual number of items a country might have under a particular category. For instance, the example for what might constitute "sub-assemblies" is "gun sights." In order to

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[374] Tellis, pp. 140-141.

determine the number of gun sights, one would have to find information first on which guns the Indian military has in its arsenal, which ones have gun sights, and then how many of those there actually are. I submit that if a country has assembled an arsenal in the first two major weapons categories, one can presume that it likely has mastered the manufacture and/or procurement of those items in the lesser categories, much like building blocks. It is for this reason that I will focus the examination on the first two categories.

Integrated Weapon Information Systems

The one example of what constitutes integrated weapon information systems that Tellis, et al. give is ADGES, so this category will include that and similar systems.[375] All three branches of the Indian military have integrated weapon information systems. The Army employs the Army Radio Engineering Network and the Army Static Switch Communication Network for communications among its field forces, and is developing the Army Strategic Information System for the exchange of operational information between Army headquarters, command headquarters and core headquarters. The Air force employs the Air Defense Ground Environment System that allows for radar, communication links, and intelligence information to be relayed to air defense elements. It also has an Integrated Material On-line System that streamlines its logistic operations. Finally, the Navy is in the process of installing its Navy Enterprise Wide Network for the purposes of allowing its fleet to communicate more effectively with shore operations. It currently uses the Integrated Logistic Management System and the Ship-Based Logistic Management System for inventory control and logistic management.[376] All of these information-based systems allow for integrated communication within and among the Indian armed forces.

It appears that the Pakistani Army does not use an ADGES-style system to link its forces as its Air Force and the Navy both do. The Pakistan Air Defence Command controls all of Pakistan's airspace, including surveillance. All of the elements such as the fighters themselves, SAMS, ack guns, etc. are fully integrated with the other components of the weapons systems to create seamless communication between them.[377] The Indian Navy is using the SUBTICS fully

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[375] Tellis, p. 141.

[376] Bakshi, Prashant, "Security Implications for a Wired India: Challenges Ahead," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxv, no. 8, November 2001.

[377] "Weapon Systems of Pakistan Air Force," from http://www.geocities.com/Baja/Dunes/1107/arm.htm, downloaded April 1, 2004.

integrated combat system in its Agosta submarines. This system handles all weapon command and control functions based on information from the sensors to which it is linked.

Major Weapons Platforms

The example given by Tellis, et al. for this category is "battleships" although an examination of major weapons platforms should include aircraft carriers, nuclear subs, advanced tanks, and combat aircraft. India has one aircraft carrier in its current fleet[378] and is projected to have a total of five nuclear-powered submarines in the near future.[379] The Indian Air Force has over six hundred combat aircraft devoted to air superiority, ground attack and second line attack.[380] Finally, India has 182 active main battle tanks, seventy-two have integrated fire control systems and night fighting equipment.[381]

The Pakistani Navy is considered its weakest link. It has no aircraft carriers in its current fleet and no nuclear powered submarines,[382] with no plans to purchase or indigenously produce any nuclear subs in the near future. The Air Force has just over three hundred combat aircraft of a similar caliber to those in India's much larger arsenal. Pakistan has approximately twenty-three hundred main battle tanks in service at this time.[383]

Defense Industrial Base - India

Variables	Indicators	Score*
Integrated weapon information systems	possession of ADGES and similar products	2
Major weapons platforms	possession of battleships, aircraft carriers, nuclear submarines and combat aircraft	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[378] "The Surface Fleet," from www.bharat-rakshak.com/NAVY/Surface.html, downloaded April 15, 2004.

[379] "The Submarine Arm," from http://www.bharat-rakshak.com/NAVY/Submarine.html, downloaded April 15 2004.

[380] "Air Force Fleet," from www.bharat-rakshak.com/IAF/Info/Fleet.html, downloaded July 23, 2003.

[381] "Army ORBAT," from http://www.bharat-rakshak.com/LAND-FORCES/Army/Orbat.html, downloaded April 15, 2004.

[382] "Pakistan Armed Forces."

[383] Cordesman, Anthony, and Arleigh Burke, "The India-Pakistan Military Balance," Center for Strategic and International Studies, May 2002.

Defense Industrial Base - Pakistan

Variables	Indicators	Score*
Integrated weapon information systems	possession of ADGES and similar products	2
Major weapons platforms	possession of battleships, aircraft carriers, nuclear submarines and combat aircraft	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Warfighting Inventory and Support

Tellis, et al. argue that "bulk" military power, in the form of bombs and bullets in the traditional sense, has become a less telling measure of an effective military force. What is more essential in this era of the revolution in military affairs is an understanding of a nation's capabilities in certain high-tech areas. One should assess a country's reconnaissance, surveillance and target acquisition technologies, its integrated battle management systems, its precision strike weaponry, its weapons of mass destruction capabilities, and its logistics system.[384]

RSTA Capabilities

With the Kargil conflict of 1999, the Indian military found that it had gaps in its reconnaissance, surveillance, and target acquisitions capabilities.[385] Recently, however, the Indian government has taken steps to solve this problem. It has negotiated the purchase of eight American P3C Orion reconnaissance aircraft. This particular aircraft is on the cutting edge of reconnaissance technology and will give India the ability to keep its eye on critical and volatile areas such as the Persian Gulf and the Indian Ocean.[386] India has also purchased several Searcher-II and Heron Unmanned Aerial Vehicles from Israel and the government's Defence Research and Development Organisation is pushing ahead with an indigenous UAV.[387] In addition to UAV capabilities, India is working to develop unmanned underwater surveillance

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[384] Tellis, p. 142.

[385] "Nuclear Weapons," from www.globalsecurity.org/wmd/world/india/nuke.htm, downloaded April 15, 2004.

[386] "India to buy P3C Orion reconnaissance aircraft from the U.S.," *Xhinhua News Agency*, September 5, 2003.

[387] Pandit, Jajat, "Lesson from Iraq: India needs to increase surveillance tools," *Asia Africa Intelligence* Wire, March 21, 2003.

capabilities.[388] While still in concept stages, the addition of this technology would be a huge step in the improvement of the protection of India's coastline.

India is also in the process of launching a fleet of Extra Fast Attack Craft with Israeli technology to strengthen its RSTA capabilities. These craft carry state-of-the-art detection systems.[389] Finally, in the area of RSTA, India is planning to purchase a fleet of radar balloons in order to enhance its early warning capabilities along its border with Pakistan[390] and is working with Russia to develop a helicopter-mounted version of an existing RSTA system. This system developed by Russia is on the cutting edge of technology and performs 3.3 billion operations per second when searching for submarines from the air.[391]

While these examples do not represent all of the RSTA equipment available to the Indian military, they do paint a picture of a government that realized a need for enhanced RSTA capabilities and then took the necessary steps to fill in those gaps with cutting-edge technology, much of which is domestically produced in collaboration with other countries possessing high-tech equipment and technologies.

Pakistan, too, has been working to improve its RSTA capabilities. It has launched the BADR II remote sensing satellite in low orbit with a 250 meter resolution[392] in order to enhance its early detection capabilities. Furthermore, Pakistan has begun the indigenous production of a high-tech UAV, the short range Vector TUAV.[393] Again, this is not a representation of everything that is occurring in the area of RSTA in Pakistan, but it gives the reader an idea of what Pakistan is currently doing to improve its capabilities.

Integrated Battle Management Systems

Integrated battle management systems, according to Tellis, et al. are those systems that mate "sensors-to-shooters."[394] Both India's and Pakistan's capabilities in this area have already been examined in the discussion of integrated weapon-information systems. ADGES-style systems in place in both countries allow for at least some degree of integrated battle management,

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[388] Kulkarni, Bhumika, "India working on underwater surveillance vehicle," *Asia Africa Intelligence Wire*, August 22, 2003.

[389] Sastry, Anil K., "Navy to acquire fleet of fast attack craft," *The Hindu*, November 20, 2003.

[390] Penney, Stewart, "India plans fleet of radar balloons," *Flight International*, September 10, 2002, p. 24.

[391] "Russia developing helicopter-mounted target acquisition system for India," Asia Africa Intelligence Wire, November 29, 2002.

[392] "Gray Space Surveillance Satellites," from http://www.au.af.mil/au/database/projects/ay1997/acsc/97-0563/graysat/surv.htm, downloaded April 6, 2004.

[393] "The New UAV," from www.global-defence.com/2002/surv-uav.html, downloaded April 15, 2004.

[394] Tellis, p. 142.

although it appears from the above that India has a higher level of achievement with regards to this than does Pakistan.

Precision Strike Weaponry

This category includes smart munitions, a term associated with missiles and missile technology, but is not clearly defined. Some sources define smart munitions simply as those that are guided to their targets. This can include inertial, radio, laser or radar homing, anti-radiation, optical, or any of the many other guidance systems available. Other sources define smart munitions as only those guided by laser or radar based systems. The cutting edge of smart missile technology, however, is a new class of guided missiles called precision-guided munitions. Both India and Pakistan have missiles with a variety of guidance systems. India has an extensive missile program, second only to China in the developing world. The government started an Integrated Guided Missile development Program in 1983 and has progressed to meet its goal of indigenous guided missile capabilities. Its current program consists of five major systems. The are the Angi intermediate range ballistic missile, the Prithui short range ballistic missile, the Trishul surface to air missile, the Akash medium range surface to air missile, and the Nag anti-tank guided missile. There is also the BrahMos cruise missile and wide speculation that India is in the process of developing an intercontinental ballistic missile to be called Surya.[395]

Pakistan began the planning phases of its missile program in 1987 with the goal of developing short and medium range missiles with guidance systems. Its current arsenal of guided missiles includes the Hatf II, the Shaheen I and II, as well as the Stinger, Redeye and RBS-7 surface to air missiles, among others. Others, such as the Ghauri II are in limited production phases.[396]

Given that the latest missile technology is focused on precision-guided munitions, it is most important to know what each country's capabilities are in that area. The 1999 Kargil conflict served as an eye-opener for India in that it learned that some of its missile guidance systems were not functioning as accurately as they had hoped/anticipated. It is for this reason that India is in the process of acquiring $200 million worth of PGMs on the international market. The major challenge faced by India with regards to this technology is integrating it into its

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[395] "National Briefings: India," from
http://www.google.com/search?q=cache:WBwPNu09KpwJ:www.cdiss.org/india_b.htm+%22national+briefings:+india%22&hl=en&ie=UTF-8, downloaded April 15, 2004.

[396] "Pakistan Armed Forces."

Russian aircraft.[397] While Pakistani aircraft have the possibility of being upgraded to take advantage of the new class of precision-guided missiles, those in the international community with the ability to develop and export the technologies are loath export to Pakistan.[398] It is likely that economic constraints as well as an unwillingness on the part of those with the technology to share it with Pakistan will keep that country from being able to fulfill its wants in this area, thus ultimately making its capabilities inferior to those of India.

Weapons of Mass Destruction

Assessing a country's capabilities in the area of weapons of mass destruction includes examining nuclear, biological and chemical weapons that cause massive destruction and high casualties.[399]

In May of 1998, India took the world by surprise when it conducted a series of nuclear tests. Since that time, India's nuclear capabilities have been increasing. India is commonly thought to have about sixty nuclear weapons, but some estimates put the number as high as 200.[400] India has domestic access to weapons-grade plutonium and has the necessary delivery capabilities to make the Indian nuclear threat a credible one.

We have already discussed India's rapid advancement and cutting edge capabilities in the area of biotechnology. It has both the facilities and the scientific manpower to support the production of biological weapons and the development of agents to safeguard troops and civilians in the event that India were attacked with biological weapons. While some of India's facilities are believed to be engaged in research and development of agents for defensive purposes despite the fact that it is a signatory to the 1972 BWC, it appears that efforts are mostly concentrated on defensive applications. The Defence Research and Development Organisation is in the process of preparing responses to threats such as Anthrax, smallpox, and botulism. Researchers have also developed protective wear such as masks, suits, and detectors.[401]

In 1992, India became a party to the Chemical Weapons Convention thus stating that it did not have chemical weapons. Despite continued statements to the contrary, in 1997, India declared that it did in fact have a stockpile of chemical weapons and announced this to the

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[397] Singh, bulbul, "Indian air force to buy precision-guided missiles," *Aerospace Daily*, March 17, 2004.
[398] "Pakistan Air Force's New Beyond Visual Range Missiles," from
    www.pakistanidefence.com/news/Articles&Analysis/PAF_BVR_Missiles.html, downloaded April 15, 2004.
[399] Tellis, p. 142.
[400] "Nuclear Weapons," from www.globalsecurity.org/wmd/world/india/nuke.htm, downloaded April 15, 2004.
[401] "Biological Warfare," from www.globalsecurity.org/wmd/world/india/bw.htm, downloaded April 15, 2004.

Chemical Weapons Convention in Geneva. The details of India's chemical weapons capabilities remain sparse, but some reports state that India has WWII era mustard gas shells as well as manufacturing facilities capable of producing small quantities of chemical agents. Here again, the government is also involved in the creation of protective gear for troops as well as the development of antibodies against chemical agents in the event of a chemical attack. As recently as 1999, there have been allegations by Pakistan that India has already used or has planned to use chemical agents against Pakistani insurgents in the Kashmir region, however, these allegations remain unconfirmed.[402]

In response to India's May 1998 nuclear tests, Pakistan conducted tests of its own later that month. As a result, the U.S. imposed sanctions upon the country. Pakistan's nuclear production capabilities rely on a well-developed infrastructure with facilities for uranium conversion and weapons production. The production of plutonium for the purposes of weapons use is still in the development phases. The current program in Pakistan is based on highly-enriched uranium, of which China has been the main supplier.[403] Pakistan is generally thought to have about 30 nuclear weapons in its arsenal.[404]/[405]

It is believed that Pakistan has the ability to conduct biological warfare research and development but would need hard-to-get foreign assistance and technology to take its current program to the next level. Pakistan has ratified both the BWC and the CWC, but it has also imported some dual-use chemicals and is attempting to establish a commercial chemical industry which could also be used to develop chemical weapons applications. Indian intelligence sources have indicated, however, that Pakistan has indeed manufactured weapons for blister, blood, choking, and nerve agents.[406]

Logistics

In order to carry out complicated, high-level military operations, a country must have a solid yet flexible logistics system.[407] Currently, the three branches of the Indian Armed services

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[402] "Chemical Weapons," from http://www.globalsecurity.org/wmd/world/india/cw.htm, downloaded April 15, 2004.
[403] Cardesman, p. 36.
[404] Kampani, Gaurav, "Safety Concerns about the Command and Control of Pakistan's Strategic Forces, Fissile Material, and Nuclear Installations," from http://cns.miis.edu/research/wtc01/spna.htm, downloaded April 15, 2004.
[405] Albright, David, "India and Pakistan's Fissile Material and Nuclear Weapons Invention, end of 1998," Institute for Science and International Security, October 27, 1999, from http://www.isis-online.org/publications/southasia/stocks1099.html, downloaded April 9, 2004.
[406] Cardesman, p. 42.
[407] Tellis, p. 143.

have three separate logistics systems, although there have been some attempts to integrate logistics operations. India's Joint Administration Planning Committee has representatives from all three branches and it is charged with preparing an administrative support plan for any operation plan developed by the Joint Planning Committee. Despite the integrated nature of the committees, and despite the fact that most if not all future military deployments will include personnel from all three branches, they are still planning each for their own separate logistic needs. This creates problems in a number of areas including procurement and general maintenance. There are problems of over-stocking and duplication and an overall lack of standardization, leading to a lack of interoperability of equipment.

The above-mentioned issues have caused inefficient operations. The most recent example of this can be found in an examination of the Kargil conflict and its logistics problems. The Indian Army had difficulty getting its ammunition replenished. Ammunition had to be shifted form theatre to theatre, unnecessarily complicating the operation.[408] This points to a crisis-oriented approach to logistics planning rather than one with the necessary foresight required of complex military operations.

Little is known about Pakistan's logistics systems. The Joint Chiefs of Staff Committee is in charge of logistics, but it is unclear how the system(s) function or how well they function.

Warfighting Inventory and Support - India

Variables	Indicators	Score*
RSTA capabilities	ADGES and similar systems - possession	2
Integrated battle management systems	N/A	2
Precision strike weaponry	smart munitions	2
Weapons of mass destruction	nuclear, biological, chemical capabilities	2
Logistics	flexibility and effectiveness of systems	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[408] Anand, Vinod, "Joint and Integrated Logistics System for the Defence Services," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxv, no. 1, April 2001.

Warfighting Inventory and Support - Pakistan

Variables	Indicators	Score*
RSTA capabilities	ADGES and similar systems - possession	1
Integrated battle management systems	N/A	2
Precision strike weaponry	smart munitions	2
Weapons of mass destruction	nuclear, biological, chemical capabilities	2
Logistics	flexibility and effectiveness of systems	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Conversion Capability

Conversion capabilities are those that allow a country to convert resources into operational capacity. The most crucial factors influencing the ability of this conversion to occur are the threats facing a country and the strategy that a country develops to deal with those threats, the nature of civil-military relations, the nature of foreign military-to-military operations, the structure of the military's doctrine, training and organization, and the capacity for innovation.[409] Understanding these qualitative components helps to develop the picture of military capabilities and thus national power.

Threats and Strategy

While Tellis, et al. submit that strategy is impossible to quantify, they also suggest that it is absolutely vital to understand the nature of a country's strategy because it allows us a glimpse into what kinds of military competencies it will attempt to acquire to meet the needs of its strategy as well as the varied ways in which the military might be used. One must take into account its geographic situation, its most likely adversaries and allies, the historical roots and continuity of external policy and goals, and any declarations of its strategic aims.[410] In order to determine a country's strategy, one should also look at its prior military strategies, its existing overall doctrine, patterns of force deployments, and training exercises.

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[409] Tellis, p. 144.
[410] Tellis, p. 146.

Threats

As discussed in a previous section on threats, India's most direct threats come from China and Pakistan. Its geographic location provides a certain amount of natural defensive perimeter, but ironically, it is in those mountainous regions where all of the disputed territory is located. In addition, India is threatened by instability in the gulf region as it depends on maritime trade for so much of its economic activity. India's strategic planning is such that it views Pakistan as its most immediate and pressing threat and China as a more long-term threat.

It is truly difficult to assess which countries might come to India's aid in the event of a conflict. Relations with the U.S. have warmed in recent years, but with Pakistan's strategic importance in the U.S.-led war on terrorism, the U.S. may be loath to enter into an Indo-Pak conflict on the side of India. Russia is in a similarly difficult position in that it has been integral in helping India to both develop and maintain its military equipment and technology, yet in a conflict between India and China, it would be difficult to support India as Russia's relationship with China is somewhat strained already. Due to these factors, it is extremely difficult to determine which countries would be likely allies, but the U.S. and Russia, depending on the nature of the conflict, would be good candidates.

Pakistan's situation with regards the nature of its threats and strategy is directly intertwined with that of India. Its geographic situation puts it in direct proximity to its largest and most likely adversaries, India and Russia. As was the case in the discussion of India, Pakistan's geography provides a certain amount of natural defensive perimeter, but it is on that mountainous border where the disputed territorial areas are located. This is both a help and a hindrance to Pakistani military operations against India in that the rough terrain, while Pakistani forces are well trained to deal with it, also provides its fair share of logistical and climactic challenges.

Pakistan's most likely ally in a conflict with India would be China. While Pakistan's forces are far outweighed by those of India, China's entry into a conflict would likely mitigate India's advantage to a certain degree. Other likely allies in any event of conflict would be other Arab countries with which Pakistan has kept close ties. The most significant of these are Saudi Arabia and the United Arab Emirates. While the likelihood of their providing military support in a conflict situation is low, they may be inclined to provide monetary and political support as they

did in Afghanistan during Soviet occupation.[411] It is difficult to determine, as mentioned above, where the United States might fit in as an ally to Pakistan, but cooperation between the two countries has been on the rise since 9/11 and long-term prospects for continued cooperation remain good.

Strategy

Identifying potential allies for a country is difficult, but identifying its strategy, as mentioned earlier, is even more so. India's short history has nonetheless made it no stranger to war. It fought an unsuccessful and devastating war against China in 1962 over two remote border areas. India went to war again just three years later, this time fighting against Pakistan over yet another remote border area: Kashmir. This war resulted in heavy casualties on both sides and was ultimately ended by a U.N. mediated ceasefire. War erupted between India and Pakistan a second time in 1971 when India became involved in an effort to help East Pakistan break away from West Pakistan. This war ended with a victory for India and the creation of the state of Bangladesh. The Indian victory came with help from the Soviet Union and caused the formerly un-aligned India to re-orient its foreign policy and align with the Soviet Union. India has managed to handle its border disputes with China in a mostly diplomatic way since their full-blown war in 1962, but the unresolved border issues between Pakistan and India have resulted in numerous military clashes, most recently manifesting itself in the 1999 Kargil conflict.

Despite India's broad exposure to military conflict and in spite of the fact that India has met with limited success in these conflicts, it has failed to learn from its mistakes and formulate solid military strategy. India's overall strategy is one of "defensive defence" with the strategic aims of "independence, internal security, and territorial integrity."[412] Any strategic planning is based on dissuasion and deterrence. This strategy, while at least consistent, has not been successful for India going all the way back to its roots 5000 years ago. During only four periods in history, the Kanishka Empire, the Chola Empire, the Early Mohgul Empire, and the British Indian Empire, was India able to successfully maintain security against external aggression.[413] Take note that none of these periods are in India's modern history.

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[411] Iqbal, Melissa and Teresita Schaffer, "Pakistan, The Middle East, and Central Asia," *The South Asia Monitor*, no. 30, February1, 2001.

[412] Klair, H.P.S., "Strategy: A Vital Determinant for Army Force Structure Planning," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxiv, no. 9, December 2000.

[413] Klair.

Many suggest that the problem with the overall strategy of defensive defense has less to do with the strategy itself and more to do with a lack of clear military policy coming from India's political leadership and the concomitant difficulty in creating strategy to compliment that policy, due not only to the fact that the policy is unclear, but also to the fact that there is a disconnect between government and military leadership. The situation is further complicated by the fact that there is no joint doctrine for India's armed services and therefore little joint strategic planning.

To highlight the problems in India's strategic planning for the military, one must look only as far back as the 1999 Kargil aggression. The conflict has its roots in the Line of Control (LoC) established following the Simla Agreement of 1972. Since that time, Pakistan has had a habit of shelling across the LoC periodically either to support insurgents attempting to cross the LoC and/or in an effort to keep the attention of both India and the international community focused on the Kashmir Valley. The shelling intensified in 1997, and by May of 1999, India discovered that a large number of insurgents had crossed the LoC and occupied areas in Kargil. By the end of May 1999, India had decided to use military force to put down the intruders.

India's strategy was predicated on the idea that it would have to contain the intruders, evict them, and vacate while denying the chance of further occupation of these areas to Pakistan. Again, we see a situation where the strategy was sensible but implementation was lacking. From the beginning, force deployment was inadequate. Furthermore, artillery had to be siphoned from other command centers to cover need in the Kargil area. India did eventually get ample troops and supplies into the area but at a cost of precious time. The IAF ran into problems when launching strikes due to the necessity of operating at high altitude and difficulties in determining the difference between fellow countrymen and the enemy. Additionally, the IAF had strict instructions not to cross the LoC which hampered its field of operation somewhat. The Air Force eventually did get its campaign together which included launching laser guided bombs and utilizing high tech electronic warfare systems and night vision technologies that allowed India to carry out operations both day and night for the first time. The Navy was not involved in direct combat due in part to the terrain, but also due to the fact that it had not previously war gamed

such a mission. The Navy was, however, put on high alert and deployed in a preventive fashion. It successfully intimidated the enemy and blocked oil from reaching Pakistan.[414]

Overall, India's operations in the Kargil conflict could be considered a success for the Indian armed forces. Indian military pressure forced the withdrawal of the insurgents, thus India realized its ultimate military objective. The conflict revealed some major problems as far as strategic planning was concerned, however. There were surveillance failures, slow troop deployment and artillery shortages. Inklings of an attempt at integration of armed services operations were present in India's handling of the Kargil aggression, but without furthering these relationships, India will not be able to use its conventional forces to their fullest potential. In fact, it can be said that India's success came only because Pakistan incorrectly but understandably underestimated India's willingness to deter its attempts to destroy the legitimacy of the LoC. History has shown that India's overall strategy has allowed for intrusion time and time again and Pakistan banked on that being the case in Kargil in 1999. Furthermore, Pakistan underestimated the influence of the international community and its support for India's responsible handling of the situation. Had India not had that support and had Pakistan not had even more miserable strategic planning than India, India may not have fared as well as it did in the Kargil conflict.

Pakistan's history is complete with a number of full-scale military operations as well. In addition to the wars between Pakistan and India mentioned above, Pakistan also supported Afghanistan in its resistance to Soviet occupation, a move that further strained relations both between India and Pakistan and between Pakistan and Russia. While conflict with India has remained intact to this day, as we have seen with the continued armed conflict in the Kashmir region, relations between Pakistan and Russia appear to be improving somewhat, in part due to their cooperation with the U.S. in its counter terrorism efforts.

Overall, the Pakistani government states that its strategy is defensive in nature, with the primary policy goal being one of war avoidance. The huge imbalance between Indian and Pakistani forces causes the strategy to emphasize "offensive defense." This includes quick preemptive strikes only once a war has already begun. The idea being that these strikes will disrupt any advance as well as take a large toll on the forces. Past training exercises such as

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[414] Anand, Vinod, "India's Military Response to the Kargil Aggression, "Strategic Analysis: A Monthly Journal of the IDSA," v. xxiii, no. 7, October 1999.

Zarb-e-Momin were designed to drive this strategic point home to India.[415] The fact that there is little information emanating from the Pakistani government or media makes this part of the framework difficult to properly to apply to Pakistan.

Threats and Strategy - India

Variables	Indicators	Score*
Threats	geographic situation	2
	most likely adversaries and allies	2
	historical roots and continuity of policy and goals	0
	declarations of strategic aims	0
Strategy	prior military strategies	1
	existing doctrine	2
	patterns of force deployments	2
	past training exercises	0

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Threats and Strategy - Pakistan

Variables	Indicators	Score*
Threats	geographic situation	2
	most likely adversaries and allies	2
	historical roots and continuity of policy and goals	0
	declarations of strategic aims	0
Strategy	prior military strategies	1
	existing doctrine	1
	patterns of force deployments	0
	past training exercises	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Civil-Military Relations

Those in the top echelons of both the political and military spheres have a great impact on conversion capacity because they both affect how military forces are assembled and used. Examining the relationship between the two is significant because war often puts them at odds

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[415] "Defense Strategy," from reference.allrefer.com/country-guide-study/pakistan/pakistan148.html, downloaded March 31, 2004.

and can therefore adversely affect military operations. One must determine what is the nature and level of access that military leaders have to civilian leaders, and if the civil-military relationship is such that military leaders are capable of securing funding and controlling procurement. [416]

It appears that civil-military relations in India are almost non-existent. That is to say, the two components must and do interact, but there is no real relationship in the traditional sense of the word. The current structure of civil-military relations can be traced back to Nehru, the first Prime Minister after India gained its independence from Britain. It was his feeling that the military should be separated from national security policymaking and planning and a system was set up with that aim in mind. The structure has remained largely unchanged. [417] Further complicating matters is the fact that those in government who are supposed to be in charge of military planning and policymaking have failed to present a comprehensive strategy or strategic policy that the armed services can use in their planning. Thus, the armed services, who also have no joint doctrine, plan according to their own perceptions, basically in a vacuum. We see a situation where those in the top echelons of the armed services have little to no access to those civilian leaders in the Ministry of Defence who are ultimately charged with obtaining policy plans and directions from others in government on defense and security issues and communicating them to those in the armed services charged with carrying them out. What ultimately happens in many cases as a result is that each branch of the armed services will develop its own plan and then have to "pitch" it to the bureaucracy, attempting to overcome one hurdle after another from securing funding to procurement and logistics issues. [418]

This total lack of cohesion between civil and military leaders causes extreme delays in decision making, overlaps and gaps in procurement and a lack of ability to engage in long-term strategic planning and policymaking.

In Pakistan, the situation is quite the opposite. Rather than a disconnect between civilian leaders and the military, we see a somewhat incestuous relationship. In other words, there are many instances where those in control in the civil sector are also military personnel. In Pakistan's relatively short history as an independent nation, it has experienced either direct or

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[416] Tellis, p. 146.

[417] Khan, Zillur R., "Civil-military relations and nuclearization of Indian and Pakistan," *World Affairs*, v. 166, Summer 2003.

[418] Klair, H.P.S., "Force Structure of the Army and Higher Decision-Making," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxiv, no. 4, July 2000.

indirect military control for half of the time since independence due to a cycle of corruption and lackluster performance on the part of government.[419] This cycle of poor performance and subsequent military intervention has allowed the military to emerge as the most uncorrupt and efficient organization in the country.[420] As a result, we see a situation where civil administration has become more militarized and the military community has more duties that are traditionally considered to be under the dominion of the civil administration. Recently, the military has been assigned to such tasks as conducting the census, managing the service sector, monitoring state supported schools, and judicial proceedings.[421] All of these are considered civil administrative roles in states with more traditional, stronger democratic institutions.

In terms of the framework, this situation actually works out in favor of Pakistan's military capabilities. There is broad access on the part of the military to civilian leaders as many of the civilian leaders are either current or retired military personnel. Furthermore, military leaders are not only capable of securing funding and controlling procurement, but they are largely in control of the budgetary process for military funding. Military and defense spending lie almost entirely outside the bounds of the civilian government.[422]

Civil-Military Relations - India

Variables	Indicators	Score*
Nature and level of access of military leaders to civilian leaders	N/A	2
Ability of military to secure funding	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[419] Lodhi, Maleeha, "Pakistan: Back to the Future," *The World Today*, November 1999.

[420] Patlanaik, Smruti, "Civil-Military Coordination and Defence Decision-Making in Pakistan," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxiv, no. 5, August 2000.

[421] Changappa, Bidana, "Pakistani Military Role in Civil Administration," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxiii, no. 2, May 1999.

[422] Patlanaik.

Civil-Military Relations - Pakistan

Variables	Indicators	Score*
Nature and level of access of military leaders to civilian leaders	N/A	2
Ability of military to secure funding	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Foreign Military-to-Military Operations

With the fast-paced nature of change in technology, it is highly desirable for a country's military to have close relations with its counterparts in other countries. Combined exercises, training and technology swapping offer an opportunity for an inexperienced or weak military to develop better problem-solving skills and learn new techniques that it can then adapt to its own situational requirements.[423] In order to gauge the nature of a country's foreign military-to-military relations, one must look for joint exercises and training as well as any changes in a country's doctrine, training, organization, or equipment that have come about as a direct result of its friendly engagement with military forces in other nations.[424]

India's traditional partner in the advancement of its military technologies has been the former Soviet Union. The fall of the Soviet Union and a warming of relations with the U.S. prompted India to look other places for its needs in the military sphere. Israel became an important partner in India's struggle to upgrade its aging aircraft and Israel has expanded its role to include helping India with the development and application of technologies in the areas of Light Combat Aircraft, surveillance equipment, missiles, Fast Attack Aircraft, and Main Battle Tanks. Russia continues to be an integral part of India's military procurement picture, but Israel has truly embraced India, at least in the areas of technology and equipment. Limitations in this relationship become apparent when we learn that many of the components of Israeli military equipment and technology are supplied to Israel by the U.S., the most sensitive of which, Israel is prohibited to export to India. The U.S., however, has begun in recent years to export certain military equipment and technologies directly to India.[425]

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[423] Tellis, p. 148.
[424] Tellis, p. 149.
[425] Naaz, Farah, "Indo-Israel Military Cooperation," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxiv, no. 5, August 2000.

In addition to the relationships that India has built with foreign militaries relating to equipment and technology, the Indian Army is building military-to-military relationships through the practice of joint exercises. In May of 2003, India conducted joint military exercises with the U.S. While these operations were of limited significance militarily, they were very significant politically and will likely pave the way for a continued and probably closer relationship between Indian and U.S. forces and therefore represent a huge step in national relations between the two countries.[426] In 2002, India held joint air and land military exercises with France and Britain[427] and has plans in the future for groundbreaking joint military exercises with Israel[428] and China[429] at separate times. The planned exercises with China are especially significant in that as recently as 1998, India named China as its largest enemy. These scheduled exercises clearly show that relations have improved since that time and will go a long way to building a more normal relationship with its northern neighbor into the future.

Pakistan's largest partner in military-to-military operations has traditionally been China. Exchanges and interactions between the two nations' armed forces have been on the rise over the past several years, especially in terms of cooperation on defense production. They are working together "in a spirit of safeguarding national sovereignty and promoting regional peace, stability and development.[430] China has long served as a source of military equipment weapons production and modernization facilities, and the two countries have recently renewed their commitment to joint projects in the aviation industry as well as advancing army-to-army exercises.[431] Other nations with which Pakistan conducts military-to-military exercises include the United Arab Emirates and Iran. The UAE and Pakistan have forged stronger defense ties over the past year.[432] Over the past two years, Pakistan and Iran have also begun to forge closer defense ties. They have decided to hold joint military exercises and held official talks to outline what will become the largest military-to-military operations between the two countries. Past exercises had been limited to small maritime activities, training, and small-arms sales. The U.S.-led war on terrorism has also served to bring Pakistan and Iran together as they try to balance

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[426] Ganguly, Sumit, "The start of a beautiful friendship? The United States and India," *World Policy Journal*, v. 20, i. 1, Spring 2003.

[427] "India, France, Britain hold joint air, land, military exercises," *Asia Africa Intelligence Wire*, November 28, 2002.

[428] "Report says India, Israel to hold military exercises," *Xinhua News Agency*, September 23, 2003.

[429] Abdi, S.N.M., "India open to military exercises w/ China," *Asia Africa Intelligence Wire*, October 9, 2003.

[430] "Top-Level Chinese Military Delegation Arrives Islamabad Monday," *Global News Wire*, March 22, 2004.

[431] "Pak-China Agree to Enhance Cooperation in Defence Sector," *Global News Wire*, October 22, 2003.

[432] "UAE Armed Forces Chief to Visit Pakistan," *The Pakistan Newswire*, March 24, 2004.

power against a growing influence in their region.[433] Turkey is yet another nation with which Pakistan is conducting military to military operations. In an effort to improve the professional skills of the forces of both countries, Turkey and Pakistan held joint exercises in late 2002. They were considered a success on both sides.[434] Finally, Pakistan expanded its cooperation with other nations operating in the Indian Ocean when it participated in Arabian Shark, a joint maritime exercise including the US, UK, France, Italy, Spain, Australia, Kuwait, and Bahrain. The goal was "to promote joint staff planning, enhance inter-operability and further strengthen maritime cooperation" and was considered a success by all involved."[435]

Perhaps the most remarkable partner that has recently agreed to hold joint military to military operations with Pakistan is the U.S. In return for Pakistan's support in the war on terrorism, the U.S. government has designated Pakistan as a "major non-NATO ally."[436] With this designation comes the opportunity for enhanced military cooperation as well as arms sales.[437] While the military operations being currently conducted relate more to training than to operations, the door has certainly been opened to deepening these linkages.

There is nothing concrete to indicate that there have been any changes in the armed services doctrines as a result of friendly relations between the militaries of Pakistan and the other above-mentioned countries, but the training experience and war-gaming cannot go unnoticed by the military elites in Pakistan. Furthermore, it is clear that close cooperation with its military counterparts in other countries has resulted in changes in equipment as we see in the literature on military-to-military cooperation between Pakistan and China.

Foreign Military-to-Military Operations - India

Variables	Indicators	Score*
Presence of joint exercises and training	N/A	2
Changes in doctrine, training, equipment or organization	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

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[433] "Pakistan, Iran to hold 'largest ever' joint military exercises," *Asia Africa Intelligence Wire*, December 24, 2002.
[434] "Pakistan military in joint exercise with Turkish commandos," *Asia Africa Intelligence Wire*, September 9, 2002.
[435] "Pakistan Navy participates in Arabian Shark-2004," from www.dailytimes.com.pk/print.asp?page=story_1-4-2004_pg7_56, downloaded April 12, 2004.
[436] "US rewards Pakistan with elite military status despite nuclear concerns," from http://sg.news.yahoo.com/040318/1/3iv6h.html, March 18, 2004, downloaded April 12, 2004.
[437] "US rewards Pakistan…"

Foreign Military-to-Military Operations - Pakistan

Variables	Indicators	Score*
Presence of joint exercises and training	N/A	2
Changes in doctrine, training, equipment or organization	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Doctrine, Training, and Organization

Doctrine, Training, and Organization lay at the very base of successful military operations. Equipment and people are not useful resources unless they are properly linked and the people are trained to be skillful problem-solvers. Having the latest technology and equipment and having a massive manpower pool will do little good militarily without the ability to join the two through doctrine, training, and organization.[438]

Doctrine

Examining a nation's military doctrine should reveal how its military uses its resources on the battlefield.[439] It appears that India has struggled with even comprehending the term doctrine and applying it to its military. Each branch of the armed services has its own single service doctrine and the armed services in India operate almost totally independently of one another. As mentioned, they plan separately, but they also train separately for the most part, although slow strides toward a joint doctrine for the Indian military have been made in recent years. Overall, the Indian Army has little experience in large, theater-level joint operations. This lack of joint doctrine affects how the Indian military uses its assets on the battlefield in that whole branches of the military and all of their concomitant supplies are rendered useless under certain circumstances. For example, the Indian Navy cannot support the Army in operations against Pakistan along its coast because it has not trained for the type of close support that would be required in that situation due to a lack of doctrinal direction. The disparate nature of these doctrines and service-to-service rivalries prevent the effective use of the total force in a

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[438] Tellis, p. 149.
[439] Tellis, p. 150.

synergized fashion.[440] No war can be won with the use of a single branch of the military and the lack of a joint doctrine greatly hinders India's ability to do battle.

Little is written about Pakistan's armed services doctrine. We know that the country has a defensive military strategy overall, but there is little to indicate how Pakistan actually uses its resources on the battlefield. As discussed earlier, we understand that the Pakistani Navy is the weakest link in its armed services therefore indicating that there would be a lack of synergism between the armed services in the even of a military altercation, and that the military in general has been unsuccessful in some recent military campaigns in the Kashmir region. Furthermore, the new non-NATO ally status given to Pakistan by the U.S. means a likely change in the resources that Pakistan will have available to it and thus a change in how they will use their resources on the battlefield. Unfortunately, however, not much more can be said with regards to Pakistan's overall military doctrine. That being the case, we can still briefly discuss one component of Pakistan's military doctrine, that is, its nuclear doctrine. It has embraced a strategy of credible deterrence, attempting to balance power against India's far greater conventional forces and at the same time, create a convincing deterrent to war in general.[441]

Training

Training is an obvious component of successful military operations. Inadequately trained forces will be ill-equipped to deal with fast-paced operational changes and will ultimately fail to make good use of their resources.[442] The Tellis text does not, however, suggest how one might assess a country's training program. We have already discussed both India's and Pakistan's various educational institutions charged with educating and training their respective military personnel. We have also learned that both India and Pakistan conduct joint exercises with a number of other countries thus receiving some battlefield simulation-style training. Outside of those two types of training and without further instruction from the text on how to best assess the extent or quality of training, the information in this category will remain inadequate.

Organization

An examination of the organization of a country's military is also crucial to determining its conversion capabilities. The question one should strive to answer through the course of such

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[440] Anand, Vinod, "Achieving Synergies in Defence," *Strategic Analysis: A Monthly Journal of the IDSA*, v. xxii, no. 10, January 1999.

[441] Aqil, Pano, "President outlines Pakistan's deterrence policy, *The Pakistan Newswire*, October 23, 2000.

[442] Tellis, p. 150.

an examination is: "Is the organizational structure of the force optimal for the missions it is tasked with executing?" [443]

Tellis, et al. actually use India as an example of a military whose force size and inventory would lead one to believe that it would be a devastating force on the battlefield but whose organizational structure is such that it greatly reduces its combat power.[444] When examining the organization structure of the Indian military, we come immediately back to the concept of the very separate nature of its armed services. Each branch has its own Chief of Staff. These individuals make up the Chiefs of Staff Committee. What is remarkable is that the COSC is largely disconnected from government. In fact, the Service Chiefs do not even serve as the primary professional advisers to the Minister of Defence.[445] One does not even need to venture into the lower echelons of force structure to answer the core question of whether the military is properly organized so that it may effectively meet the challenges that it faces. The peninsular nature of the country and the disputed borders with China and Pakistan require integration of forces in order to best defend itself, and the current organization of the heads of the armed forces does not allow this to occur.

This, again, is a more difficult assessment to make as far as the Pakistani military is concerned. Available literature does not indicate that there is a problem with the way the military is organized, other than the fact that the Navy has some issues, nor does it put Pakistan up as an organizational model. The fact that there is corruption high in the ranks of the military, as discussed earlier, however, does not bode well for a strong organizational structure. A policy of promotion based on nepotism rather than achievement can upset organizational structure at its most basic level and can create havoc in the command and control sectors of the armed services.

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[443] Tellis, p. 151.
[444] Ibid.
[445] Anand.

Doctrine, Training, and Organization - India

Variables	Indicators	Score*
Doctrine	battlefield resource use	2
Training	not laid out in the text	0
Organization	proper connection between organization and missions	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Doctrine, Training, and Organization - Pakistan

Variables	Indicators	Score*
Doctrine	battlefield resource use	1
Training	not laid out in the text	0
Organization	proper connection between organization and missions	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Capacity for Innovation

The last component of conversion capability is a military's capacity for innovation. The Tellis text, in an effort to identify how best to measure a military's capacity for innovation, presents a synopsis of the extensive literature available on the subject. According to Tellis, et al., the three dominant schools of thought on military innovation are the neorealist, societal, and organizational theory schools.[446] Neorealists believe that those militaries facing a more hostile security environment are necessarily innovative. Societal thought puts a military's ability to innovate on societal conditions, arguing that the more cohesive the society supporting the military, the more effective and innovative that military will be.[447] The last school of thought, organizational theory, is based on the idea that certain states have organizational characteristics that lend themselves to military innovation. Tellis, et al. identify three approaches to looking at organizational theory: the rational systems approach, the open systems approach, and the national systems approach. The researchers conclude that the natural systems approach is the

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[446] Tellis, p. 152.
[447] Tellis, p. 153.

best one for analyzing military innovation due to the fact that the other approaches rely on the idea that the military is a rational actor, which cannot be necessarily assumed.

The natural systems approach can be further divided into the institutionalist and professionalist schools. The institutionalist school posits that the military is more concerned with institutional well-being than innovation and will be unlikely to innovate due to its generally conservative nature. The military, according to institutionalists, will be more likely to focus on immediate needs than long-term vision.[448] Professionalists hold the view that the military is, by nature, focused on its job: maximizing its state's security. Professionalists believe that the military's chances of successful innovation are relatively good due to the fact that, under certain conditions, organizations can learn.[449]

In presenting these various approaches to assessing a military's chances of successfully innovating, the researchers set the stage for a comprehensive examination and argue that answering certain questions based on the three major perspectives will create a clear picture of a country's capacity to innovate. One should attempt to answer the following questions:

1. Does the country in question face a high threat environment?
2. Does the country seek to pursue revisionist aims
3. Does the country in question face high resource constraints?
4. Does the country in question exhibit high societal cohesion and how is this cohesion (or lack there of) reflected in the military?
5. Has the country/military force in question experienced conspicuous failures in the past?
6. Are there identifiable "product champions" within the military?
7. Are there plausible paths for career enhancement as a result of resolving existing technological, organizational, or doctrinal problems facing the military?[450]

Tellis, et al. posit that while these questions will reveal mostly qualitative information, the absence or presence of the elements identified will make a difference in the military's ability to add warfighting competencies to its arsenal.[451] I will attempt to answer each question in turn.

1. Both India and Pakistan, in fact, face a high threat environment. The ongoing insurgency in the Kashmir region has become extremely volatile at times, bringing India and

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[448] Tellis, pp. 153-154.
[449] Tellis, p. 155.
[450] Tellis, p. 156.
[451] Tellis, p. 157.

Pakistan close to war even in recent years. Furthermore, India has an enormous conventional military force and nuclear power in the form of China bearing down on it from the north in addition to the threat it faces in Pakistan. On the other side of the coin, Pakistan has the force of the Russian military bearing down on it in addition to the threat it faces from India. The nuclear status of these countries and the very real possibility of conflict with them make both countries' national security threat level high.

2. The idea of revisionist aims is a difficult concept when discussing India and Pakistan and is one that has been discussed in an earlier section on the pursuit of irredentist goals contained in this composition. The dispute over the Kashmir region has both sides technically pursuing revisionist aims in that they are each trying to claim the territory as their own. The international community sees the Indian struggle for the territory as the more legitimate one, but only time will tell in whose favor the resolution of the conflict will be.

3. Both India and Pakistan face certain resource constraints, mostly related to their generally poor budgetary conditions. We see a situation in Pakistan, however, where there is little to stop the military from taking as much of the overall budget as it desires and putting it toward military expansion, etc. due to the lack of civilian check on the military regime. So while each country faces the same resource constraint, the Pakistani military is in a better position as it can take a bigger piece of the pie, no matter how small the pie might be.

4. Societal cohesion in the two countries has also been reviewed in an earlier section of this composition. The conclusion was reached that neither country has a particularly cohesive society. There are many social cleavages pitted in differences in language, religion, class, caste, region, and ethnicity. Efforts by India's political leaders to unify India under the auspices of a common Indian nationality have met with little success. It does not appear, however, that this lack of cohesion at the societal level translates into problems in the military. As mentioned earlier, the Indian Armed Services have gone to great lengths to insure that recruiting is conducted in a fair way with no discrimination in the basis of ethnicity, class, caste, religion, etc. The Pakistani government has also taken some steps in its recruitment process to insure that there is social balance in its military forces,

however, the literature on whether or not any social cleavages hinder the military was sparse.

5. India has indeed had conspicuous military failures in the past. Its devastating loss to China and the massive casualties that India suffered in both of its wars with Pakistan are glaring examples of these failures. For Pakistan, the lack of decisive success in the Kashmir and the devastating surrender of 90,000 troops in the conflict with India over East Pakistan serve as examples of significant military failures.

6. The Tellis text intends to draw attention to so-called "product champions" within the military in seeking the answer to this question. This term, however, is not expanded upon or defined in any way within the context of the military's capacity to innovate and therefore this question is virtually unanswerable.

7. It is unclear whether the Indian or Pakistani militaries reward those who successfully solve problems in the military related to problems of technology, organization, or doctrine. We do know, however that there are definite paths to becoming an officer in the Indian Armed Services. All of the mechanisms currently in place for becoming an officer are related to education and testing, and do not appear to be based on reward for innovation. In Pakistan, as has been touched on in other areas, innovation is not as important as cronyism and nepotism in securing a higher rank in the military. Career enhancement is largely not based on one's ability to innovate.

In answering the above questions, we see both in India and Pakistan a situation where there is a high threat environment, a precursor to innovation in the neorealist view; low social cohesion, a detriment to innovation in the societal view; a military that faces resource constraints in the form of budget shortfalls, and conspicuous past military failures, all barriers to innovation in the organizational theory view. These issues point to the likelihood that neither military is oriented toward innovation based on the outline for what constitutes an orientation toward innovation in the framework.

Capacity for Innovation - India

Variables	Indicators	Score*
Does the country in question face a high threat environment?	N/A	2
Does the country seek to pursue revisionist aims?	N/A	2
Does the country in question face high resource constraints?	N/A	2
Does the country in question exhibit high societal cohesion and how is this cohesion (or lack there of) reflected in the military?	N/A	2
Has the country/military force in question experienced conspicuous failures in the past?	N/A	2
Are there identifiable "product champions" within the military?	N/A	0
Are there plausible paths for career enhancement as a result of resolving existing technological, organizational, or doctrinal problems facing the military?	N/A	1

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Capacity for Innovation – Pakistan

Variables	Indicators	Score*
Does the country in question face a high threat environment?	N/A	2
Does the country seek to pursue revisionist aims?	N/A	2
Does the country in question face high resource constraints?	N/A	2
Does the country in question exhibit high societal cohesion and how is this cohesion (or lack there of) reflected in the military?	N/A	2
Has the country/military force in question experienced conspicuous failures in the past?	N/A	2
Are there identifiable "product champions" within the military?	N/A	0
Are there plausible paths for career enhancement as a result of resolving existing technological, organizational, or doctrinal problems facing the military?	N/A	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Combat Proficiency

The ability to successfully carry out combat missions is the "ultimate output" of any military establishment. Tellis, et al. point straight away to the fact that measuring combat proficiency is an extremely difficult task. The researchers lay out a complicated methodology for doing so, based in the work of Jeffery Isaacson. Isaacson developed a framework for assessing warfighting capabilities that involves looking at these capabilities in ground, naval, and air operations.[452] Capabilities in these areas can be organized along a spectrum that increases in complexity.[453] Determining the level at which a country is operating in each of the areas of ground, naval, and air capabilities allows one to compare combat proficiency across countries and over time.

Tellis puts forth a spectrum of capability for each combat area. For the purposes of this analysis, I will give each point on the spectrum a number and treat them as building blocks. In other words, if a country has achieved the highest level, it can be assumed that it has capabilities at the lower levels, since, according to the text, one builds from the lowest level, adding technologies and integrating forces and equipment to reach the highest level.

Ground Warfare

The spectrum of ground warfare capabilities ranges from irregular infantry operations at the simplest end to full knowledge-based warfare at the most complex level. In total, there are nine points along the ground warfare capabilities spectrum.[454] Starting at the highest level and work down the spectrum, one can rule out levels based on equipment or techniques that a country does not possess, thus determining the highest level that a country has achieved.

According to the Tellis text itself, no country has mastered knowledge-based warfare, but the U.S. is perhaps the closest. One can safely say that India has not reached the highest level of ground warfare capabilities. The next step down the spectrum is adaptive warfare capabilities. A country that has achieved this level can launch deep attacks using excellent intelligence data. Also, there is a rapid decision cycle present at this level of combat proficiency.[455] As is clear from the literature on India's handling of the 1999 Kargil aggression, the Indian Army has not

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[452] Tellis, p. 158.
[453] Tellis, p. 159.
[454] Tellis, pp. 162-163.
[455] Tellis, p. 164

yet reached this level. Intelligence was poor and the decision cycle was slow due to the disconnect between government and military officials.

Down from adaptive warfare on the spectrum is joint warfare. One key component at this level is an integrated fire plan that includes coordinated ground, air, and sea strike capabilities.[456] Even without assessing India's capabilities in the other components of joint warfare, one can state with confidence that India has not achieved this level of combat proficiency on the ground. The lack of joint planning does not allow India to have the type of integrated fire plan found at this level on the spectrum.

Following joint warfare on the spectrum is full combined arms. This level is characterized by the use of full combined arms task forces, basic joint operations (mainly in the form of close air support), and medium quality night vision equipment. We saw the use of basic joint operations by the Indian Army and the Indian Air Force in the 1999 Kargil conflict, and we know that the Indian Army has brigade and in some cases regiment-size combined arms groups.[457] Furthermore, we know that India performed day and night operations in the Kargil conflict and therefore possesses at least medium quality night vision equipment. The fact that India meets the major criteria for having achieved the full combined arms level of combat proficiency on the ground makes it a six on the scale of one to nine in assessing ground warfare capabilities according to the Tellis framework.

In examining combat proficiency on the ground for Pakistan, the same qualifying statement that applied regarding knowledge-based warfare when discussing India applies to Pakistan. Only the U.S. has even come close to achieving this level of combat proficiency, so it is necessary to assess Pakistan's proficiency on a lesser level. Based on what, according to the Tellis text, is required to reach proficiency at the adaptive warfare level, we can see that Pakistan has not yet reached that level either. The Inter-Services Intelligence unit is supposed to work with the Joint Chiefs of Staff Committee to integrate and coordinate the services based on available intelligence. The large number of Inter-Services Intelligence unit employees, the fact that it has become less and less accountable to either the military or civilian leadership which has led to corruption and involvement in the illicit drug trade, and the fact that there have been

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[456] Tellis, p. 163.
[457] "Army," from http://www.globalsecurity.org/military/world/india/army.htm, downloaded April 21, 2004.

massive intelligence failures as recently as 1999[458] with no indication of learning from these incidents leads us to conclude that Pakistan has a low level of proficiency in adaptive warfare as it requires excellent real-time intelligence and a quick decision cycle based on that intelligence. Furthermore, Pakistan has poor joint warfare capabilities according to the Center for Strategic and International Studies.[459] The problem has largely been one of integrating the Navy with operations involving the Army and Air Force, as the Navy is considered Pakistan's weakest link.

Pakistan does not generally have or want a mechanism or mechanisms to disseminate information concerning its military operations. In fact, open-source reporting on military operations is virtually non-existent.[460] This makes assessing combat proficiency on the ground for Pakistan difficult as it is necessary to look at past operations to determine capabilities. That being said, there are troops charged with combined arms operations within the Pakistani armed forces[461] and more than half of the Pakistan Air Force is devoted to close air support,[462] the two major components of full combined arms capabilities. Furthermore, Pakistan has received night vision goggles and the necessary training to operate and integrate them from the United States.[463] This gives Pakistan the same footing as far as the possibility of 24-hour operations. These three factors combine to make Pakistan a six on the scale from one to nine according to the specifications in the framework for combat proficiency on the ground.

Naval Warfare

Naval force competencies in the Tellis framework are arranged on a spectrum from coastal defense and mining at the lowest, least complex level to comprehensive sea control at the highest, most complex level of the nine naval combat proficiencies in the framework. Comprehensive sea control, according to the researchers themselves, is something to which even the U.S. army can only aspire at this point.[464] This eliminates comprehensive sea control as a proficiency level reached by either India or Pakistan.

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[458] "Directorate for Inter-Services Intelligence (ISI), from
http://www.globalsecurity.org/intell/world/pakistan/isi.htm, downloaded April 20, 2004.
[459] Cordesman, p. 4.
[460] Tellis, et al., Limited Conflict Under the Nuclear Umbrella, Rand Corporation, 2001, p. 29.
[461] "Structure of Field Formations," from http://orbat.com/thelastround/forcesummary.html, downloaded April 21, 2004.
[462] "Air Force," from http://www.fas.org/nuke/guide/pakistan/agency/paf.htm, downloaded April 21, 2004.
[463] "US says reforms need in Pak law enforcement agencies," The Press Trust of India Limited, February 14, 2004.
[464] Tellis, p. 170.

The next step down from comprehensive sea control on the naval warfare proficiency spectrum is multi-mission air control, limited sea control, and deep strike capabilities. Equipment and operations at this level include advanced aircraft carriers capable of launching specialized aircraft, high-speed communications systems, and advanced cruise missiles.[465]

India has only one aircraft carrier active in its current fleet as mentioned earlier. This is a Centaur Class vessel and does not meet the criteria outlined above for what constitutes an "advanced" aircraft carrier. It does have the Italian Elmar communication system, and has SATCOM systems on board; however, it is not fitted with cruise missiles, and it cannot handle conventional take-off and landing aircraft.[466] For these reasons, we must say that India does not meet the criteria for this category of naval combat proficiency.

The next category down on the spectrum is naval strike and limited air control. At this level, a country is able to project its power from ship to shore. This level of proficiency also requires an aircraft carrier, but one with aircraft capable of light attack. It must be equipped with satellite imagery or land-based maritime patrol aircraft and be integrated with the rest of the fleet. Coordinated with the aircraft carrier must be guided missile frigates, destroyers and cruisers.[467] SATCOM systems are capable of receiving satellite imagery, and the aircraft on board the carrier are BAe Sea Harrier FRS Mk.51 / T Mk.60 which have strike, reconnaissance, and ASV roles. Furthermore, the Indian Navy has guided missile frigates, destroyers, and cruisers.[468] The Indian Navy is in the process of acquiring a Russian Kiev class aircraft carrier and the accompanying MiGs. While this puts India on the cusp of multimission air control, limited sea control, deep strike proficiencies, and other aspects of so-called "blue water" capabilities, it has not quite reached that level at present. At first glance, given the above, it may seem as though India has reached this level of proficiency, however, the one aircraft carrier in its fleet is largely considered to be symbolic. While it does have light attack aircraft, there are only six of them, and it does not appear that the aircraft carrier is used as the valuable asset that this type of vessel could be in any country's arsenal. It is not fully integrated with the rest of the fleet and there is no evidence that the carrier is a major part of training exercises.[469]

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[465] Tellis, p. 169.
[466] "Centaur Class," from http://www.bharat-rakshak.com/NAVY/Viraat.html, downloaded April 21, 2004.
[467] Tellis, p. 169.
[468] "Centaur Class."
[469] Cordesman, p. 6.

Down on the spectrum from naval strike and limited air control is anti-submarine warfare with submarines. This level of proficiency requires passive sonar operations and advanced fire control training. Possession of nuclear submarines or one of the late model diesel submarines such as the German Type 209 or the Russian Type 636 Kilo, and the logistics to support them, therefore, are imperative in reaching this level.[470] India does have Kilo class submarines with the quiet diesel-electric propulsion system and sonar capabilities that make it excellent for anti-surface warfare in its current fleet.[471] Officers receive specialized anti-submarine training at the Goa Naval Academy[472] and India has conducted anti-submarine warfare exercises both solo and with other countries[473] which is an indication that the type of coordination necessary to successfully execute anti-submarine warfare with submarines is present in the Indian Navy. This puts the naval combat proficiency level for India at a seven on a scale from one to nine.

Pakistan does not have any aircraft carriers, symbolic or otherwise, in its current fleet and can therefore not be said to have achieved either of the highest two levels of naval combat proficiency. It has recently finished indigenous construction of the Agosta 90 B submarine, however, that has sophisticated sonar equipment, a quiet diesel-electric engine, and the ability to fire anti-ship missiles and other torpedoes.[474] Furthermore, Pakistan has used the Agosta submarines in a variety of missions, including long patrols, military-to-military exercises with a number of other countries.[475] Given the above, Pakistan also meets the criteria in the Tellis text for being rated at a seven on a scale from one to nine in naval combat proficiency.

Air Warfare

Air combat proficiency is set out in the Tellis reading in a similar fashion to ground and naval proficiency in that there is also a scale of achievement set forth. There are also nine levels on the air combat proficiency scale, the lowest being airspace sovereignty defense, and the highest being suppression of critical mobile targets and information dominance.[476] Again, this highest level is considered an ideal at this point as no air force has managed to fully reach it.[477]

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[470] Tellis, p. 168.
[471] "World Navies Today: India," from http://www.hazegray.org/worldnav/, downloaded April 25, 2004.
[472] "The Indian Navy" from http://www.globalsecurity.org/military/world/india/navy-intro.htm, downloaded April 25, 2004.
[473] "Indian, French Navies Begin Joint Exercises Off Goa Coast," *Dow Jones International News*, April 7, 2004.
[474] "Navy gets Agosta 90 B Saad today," *The Daily Times*, April 26, 2004, from http://www.dailytimes.com.pk/default.asp?page=story_1-12-2003_pg7_2, downloaded April 25, 2004.
[475] "Agosta," from http://www.globalsecurity.org/military/world/europe/agosta.htm, downloaded April 25, 2004.
[476] Tellis, pp. 172-173.
[477] Tellis, p. 175.

To achieve proficiency at the next highest level, advanced SEAD, a force must have low observable aircraft and munitions, jamming capabilities, intelligent anti-radiation missiles, and air expeditionary wing capabilities. The force must have extensive combat, control and communications training, air controller training, etc. The U.S. Air Force remains the only force that has reached this level of air combat proficiency.

The next level down on the spectrum is offensive counterair, advanced strategic strike, and advanced deep interdiction capabilities. Achievement of this level means that a force must be able to perform decisive offensive counterair campaigns including airbase suppression through an interdiction campaign that can be run twenty-four hours a day and under any weather conditions, and sophisticated navigation and ground surveillance radars. In addition, the force must have bunker busters, and air launched cruise missiles with GPS guidance. [478]

The Indian Air Force is capable of sustaining 24 hour a day operations and thus has all of the necessary surveillance and navigational equipment required to perform such operations. One recent example of this occurred in the 1999 Kargil conflict. [479] Furthermore, the Indian government, in conjunction with the Russian government has developed the BrahMos guided cruise missile. This particular missile is amazingly capable in that it travels faster than the speed of sound and is equipped with an extremely accurate GPS system. The BrahMos has air launch capabilities as well. [480] The fact that the Indian Air Force has the necessary equipment and capabilities to conduct round the clock operations and has air launched, GPS controlled cruise missiles puts it close to achieving this level of air combat proficiency, but the fact that the BrahMos is a fairly new and therefore probably not well integrated into the Air Force (or the Navy for that matter) well enough to be considered a real danger to the armed services of another country keeps it from truly having reached this level.

The next level down on the spectrum is fixed-wing close air support, basic suppression of enemy air defenses (SEAD) and basic deep interdiction. A force at this level can provide direct air support to ground elements engaged in close combat, has an established SEAD capability including jamming technology, decoy and reconnaissance drones, and basic anti-radiation missiles. It is likely that a force with this level of competency will have active radar missiles,

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[478] Tellis, p. 174.
[479] "Indian Air Force: Kargil Update," from http://indianairforce.nic.in/afkargil/news3.htm, downloaded April 25, 2004.
[480] "PJ-10 BrahMos," from http://www.globalsecurity.org/military/world/india/brahmos.htm, downloaded April 25, 2004.

sophisticated airborne early warning systems and ADGES. All of these capabilities and technologies must be highly integrated for attainment of this level. This requires an emphasis on combat, control, and communications training and well-trained forward air controllers.[481]

We have already discussed the fact that India has close air support capabilities and the MiG-23s and MiG-25s that the Indian Air Force possesses are used for SEAD purposes.[482] The IAF also has spy drones in its inventory.[483] We have also discussed India's ample ADGES capabilities, however, India does not have sophisticated AEW systems already in place, although purchase of such equipment from Israel is in the first phase of negotiations.[484] It is not clear that India has many of the other necessary components of this level of competency such as anti-radiation missiles, active radar missiles, or extensive C3 training. We must therefore move to the next level down the spectrum to continue this analysis.

This level is battlefield air interdiction, basic strategic strike, and maritime strike. Achievement here involves the possession of basic attack aircraft, ground surveillance radars, cluster munitions, and basic anti-armor PGMs. Air launched cruise missiles and aerial refueling technologies are components of this level of achievement as well.[485]

India seems a good fit for this category of air combat proficiency. India has basic, even advanced, attack aircraft,[486] ground surveillance radars,[487] cluster munitions,[488] and PGM capabilities.[489] We have already discussed the fact that India does possess air launched cruise missiles, and it appears that it also has aerial refueling technologies in place, if only recently.[490] While the Indian Air Force is an extremely large force, the fact that it has apparently mastered this level of proficiency and has several components of the next category up on the spectrum allows a score of just 5.5 on a scale from one to nine.

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[481] Tellis, p. 174.

[482] "Indian Air Force Aircrafts," from http://www.defenceindia.com/def_common/airforce_aircrafts.html, downloaded April 25, 2004.

[483] "India's new "Lakshya" pilotless spy drone clocks successful flight," *Agence France Presse*, February 5, 2004.

[484] "Phalcon," from http://www.globalsecurity.org/military/world/india/phalcon.htm, downloaded April 26, 2004.

[485] Tellis, p. 171.

[486] "Air Force Equipment," from http://www.globalsecurity.org/military/world/india/air-force-equipment.htm, downloaded April 26, 2004.

[487] "India Defence Consultants," September 1, 3002, from http://www.globalsecurity.org/military/world/india/air-force-equipment.htm, downloaded April 26, 2004.

[488] "National Briefings: India," from http://www.cdiss.org/india_b.htm, downloaded April 26, 2004.

[489] "India's missile programme is spurring industries," from an interview with Dr V. K. Saraswat, Director, Research Centre Imarat, from http://www.thehindubusinessline.com/2004/02/06/stories/2004020601500900.htm, downloaded April 26, 2004.

[490] Joseph, Josy, "IAF puts its UAVs and refueling tech on display," from http://in.rediff.com/news/2003/oct/08iaf.htm, downloaded April 26, 2004.

Pakistan does not have either true 24-hour operational capabilities or air launched cruise missiles with GPS technologies. Its current missile arsenal is relegated to land-based SRBMs.[491] These are two of the major criteria for having reached the first possible attainable level on the spectrum after the ideal air force proficiency scenario (number nine on the scale) and the level that only the US Air Force has achieved (number eight on the scale) and therefore, we must move to the next level down the spectrum as Pakistan has not yet achieved this level.

In putting the Pakistani Air Force up against the framework at the next level down the spectrum, we see some progression, but not a true attainment of the level of proficiency. Pakistan does have UAVs or drones in its current inventory.[492] There is no evidence that it has basic anti-radiation missiles, active radar missiles,[493] or advanced early warning aircraft.[494] While Pakistan is attempting to purchase some of this technology from abroad (namely from China), the orders have either been slow to materialize or have fallen through all together. It is also unclear whether Pakistan has the ADGES systems necessary for this level of proficiency. It is thus necessary to move to the next level down to determine Pakistan's air combat proficiency.

At the next level down the spectrum, which is battlefield air interdiction, basic strategic strike, and maritime strike, we see and even greater propensity toward having achieved it. Pakistan has basic attack aircraft such as the F-16 and the Mirage III and Mirage 5, with the F-16 being the most sophisticated.[495] Furthermore, Pakistan has ground surveillance radar equipment at present and is attempting to upgrade that equipment via a newly negotiated deal with the US,[496] it has cluster munitions in its current inventory, and it has precision guided missiles in its arsenal.[497] Pakistan has had midair refueling technology since the late 1990s,[498] but does not have air launched cruise missiles. The possession of air launched cruise missiles, however is at

[491] "A Detailed Assessment of Pakistan's Missile Capacity, in the eyes of US experts," The South Asia Tribune, i. 82, March 7-13, 2004.

[492] "UAV Flight in Pakistan," from http://www.uavflight.com/UAV_Gallery_Pakistan.htm, downloaded April 26, 2004.

[493] Hewson, Robert, "Chinese Missile may be for Pakistan's F-16s," Jane's Defence Weekly, April 21, 2004.

[494] Badri-Maharaj, Sanjay, "Strategic Air Defences in a Nuclear South Asia," from http://www.bharat-rakshak.com/IAF/Info/SAD.html, downloaded April 26, 2004.

[495] "Nuclear Weapons Database: Pakistani Nuclear Delivery Systems," from http://www.cdi.org/issues/nukef&f/database/panukes.html, downloaded April 26, 2004.

496 "PAF To Receive AN/TPS-77 Air Surveillance Radars Soon," from http://www.pakistanidefence.com/news/FullNews/2004/March2004/antps77Radars_soon.htm, downloaded April 26, 2004.

[497] "Pakistan develops anti-tank guided missile," *PakTribune*, April 21, 2004.

[498] "The end of nuclear virginity…," from http://www.rediff.com/news/1998/may/12rajeev.htm, downloaded April 26, 2004.

the outer edge of the capabilities necessary to fulfill the requirements of this level, and therefore, Pakistan can be considered a five out of nine on the scale presented in the Tellis text for air combat proficiency.

We see a situation in the area of combat proficiency where India is at a higher level than Pakistan in terms of only air combat proficiency according to the standards for equipment, etc. put forth in the Tellis text. The fact that the aircraft carrier in India's naval fleet is considered to be largely symbolic and not truly an integral part of its training or operations helps to level the playing field in that area, and the fact that the Pakistani Army has increased its defense budget and made upgrades to its armed services has helped it achieve a level of combat proficiency on the ground equal to that of India. The fact remains, however, that combat proficiency is just one part of what makes up a country's military capabilities. The fact that defense spending in India is growing at a rate higher than that of Pakistan and the fact that India outnumbers Pakistan in manpower and total equipment and weapons arsenals gives India a clear military edge over Pakistan despite the apparent near-parity in combat proficiencies.

Combat Proficiency - India

Variables	Indicators	Score*
Ground	level on spectrum	2
Naval	level on spectrum	2
Air	level on spectrum	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Combat Proficiency - Pakistan

Variables	Indicators	Score*
Ground	level on spectrum	2
Naval	level on spectrum	2
Air	level on spectrum	2

*0 = no available data, 0.5 = substitute data used, 1 = some data available, 2 = data requirements of framework fully met

Testing the Framework

The objective of the above exercise was to answer the question of whether national power can actually be measured in the way in which Tellis, et al. suggest that it can be in their work entitled <u>Measuring National Power in the Postindustrial Age</u>. The framework was to be judged, through the use of India and Pakistan as case studies, on two levels: 1) can a researcher with broad access to scholarly journals, books, and other open source intelligence materials as well as access to a number of related statistical databases actually hope to find all of the data, both qualitative and quantitative, necessary to flesh out the framework, and 2) if so, does the information gathered provide a meaningful way to evaluate the national power of one or two nations.

In reference to the first provision, I submitted in my introduction that if a researcher is able to gather at least some information relative to eighty-five percent or more of the total number of indicators outlined in the text, one would have a clear picture of a country's national power, based on the fact that the framework is so detailed that even eighty-five percent of the total information required to flesh out the framework would go beyond what most current models for measuring national power would deem necessary. There were a grand total of 178 indicators for a range of variables outlined in the framework. In order to meet the criteria set out at the beginning of this composition for testing this framework, one would have had to be able to find information for at least 152 (151.3 rounded) of the indicators in order to reach the eighty-five percent mark.

When attempting to assess national power for India based on the bounds of the framework, we see that information was available for 148 of the 178 indicators. If we subtract for the number of instances in which substitute data were used, the number drops to 136, and if we tally just those instances in which the requirements were fully met, the number lies at 106. For Pakistan, information was available for 124 of the 178 indicators. When the number of instances in which substitute data were used is subtracted from that total, the number drops to 118. Furthermore, when considering only the number of instances when the requirements of the framework were fully met, the number drops to 91. We see that ultimately neither country's data were sufficient to support the eighty-five percent threshold set forth at the beginning of this

composition, although India comes extremely close to that mark. As suspected, information was harder to come by, in general, for Pakistan. The above numbers indicate that the Tellis framework fails the first portion of the testing of that framework: availability of data.

There were many areas, however, where all of the information necessary to fulfill the requirements of the framework was available for both countries. These areas include aeronautics and surface transportation, energy and environmental, diffusion of innovation (alternate measure), formal and informal education, extent of savings, aggregate growth, energy stocks, external threats, nature of state interests, nature of political interests, social control, military manpower, warfighting inventory and support, civil-military relations, foreign military-to-military operations, capacity for military innovation, and combat proficiency. There were also many other areas in which most of the necessary information was available for both countries. This brings us to the second part of the test of the framework.

The second part of the test of this framework as set forth in the introduction of this composition was a more common sense-based approach. Does the framework, once fleshed out, allow a researcher to make comparisons of the two countries in the major areas outlined in the model, and do the conclusions drawn based on the data, in general, run parallel with reality? Despite the fact that the framework fails to meet the first criterion for success as outlined in this composition, a world of knowledge can be gained by organizing and gathering information based on the framework set out by Tellis, et al. Given the information gathered (remembering that the scores in the tables have nothing to do with level of achievement of country, only level of success in obtaining data) above, one sees that both India and Pakistan have an extremely long way to go in terms of becoming true players on the international scene. Both are dichotomies in terms of their level of technological acumen, with each having elements of an extremely technologically savvy nation and those of one that is backward. Both have educational systems that are sub-par in many respects, and both have problems in meeting the most basic needs of their citizens, etc. There are many other areas where India and Pakistan have comparable abilities. Often, however, when we find differences, they are not complete differences, but rather, differences of degree. In other words, for example, we can agree that both India and Pakistan have problems in their educational systems, but the crux of a good analysis allows one to determine the degree to which one is performing better or more poorly that the other. The Tellis framework allows for just that type of analysis, as it gets to some of the most minute of

indicators for variables that are often analyzed only in broad terms. As each country's capabilities in a particular area are summed up at the end of each section, it would be redundant to go into detail in this portion of the composition as to how each country performed in each section, but suffice it to say that, after reading the information above, one can truly gain insight into both countries' national power situation. Most of the information presented here does runs parallel to the widely considered notion that India has made greater strides toward becoming a true superpower than has Pakistan. The one notable exception is in combat proficiency. According to the bounds of the framework and the data collected, the Indian and Pakistani armies and navies are considered to be on equal footing and the air forces of the two countries are separated by a slim margin. The armed services in Pakistan are generally considered to be inferior to those of India, so this is one striking area where the framework does not fit well with the widely-believed notion that Pakistan is far inferior to India with regards to conventional warfare.

There are, however, some obvious weaknesses of the framework. One element of the way that the Tellis framework is laid out that creates confusion for both the researcher and the reader is the fact that, at times, the absence of a particular resource or skill set gives the appearance of failure in that area. For example, in the presentation of variables related to aeronautics and surface transportation, the framework asks for information regarding a country's inventory of hypersonic aircraft. Neither India nor Pakistan has any hypersonic aircraft in its inventory; however, no country is currently operating hypersonic aircraft, but this information has less impact when one understands that this is actually the norm. The framework addresses this concern in only one area and that is combat proficiency. Only there does it provide the reader with the necessary knowledge that no country or perhaps only one country had achieved a particular ideal.

Furthermore, the Tellis framework, in its efforts to expand thinking on how researchers should measure national power in the postindustrial age, seems to dance around some concepts without making any critical connections between them. For example, the title of the work implies on some level that our society is in the postindustrial phase. Some of the components of the framework so attempt to get at "postindustrial" concepts such as the switch in focus from the production of goods to the provision of services contained in the section on sector growth or the attempt at measuring educational attainment in the higher levels of the armed services ranks in

an effort to determine the level of critical thinking there. The problem, however, is that most of the world is not in the postindustrial age at this point. This limits the transfer and transformation of power. It is difficult, for example to apply postindustrial concepts to a country such as India which is analogous to some western countries in the mid-20th century. This difficulty aside, many aspects of what makes a society/country postindustrial such as quality of life concerns outweighing the traditional notion of the protestant work ethic as the path to happiness in life, the increase in leisure time that has come with economic well-being and affluence, and the presence of more white collar than blue collar workers are not even explored within the bounds of the framework.

Another weakness of the framework lies in its treatment of soft power concepts. These concepts, according to the person who actually created the term for them, Joseph Nye, relate to principles, political values, culture, and domestic and foreign policy. Soft power refers to the ability to win by persuasion rather than force. Soft power is often used in conjunction with hard power and allows countries to achieve their goals at a lower cost than the use of hard power alone. The framework addresses some of these concepts in the sections devoted to National Performance, but there is no mention of any link between the notion of soft power and these more qualitative aspects of the framework. Some aspects of soft power such as culture are left out of the equation all together. For example, the film industry, something not taken into consideration in the framework is extremely important to the Indian economy. In measuring national power, it is important to realize that the films and thus images coming to the U.S. from India also give India a soft power advantage over a country like Pakistan to which the citizens of the U.S. have few opportunities to make a connection. It is these soft power resources that, depending on whether one has an abundance of them or not, can determine the outcome of events. The Cold War was won with a combination of soft and hard power, for example, but the U.S. is struggling with its obligations in Iraq largely due to its dearth of soft power elements. The U.S., with all its hard power (i.e. military strength), has not been able to bring about the desired outcomes in Iraq and will likely not be able to do so until it gains ground in soft power areas.

The framework is on the cusp of embracing the notion of soft power but relies heavily on the traditional measures of hard power. So while it partially achieves the goal of taking traditional measures of hard power a step further to include some elements of the postindustrial

society and examines some elements of what might be considered soft power, it falls short of the mark in fully reaching that goal.

Other Observations and Conclusions

There were many assumptions that I made going into this endeavor that I have realized to be false upon its completion. As aforementioned, the assumption that the data would be more difficult to collect on Pakistan than on India bore itself out. What I did not correctly anticipate were the areas of the framework for which information would be most difficult to collect. I assumed that information regarding the militaries of the two countries would be nearly impossible to find in the detail required by Tellis, et al. While there were many areas of the section on military capabilities for which it was impossible to find information, the section on national resources proved to be much more difficult than I had originally thought. Technology is an area that is constantly changing. What is considered cutting edge one day is obsolete the next, and as a major component of national resources, technology caused problems relative to the collection of data for the framework. On some occasions, information that I thought should be readily available took literally hours to track down and other pieces of information that I thought for sure would be considered classified were readily available. So while information regarding the national power situation for India and Pakistan paralleled reality, my assumptions, in some cases did not.

Limitations

There some obvious limitations to the research conducted above. In a perfect world with perfect data, the framework would likely be nearly perfect for assessing national power in both India and Pakistan. The fact remains, however, that there is no such thing as perfect data. In regards to the above research, data from the same source/year were used whenever possible, but it was often difficult to achieve that ideal. Furthermore, one hurdle that is difficult for many to overcome in accepting the framework is its emphasis on military power as the ultimate yardstick for national power. The authors place special emphasis on military power as being the most important determinant of national power. Fortunately, the framework is detailed enough to require information on other areas of a country's capabilities/limitations and therefore remains pertinent despite the initial impression of its being geared mostly toward evaluation of the military. Finally, in addition to the fact that perfect data is not a reality, a perfect researcher is not a reality. I recognize that my research skills, my level of access to classified information,

and the fact that some of the available literature may be outside of channels at my disposal for research regardless of the level of their classification may have limited my ability to gather information in some areas of the framework. Even in the course of the year and a half that it has taken to complete this composition, the international situation has changed and the nature of what constitutes cutting-edge in some cases has also changed. I have attempted to be as thorough as possible so as to provide as much information as was possible to gather while realizing that there would be no way to gather every piece of information necessary. In the end, I feel that this composition adds to the body of social scientific knowledge in that it tests one framework that includes many previously unconsidered areas of a nation's being in the study of a country's national power but must conclude that it does not fully realize its goal of measuring national power in the *postindustrial* age. The exclusion of a way to measure many of the concepts that are crucial to understanding the broader notion of what it means to be postindustrial as well as the lack of more specific reference to soft power measures makes this framework more of a step in the right direction than a revolutionary new tool for measuring national power.

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