PREFACE

This report is designed as a summary of the main report, *Measuring National Power in the Postindustrial Age,* MR-1110-A. It is intended to provide the reader with the substance of the concepts and metrics for assessing national power without presenting extensive background or the analytic underpinning. Those interested in these explanations should refer to the main document.

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MEASURING NATIONAL POWER IN THE POSTINDUSTRIAL AGE: ANALYST'S HANDBOOK

The Office of Deputy Chief of Staff for Intelligence (ODCSINT), U.S. Army, tasked RAND's Arroyo Center to examine how national power ought to be understood in the context of the technical and social changes taking place today. Three concerns made such a reassessment particularly pressing:

- A growing unease with the current aggregate measures of national power used within the intelligence community.
- A growing suspicion that the nature of warfare itself may be changing in fundamental ways.
- An increasing concern that the lack of an adequate methodology to assess national power might cause the United States to miss or misinterpret incipient changes in power capability that may be taking place within many countries in the international system.

These three concerns acquire special resonance given that the Soviet Union and Iraq were classified as relatively significant powers by most aggregate indicators of capability and either collapsed through internal enervation or proved utterly ineffectual when their capabilities were put to the test in war. Both examples suggest that appreciating the true basis of national power may require not merely a meticulous detailing of tangible military assets, such as force inventories and logistics capabilities, but also an assessment of other, intangible elements such as training, doctrine, leadership, experience, readiness, and integrative skill. It also seems to suggest that standard measures of power such as GNP and annual economic growth rates ought to be situated within a larger scrutiny that

addresses issues such as the external environment facing a country as well as the aptitude of its populace for innovation, the nature of its domestic economic and social institutions, the constitution of its state-society relations, the quality of its knowledge base, and the character of its ideational ethos—all of which conceivably bear upon a country's capacity to produce the one element that is still fundamental to international politics: effective military power.

WHAT'S WRONG WITH THE WAY WE HAVE BEEN MEASURING NATIONAL POWER?

The traditional approaches to measuring national power may be summarized in the following way.

First, most traditional approaches sought to rank order the status of countries in terms of their capacity for war. The objective in most cases, thus, consisted of charting the hierarchy of capabilities in the international system, based on the premise that the capacity for war was what ultimately distinguished the power of one country from another.

Second, while the various indexes can be distinguished in terms of the number of variables employed and how they relate internally, the most conspicuous characteristic of the traditional approaches is their diversity. That is, each index differs from the others in terms of the number of states assessed, the time frames of comparison, and the complexity of formulas employed.

Third, most indexes incorporate only summational elements, that is, material elements that can be simply added, in various combinations.

Fourth, most of the indexes focus mainly on the "country" as the appropriate unit of analysis. The country here is treated as a "resource container" possessing certain measurable contents that yield an understanding of its inherent capability. Traditional approaches typically do not descend "below" the national level to examine either political institutions or ideational ethos.

Fifth, most of the indices used in the traditional indexes of power are invariably gross ones. Even measures of military capability largely

consist of gross measures like the size of inventory or the numbers of specific pieces of equipment. Both the assets counted and the resources identified as salient are clearly those that acquired significance in the industrial age, when variables such as the level of steel production, the extent of energy consumed, and the size of food stocks mattered much more than they had before.

Most studies using these approaches yield similar findings in terms of their rank ordering of national capabilities. Thus, irrespective of the variables measured or the formula of measurement employed, the most powerful countries in the system turn out to be the same across all indexes. Further, when some of the approaches attempt to measure the absolute amounts of power possessed by countries, the findings across studies seem to be even more congruent than the findings based on rank-ordered scores. In all cases, however, the similarity of findings is greatest for the developed world and least for the developing world—an outcome generally attributed to analysts' greater interest in and familiarity with the great powers as opposed to the underdeveloped countries.

The finding that single-variable measures of power turn out to be just as effective as more complex indexes for purposes of rank ordering countries—even when they focus on entirely different variables altogether—suggests that exercises in rank ordering may not indicate very much about what makes countries "really" powerful. Such exercises are not grounded in a clearly specified criterion for what makes certain nations powerful or why some nations can be said to have more power than others. Further, in focusing on rank ordering, traditional approaches to measuring power offer an "extensive" rather than "intensive" picture that depicts the global distribution of capabilities but does not enable a close and detailed scrutiny of any specific target country. Finally, most traditional indexes fail to incorporate qualitative factors that describe state capacity.

A BETTER APPROACH TO MEASURING NATIONAL POWER

The key limitation of the traditional approaches is that their methodology is inappropriate for intensively investigating national power. For the intelligence community, developing a universal hierarchy of national power capabilities is an interesting effort, but one of secondary importance. The primary objective must be to assess

the power capability of a few critical countries, one at a time. These countries must be investigated "intensively" in order to assess both the extent and the depth of their capabilities, and such investigations must proceed in accordance with some standardized "template" so as to enable both diachronic comparisons of progress and synoptic comparisons among a small group of peers. The conceptual underpinnings of this template are depicted in Figure 1. This graphic suggests that national power is ultimately a product of the interaction of two components: a country's ability to dominate the cycles of economic innovation at a given point in time and, thereafter, to utilize the fruits of this domination to produce effective military capabilities that, in turn, reinforce existing economic advantages while producing a stable political order, which is maintained primarily for the country's own strategic advantage but also provides benefits for the international system as a whole.

A THREE-LEVEL FRAMEWORK FOR DESCRIBING NATIONAL POWER

National power can be defined simply as the capacity of a country to pursue strategic goals through purposeful action. This view of national power suggests two distinct but related dimensions of capacity: an external dimension, which consists of a nation's capacity to affect the global environment through its economic, political, and military potential, and an internal dimension, which consists of a nation's capacity to transform the resources of its society into "actionable knowledge" that produces the best civilian and military technologies possible. Any effort at creating a useful national power profile must incorporate variables that capture these two dimensions.

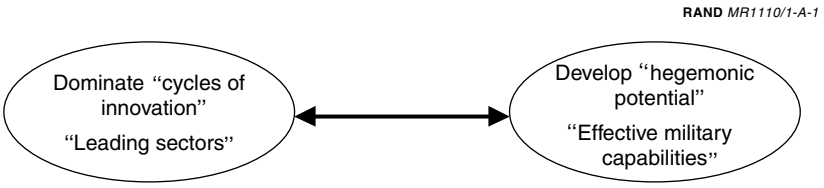

Figure 1—Explaining the Generation of National Power

The revised framework for measuring national power, illustrated in Figure 2, attempts to capture both these dimensions of national power in terms of three distinct realms.

The first realm, "national resources," seeks to capture the "building blocks" a country needs if it is to develop modes of production that enable it to dominate the cycles of innovation in the global economy and increase its hegemonic potential through the creation of highly sophisticated military forces that can execute the most demanding military operations against a diverse variety of adversaries. Since the beginning of the current international system, these "building blocks" have usually been measured by variables such as population, size of territory, economic strength (usually measured in terms of GNP/GDP), and natural resources.[1] Not surprisingly, these are the indicators commonly identified by the traditional approaches to measuring power, and they cannot be—and have not been—simply jettisoned. They remain important and, more critically, indicate the thresholds through which countries must pass if they are to become

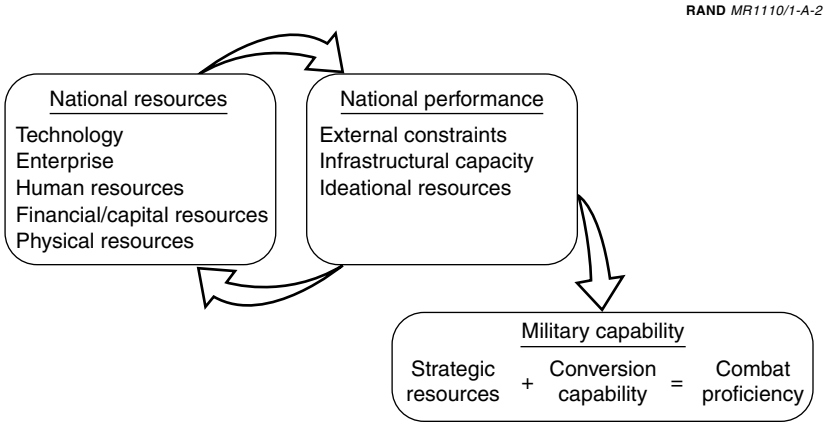

Figure 2—A Revised View of National Power

[1]Jack S. Levy, *War in the Modern Great Power System, 1495–1975* (Lexington, KY: University Press of Kentucky, 1983); A.F.K. Organski, *World Politics* (New York: Knopf, 1958); and Kenneth N. Waltz, *Theory of International Politics* (Reading, MA: Addison-Wesley, 1979).

important political and military actors in the international system. Consequently, they are incorporated in our framework for measuring national power, but in the context of other, newer qualitative variables that speak to a country's wider ability to incorporate the science-based knowledge revolution in its economic life. This ability to incorporate newer and ever more effective forms of "actionable knowledge" in every realm of material life is critical because it contributes to creating the foundations for new forms of military power. The "building blocks" of national power identified in this framework are therefore discussed here under the rubric of (1) technology, (2) enterprise, (3) human resources, (4) financial/capital resources, and (5) physical resources.

The second realm, "national performance," seeks to capture the mechanisms that enable countries to convert the "building blocks" identified in the first realm, which represent latent power, into tangible forms of usable power. The objective of introducing this dimension of national power is to move beyond the traditional view of countries as "bordered power-containers"[2] to something that models countries as active social structures consisting of state and societal actors and institutions, all of which exist in an environment populated by many similar such entities abroad. Introducing this dimension allows the framework to capture an element that most traditional measures of power do not accommodate: the relationship a state has with its own society and the consequences thereof for national power capability. In particular, this level of analysis allows the analyst to assess both the external pressures confronting a given country as well as its awareness of the new resources that must be produced if it is to develop the capability to dominate the cycles of innovation and then transform that dominance into effective hegemonic potential. Including variables like the infrastructural and ideational capacity of a country then enables the analyst to characterize the state's capacity for: *discerning* the appropriate socio-technical production choices for augmenting its power given the current and prospective challenges imposed by both economic processes and international competition; *developing* the resources necessary to dominate both the cycles of innovation and the processes of interna-

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[2]Anthony Giddens, *The Nation-State and Violence* (Berkeley: University of California Press, 1985), p. 121.

tional politics; and, finally, *transforming* existing resources into effective capital instruments for securing favorable outcomes in both the productive and the coercive arenas internationally. At this level of "national performance," the three variables to be examined are: (1) the external constraints emerging from the international system; (2) the infrastructural capacity of a given state; and (3) its ideational resources.

The third realm, "military capability," seeks to capture the manifest signs of national power that are ultimately personified by the combat proficiency of a country's military force. Military capabilities may be treated almost as the "outputs" of national power production because they represent the effective coercive strength that a country can bring to bear against any competitors, which is, in the "anarchic" system of international politics, its first line of defense. In the framework illustrated in Figure 3, military capabilities are understood to be a product of the continual, cyclic, *interaction* of both national resources and national performance: resources may be "building blocks," but these building blocks, far from existing in nature, must be consciously produced as a result of human artifice, which is captured, however imperfectly, by the domain of national performance. The institutions inhabiting this latter realm, in turn, rely on the resources they have produced both to maintain themselves internally and to expand their own (or their country's) power externally, and the most important manifestation of this external power is military capability. Many traditional indexes of national power incorporated military capabilities in some form or another, though this was usually done through the use of summary variables like the levels of military expenditure or the gross size of the armed forces. The kind of capabilities focused on in this framework seek a greater level of detail. Toward that end, the examination of military capability as a vector of national power is patterned analogously to the larger framework for assessing national power. It identifies the following variables of interest:

(1) The strategic resources a military receives from the government it serves, which include defense budgets, manpower, military infrastructure, combat RDT&E institutions, the defense industrial base, and the warfighting inventory and support;

(2) The variables bearing upon the means by which these resources are converted into effective capabilities, for example, the threats facing a country and the strategy developed to cope with them; the structure of civil-military relations, the density of foreign military-to-military relations, the nature of doctrine, training, and organization, and, the potential and capacity for innovation; and

(3) The capabilities of the combat force itself, understood via a spectrum of warfighting competencies that may be attained to a greater or lesser degree and which may be compared across countries.

The remainder of this handbook discusses the three components of national power in greater detail, breaking each level into its component parts and describing the measures associated with them.

NATIONAL RESOURCES

This realm of analysis includes five areas of interest: technology, enterprise, human resources, financial/capital resources, and natural resources.

Technology

Attention will focus mainly on technologies that hold the potential to enable a country to participate in the leading-edge technologies relevant to power today. There are six, and they appear in Figure 3.

Six technologies are critical to the production of national power. The most important technologies today are **information and communications**, which include high-performance computing and networking, software, data storage and peripherals, computer simulation and modeling, microelectronics and optoelectronics, sensors and signal processing, and high-definition imaging and displays. But the leading sectors of tomorrow could develop from one or more of the following five technology clusters. **Materials** are the ceramics, composites, and high-performance metals and alloys that promise significant improvement in the performance of items produced and used by virtually every sector of the economy. **Manufacturing** technologies crucial to national power are precision machining, materials

manufacturing, micro- and nano-fabrication technologies, and machine tools. The **biotechnology and life sciences** include both applied molecular biology and medical technology that permits unconventional solutions to major problems in diverse fields like agriculture, manufacturing, and the environment. **Aeronautics and surface transportation** include advanced systems that enhance our civilian and military capabilities and increase the ease and safety of travel. **Energy and the environment** includes technologies that could provide safe, secure, and enduring sources of energy and ensure a healthy environment for future generations. Finally, attention must be paid to militarily critical technologies.

Assessing a country's technology base clearly requires a detailed assessment of its capabilities in each of the six areas identified above. In each of these areas, an adequate assessment requires analysts 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;

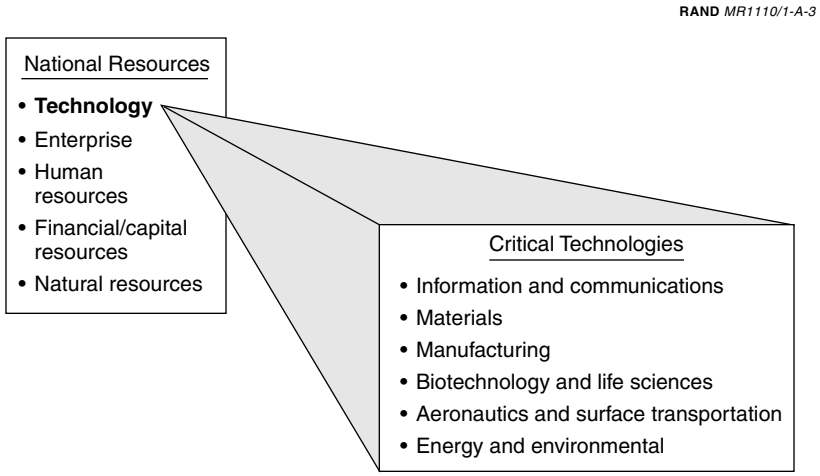

Figure 3—Technologies Critical to National Power

- Has trade access to foreign capabilities in a given technology area; and
- Engages in research and developmental work even if not in commercial production.

Enterprise

While the concept of enterprise has many shades of meaning, the term "enterprise" here is used as a collective expression for the level of invention, innovation, and the diffusion of innovation within a given society. By incorporating the notion of enterprise as a component of national power, this framework seeks to emphasize that technology does not subsist autonomously but is always a product of prior societal and state choices in other areas like education and health, investments in human capital, and communications and infrastructure. Figure 4 shows the components of enterprise and their associated measures.

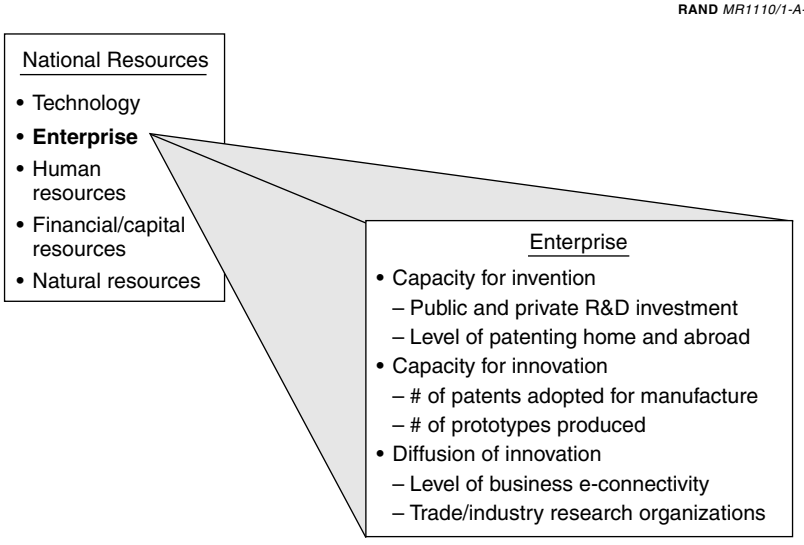

Figure 4—Components of Enterprise

Measuring capacity for invention. A country's capacity to produce useful inventions may be captured by a variety of measures. **Government expenditures on R&D as a percentage of GNP** are a particularly important index, because studies suggest that the annual rate of return from R&D to society as a whole may be close to 50 percent, a value assessed to be twice the private return to an individual firm.[3] The level of government R&D expenditures in the core technology areas identified previously represents another, more focused, measure of inventive potential. Government-level expenditures alone, however, may not be sufficient to assess the potential for invention, because these values are crucially affected by the character of state-society relations within a given country. Strong states presumably will spend more on R&D (both generally and in specific technology areas) than weak states might, but strong societies may in some instances spend as much if not more on R&D both generally and specifically in comparison to some strong states. Consequently, **aggregate private R&D expenditures as a function of GNP**, as well as more focused expenditures on critical technology, should also be assessed as a complementary measure of a country's inventive potential.

Where actual inventive performance is concerned, however, patenting activity appears to provide the best measure of national inventiveness.[4] The first specific measure consists simply of identifying the level of **domestic patenting activity** both generally and in the specific technology areas mentioned previously. But because patenting systems and the laws governing intellectual property rights vary across countries, a useful complementary measure of inventiveness consists of measuring not simply domestic patenting but **patents sought and secured by inventors in foreign countries, especially the United States**. Patenting in the United States is actually an appropriate metric for assessing the inventiveness of all other countries, since the United States not only has an excellent and well-organized patent office but is also the wealthiest country, whose

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[3]Pam Woodall, "The World Economy: The Hitchhiker's Guide to Cybernomics," *The Economist,* September 28, 1996, p. 44.

[4]An excellent analysis of patenting as a measure of inventiveness can be found in Z. Griliches, "Patent Statistics as Economic Indicators: A Survey," *Journal of Economic Literature,* Vol. 28 (December), pp. 1661–1707.

economic system attracts leading-edge technologies that foreign inventors would seek to protect for purposes of revenue generation both in the United States and abroad.[5] These foreign patents secured within the United States should again be measured both in aggregate terms as well as in disaggregated form, focusing on activity in the high-technology fields identified earlier.

Measuring capacity for innovation. For inventions to become valuable they must be transformed eventually into innovations, or else they remain merely novel ideas of no economic consequence. Innovation is thus the development of an invention that is actually used or produced as an economic good within the economy. Numerous difficulties limit evaluating a country's ability to innovate, but at least two measures relating to the actual level of innovation suggest themselves: compiling data relating to **the number of product or process patents adopted for manufacture** and **the percentage of prototypes actually line produced** either across the economy as a whole or within the critical technology areas identified earlier. Either or both of these measures would help to indicate the level of innovation witnessed within a given country and thereby contribute to a qualitative assessment of the entrepreneurial capacity of the country as a whole.

Measuring the diffusion of innovation. The third and last dimension of enterprise measures focuses on the diffusion of innovations within a productive system. This dimension is crucial for the creation of national power, because the diffusion of innovations—be they products or processes—is the way that productivity gains are dispersed throughout society at large. The ability to diffuse innovations effectively must therefore be seen as deriving from two broad but different kinds of sources. The first source is simply the **degree of connectivity of different firms with the rest of the national economy**. The second source is the **number of specialized national or industrywide research institutes** that play a role in building up cumulative technological capability.

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[5]K. Pavitt, "Patent Statistics as Indicators of Innovative Activities: Possibilities and Problems," *Scientometrics,* Vol. 7 (1985), pp. 77–99.

Human Resources

While the most visible elements of the postindustrial age are the myriad information technologies, the most critical component of this era is not technology per se or even the innovations that give rise to it, but rather the individuals who create its various artifacts. Figure 5 depicts the elements used in assessing a nation's human resources.

Formal education. The most general measure of human capital is a country's **expenditure on education** and its **number of educational institutions**. Both education expenditures and the number of institutions—private and public—must be disaggregated to capture the relative emphasis on primary, secondary, tertiary, and vocational and continuing education.

While information about the size and balance of the educational infrastructure is vital, it is not sufficient. It must be supplemented by information about enrollment at all educational levels, with special

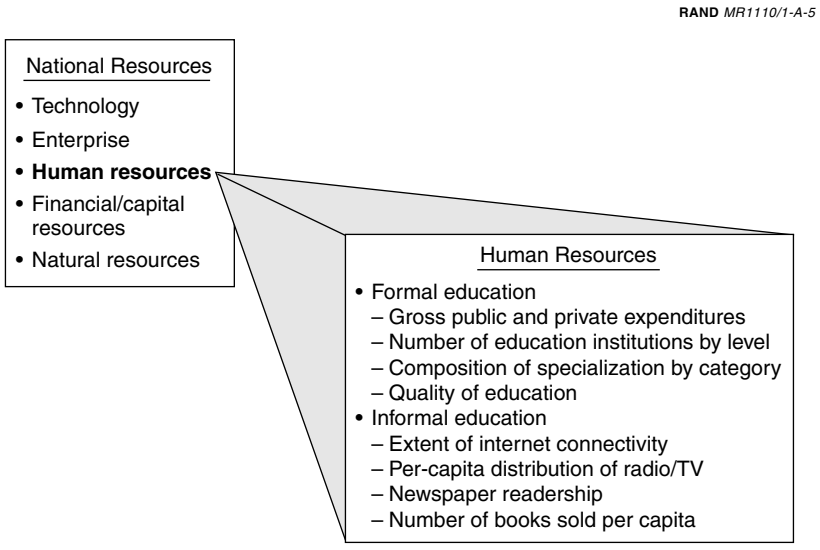

Figure 5—Components of Human Resource Assessment

attention paid to the tertiary level, since the net analytic capacity of the work force will be of a higher caliber in direct proportion to the percent of the population that attends a university, and higher still according to the percent that actually receives an associate's, bachelor's, master's, or doctoral degree.[6] With the increasing access to international education, the number of students receiving an education abroad at all levels (but especially the tertiary level) should also be accounted for.

The information pertaining to the enrollment in higher education needs to be further refined if it is to capture certain critical dimensions of human capital relevant to the postindustrial age. Among the most important such refinements is the **composition of specializations** among the highly educated subset of the populace. The specific specializations of interest are mathematics and physical sciences, biological sciences, engineering, social sciences and behavioral sciences, and the arts and humanities. While the last specialization is necessary for the preservation of culture and humanity, it is less relevant in comparison to the first three disciplines for the production of national power; the social and behavioral sciences fall in between.

The final measure of a country's formal education system consists of assessing the **quality of its system of higher education** and the levels of recognized excellence that may exist in its knowledge-production complex, especially in the key areas of mathematics–physical sciences, biological sciences, and engineering. Several objective criteria of educational quality merit exploring as indices of national performance in a given disciplinary area. These include:

- The number of published articles and books emerging from a given research area;
- The estimated "overall influence"[7] of published articles and books;

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[6]The Harbison-Myers Skills Index is one example of such an index that measures the attainments in secondary education and beyond as a measure of national capacity. See The World Bank, *World Development Report 1992* (New York: Oxford University Press, 1993) for its application.

[7]An elaborate methodology for evaluating "overall influence" has been developed in Francis Narin, *Evaluative Bibliometrics: The Use of Publications and Citations Analysis*

- The number of recognized national and international grants awarded to researchers in a given discipline; and
- The number of recognized awards and honors earned by researchers in a given research area.

Informal education. However, people are not educated just in formal institutions. They gain knowledge in other ways as well, and it is important to gauge these other indications of a populace's education level. Other suggested metrics include the following:

- Extent of Internet connectivity
- Per-capita distribution of radio/TV
- Newspaper readership
- Number of books sold per capita.

Financial/Capital Resources

It is important to measure capital as an element of national power for three reasons. First, a greater abundance of capital means that societies with higher stocks of it can use more capital instruments in the production of any given good, and this results not only in increased productivity but also in greater consumption and enhanced incomes. Second, a greater accumulation of capital enables broader economic expansion than might be possible otherwise. Third, a greater accretion of capital enables the pursuit of rapid technical change. It finances the discovery of what was unknown before or the adaptation of existing knowledge for purposes of commercial exploitation; it underwrites the costs of restructuring organizational changes as well as provides for investment in new human capital. For all these reasons, capital becomes the principal avenue through which all other determinants, whatever those may be, condition the long-run development and prospects affecting a country's power.

Measuring the sources of capital formation as a means of understanding a country's ability to provide usable investment resources

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in the Evaluation of Scientific Activity, Report to the National Science Foundation, March 1976.

includes measuring the overall extent of saving in the economy (disaggregated by source if needed), the aggregate growth of capital in the country, and the growth in important sectors. Figure 6 displays these elements and their subcomponents.

Extent of savings. The extent of a country's savings may be determined by ascertaining the **level of private savings as a fraction of the GNP**. Also important is the country's access to external resources, and that may be gauged by how much **official development assistance** is provided by the government. Finally, the amount of **foreign direct and portfolio investments** are also important to capture.

Aggregate growth. In measuring a country's aggregate growth, the first step is determining the **size of the GNP and its annual growth rate**. While size of capital resources in a gross sense is an important index of power, it must be refined in two ways. First, it is important to assess how the value of accumulated outputs or capital stacks up in the face of the size of the existing population. The **measure of per-capita GNP** thus becomes important because it describes a country's

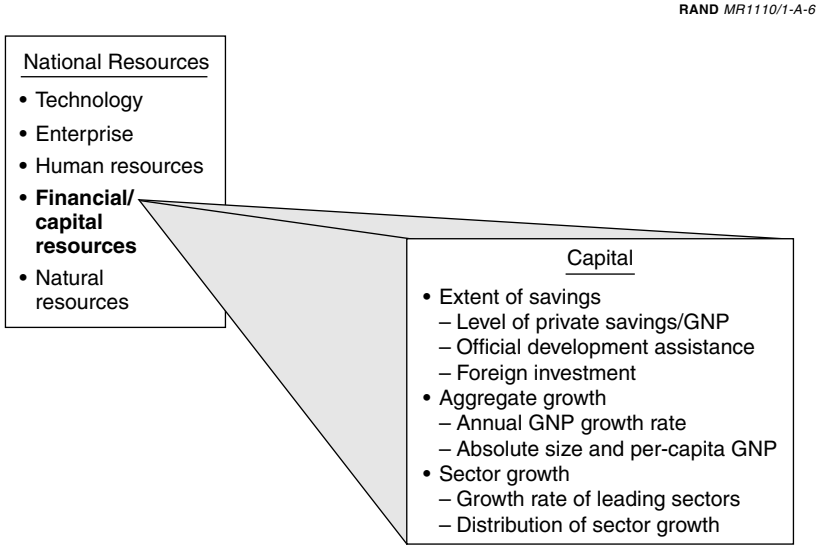

Figure 6—Components of Financial/Capital Resources

level of internal development in notional terms, while simultaneously providing some sense of the balance between internal and external demands on the country's resources. Per-capita GNP, thus, describes the size of the capital stocks per individual and thereby depicts the relative access to wealth and consumption within a country. It could therefore serve as a corrective measure in some cases insofar as it relates a stock measure of wealth to the number of people who must be supported by it.

Sector growth. It is important to assess what proportion of a country's output derives from the activities that are particularly important in the knowledge-based postindustrial age. Both GNP and per-capita GNP describe the levels of capital resources in aggregate and distributed terms respectively. However, they do not identify how these capital resources are produced. Understanding whether a country's overall **growth derives from certain leading-edge sectors** as opposed to "sunset" sectors is important for assessing a nation's power capabilities. Because the leading sectors today remain information and communications, in addition to materials and manufacturing, understanding where the sources of accumulation lie in these three areas provides a qualitative profile of the structure of capital generation in a country. It is also important to assess the **distribution of growth across the key sectors**.

Natural Resources

Figure 7 shows the four components of interest for natural resources.

Food and energy. Although not as important as they once were, energy and food remain important, and the significance of these resources is as much technical as it is political: because energy and food remain inputs necessary for the functioning of about everything else in a modern economy, countries in general are extremely sensitive to the potential for disruption and cut-off in supply. Consequently, fossil fuel resources like oil, coal, and natural gas will continue to remain important, as will nonnatural fuel resources such as nuclear power.

Critical minerals. Peculiar to the postindustrial age, however, will be nonfuel resources like jewel bearings used in sophisticated machine tools and beryllium used with copper in electrical and computer

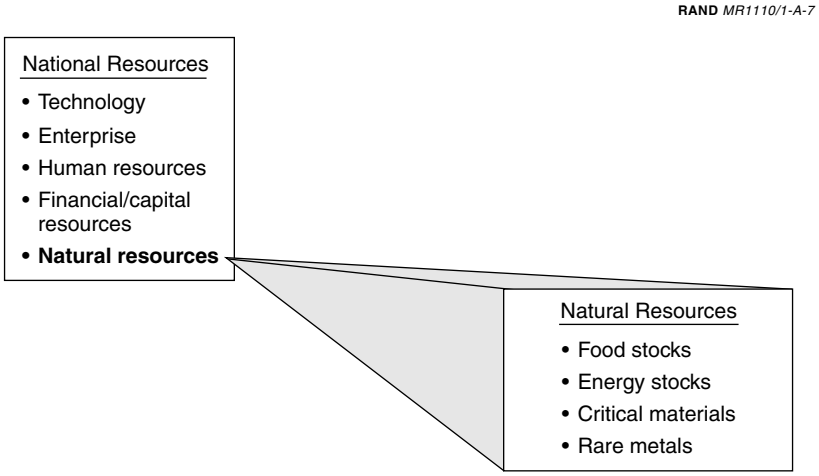

Figure 7—Components of Natural Resources

components. Light, but strong and flexible metals like titanium, vanadium, chromium, cobalt, aluminum, and columbium, the vital components of complex machines, especially in the aerospace industry, will also remain significant.

Rare metals. A set of similar other resources have also become critical with the progression of the information revolution. For instance, platinum group metals (iridium, palladium, and platinum) are critical components of information age electronics such as circuit boards and computer network connectors; platinum is also used in the production of optical fibers for telecommunications. Germanium, a by-product of zinc processing, has become important for its use in high-data-rate optical communication systems, lasers, night-vision systems, and weapons guidance.[8] The aluminum by-product gallium arsenide has also received heightened attention because of its role as a component of high-speed integrated circuitry, especially relied upon in military computing. Silicon is another element that has received heightened attention because of the information age.

[8]Kenneth A. Kessel, *Strategic Minerals: U.S. Alternatives* (Washington, D.C.: National Defense University Press, 1990).

Widely abundant, as the backbone of computer chips and fiber optics, silicon should not be ignored as a necessary building material. Lastly, the inputs for sophisticated materials technologies round out the list of critical information technologies. These inputs include the components of composite materials (graphite, carbon, asbestos, and other fibrous materials) and of ceramics (rare earth elements; pure, inorganic, nonmetallic powders; and fibers for reinforcement). These materials are increasingly vital to the production of sophisticated machinery (again, especially aerospace and weaponry). In addition, they have sparked interest in the possibility that synthetic materials might replace many former mineral dependencies.

In gauging power, a nation's stockpiles and supplies of each category of these items are important to consider. However, it is also important to go beyond those sources and consider the accessibility to these resources during times of crisis. To measure this accessibility, both the obvious domestic sources and the degree to which these resources originate from stable external sources, i.e., allies or neutrals with stable governments, ought to be considered. This provides an indicator of the extent to which countries are dependent on vulnerable sources for the basic physical building blocks of power.

NATIONAL PERFORMANCE

This realm of analysis comprises three major areas: external constraints, infrastructural capacity, and ideational resources. The first pertains to the external pressures that challenge the country. The second describes the relationship between the state and other social groups in the country. The state, in this context, is understood to be the governing institutions of a country. The state has to be strong enough to mobilize a country's capacity to provide the resources necessary to create military power. Whereas infrastructural capacity refers to materiel, ideational resources are less tangible but no less essential. They are required to convert the material into power. They comprise such things as a nation's value system and problem-solving ability.

External Constraints

Figure 8 shows the three major components of external constraints and their subdivisions.

Nature of external threat. Since fear is a powerful incentive for countries to increase their national power, countries that are threatened by others—or perceive that they are threatened—are likely to be motivated to increase their resources and their military capabilities necessary to enhance national survival. The extent of this motivating fear deriving from external threats can be judged by assessing **the number and relative size of the direct challengers facing the country**; the **extent of any competitive arms racing** that the country in question may be involved in, and the **salience of the internal-external nexus**. By this latter is meant the extent of any external support for internal challenges facing the state.

Nature of state interests. Since countries with expanding interests also have strong incentives to acquire or increase their national

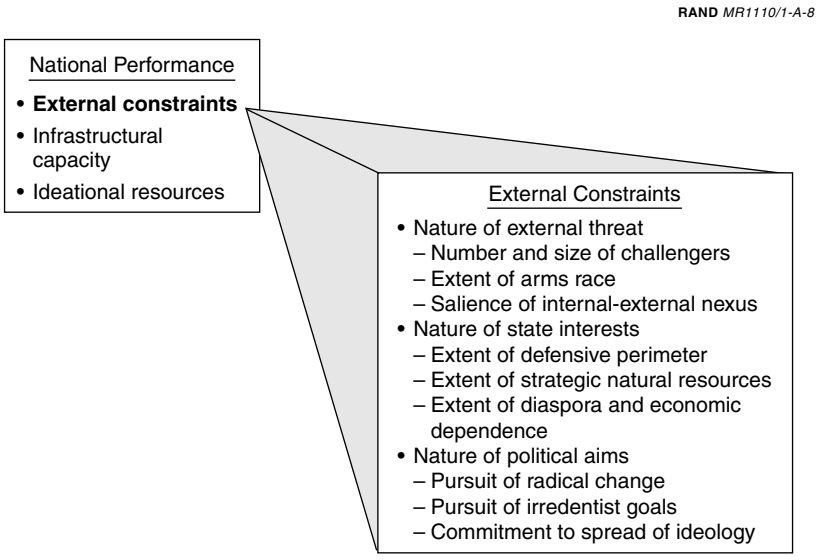

Figure 8—Components of External Constraints

power, discerning a state's interests would also provide a way to assess the motivating effects of external pressures. The nature and extent of a country's interest could be judged along the following lines: its geographic location and the **extent of its defensive perimeter**, with the location identifying its geopolitical value and its defensive perimeter indicating both the areas it must actively defend and those it has an interest in; the **extent of its strategic natural resources** (and possibly its composition of trade), these variables indicating whether it has resources that may be coveted by others as well as the extent of its external dependency; and the **extent of and commitment to its natural diaspora** or dispersion of its people, indicating the extent of the critical political commitments it may have to service.

Nature of political aims. Since countries with revisionist political aims also have strong incentives to increase their national power, assessing the nature of a country's political aims also contributes to providing a more complete picture of the external pressures facing a state. Here it is useful to discern whether a country is pursuing the goal of **securing radical changes** in the established international order through force, or **recovering irredentist claims**, or **promoting ideological proselytization**. If a country appears to be preparing to use force to alter the geopolitical status quo for any of these reasons, it will in all likelihood not only want to increase its national power but will actually want to ensure that its military forces are prepared and have the capabilities to prevail over its likely opponents.[9]

Infrastructural Capacity

Turning to the next aspect of the national performance level, infrastructural capacity has two primary aspects: self-control and social control. The further subdivisions of these two aspects are depicted in Figure 9.

Self-control. The first dimension of infrastructural capacity is the ability of the state to define its goals, here termed self-control. The extent of a state's capacity for self-control requires understanding

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[9]Barry Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars* (Ithaca: Cornell University Press, 1984), p. 74.

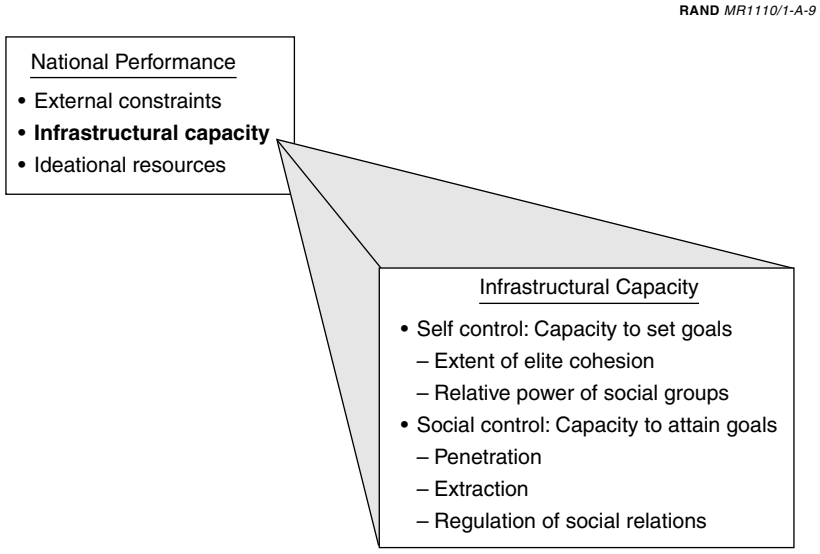

Figure 9—Components of Infrastructural Capacity

the sources of that control. A state's capacity for self-control is inexorably a function of the **coherence exhibited by its political elite**, an entity that can be defined as those individuals or groups who possess varying degrees of either high traditional status, economic influence, administrative power, or coercive capacity. Consensus among state elites would indicate a greater likelihood of goal-setting success, while stark divisions among elites would indicate either unstable goals or an inability to pursue the national goals normally associated with the accouterments of power. Specific indicators of coherence among the elite include the following:

- Consistency of the ideology and rhetoric issuing from key elite actors to the public;
- The internal organizational and social linkages between the state managers and elite;
- The nature, durability, and effectiveness of higher political institutions; and

- The robustness of shared norms among key members of the regime and the social bases of their support.

While the extent of elite cohesion remains a key variable affecting the ability of states to set goals, the second dimension of self-control pertains to the **relative power of various societal groups** within a country. To determine the relative power of groups, it is necessary to examine three distinct sets of issues relating to the social structures of a given country. First, it is necessary to establish the extent and pattern of structural cleavages simply to paint a "social map" of the country's patterns of political, economic, and social interaction. Second, the strength of existing state managers must be discerned at two levels: (1) the extent of support that state managers can garner from certain privileged elites in society, and (2) the extent of power that the state managers and their supporting elites in combination possess vis-à-vis other mobilized social groups in society who may seek national goals different from those being currently pursued. Third, the existence of other latent groups, which may share affinities based on class, religious, linguistic, ethnic, or regional divisions, must be discerned. Their potential for mobilization must be assessed and the consequences of their mobilization for the future of the national goals associated with the pursuit of power must be analyzed.

Social control. Social control is the second kind of power in the domain of infrastructural capacity, and it identifies the sources that speak to a state's capacity to implement its goals. Specifically, social control refers to the kind of power through which the state translates its goals into goal-oriented action. The power that facilitates social control issues from three sources: penetration, extraction, and regulation of social relations.

Penetration precedes and in fact makes possible its extraction of resources from society.[10] Empirical studies have suggested several different measures of penetration, all linked by their common focus on the state's fiscal powers vis-à-vis society. In countries that have

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[10]Lewis W. Snider, "Identifying the Elements of State Power: Where Do We Begin?" *Comparative Political Studies,* Vol. 20, No. 3 (1987), pp. 320–321, and "Comparing the Strength of Nations: The Arab Gulf States and Political Change," *Comparative Politics* (July 1988), p. 467.

legal-rational institutions, the **ratio of taxes on international trade and foreign transactions as a percentage of total government revenue** has been identified as the most useful indicator of authority. A second related measure is the **ratio of direct to indirect taxes** in a given country. Both measures together would indicate the extent of state strength: strong states, that is, states with greater authority, should be able to collect a higher level of taxes from direct levies domestically as opposed to weaker states, which would rely more on trade and indirect taxes as a percentage of total revenue. The state's susceptibility to external shocks requires another type of measure, though also one derived from the tax system. This measure of flexibility consists of examining the ratio of nontax revenues to the taxes on international trade and transactions or even more simply as **the ratio of nontax revenues to indirect taxes**. Such a measure is necessary because the greater the proportion of taxes coming from international trade, the greater a state's susceptibility to shocks emanating from the international system. A final measure of the state's ability to penetrate society is the **extent of its control over or access to key services**.

Extraction. Extraction is another crucial manifestation of social control. It is a measure of the state's ability to gain the resources it needs to achieve its goals through the labor, participation, and cooperation of society. The best measure for determining a state's capability for extraction derives from the fiscal system but this time focused on the level of revenue rather than on the character of the tax structure. A state's political capacity for extraction can be expressed by the ratio of the **revenues a state actually extracts divided by the predicted values of what it could extract** ***compared to other states with a similar resource base***.

Regulation of social relations. The final locus of social control is the state's ability to regulate social relations. The way or extent to which a state can control the relationships between members of its society will become a source of infrastructural power by providing a state with the leverage to prevent its goals from becoming proxy to special interests. Testing for **the "fit" between the pattern of tax breaks, subsidies, and penalties with respect to national policy** provides a good indication of how powerful the state may be vis-à-vis powerful social groups (including those that might support the state) *after certain national goals are framed and the resources collected to pursue*

them. Tax breaks, subsidies, and penalties that are at variance with the proclaimed objectives of the state would suggest that state organs are in fact hostage to powerful special interests. That is, no matter how well they can articulate their interests and garner the resources necessary to pursue those interests, they still have some difficulty in implementing their preferred course of action at the level of actual policy.

Ideational Resources

As Figure 10 shows, ideational resources fall into two categories: instrumental rationality and substantive rationality. The former is the ability to relate means to ends, and the latter is a national commitment to the pursuit of wealth and the acquisition of power.

Instrumental rationality. The first issue, from the perspective of analyzing the ideational resources that make for national power, consists of assessing the extent to which any country exhibits the

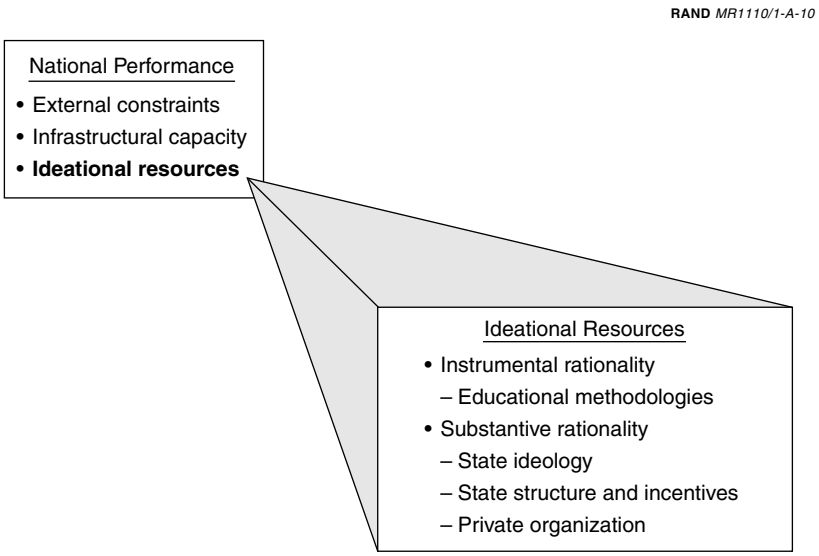

Figure 10—Components of Ideational Resources

kind of "methodical thinking"[11] that makes effective problem solving and political rationalization possible. The best evidence for such a phenomenon at the national level will be found in the institutions of socialization involving mass education. At this level, the emphasis placed by the polity on the acquisition and transmission of methodical thinking, especially in the form of an effective problem-solving orientation, can be best discerned. Accordingly, the most useful indicators of embedded instrumental rationality will be found in the school system, particularly at the secondary level. If a national-level assessment is desired, however, it is important first to acquire data on **enrollment and attainment rates**, especially at the secondary level. The secondary level is critical because primary education consists mainly of transmitting knowledge rather than training individuals in the art of problem-solving associated with the notion of methodical thinking. Consequently, enrollment and attainment rates at the secondary level provide the best quantitative indicators about the extent of the opportunities available for transmitting the techniques of methodical thinking within a country. Lower enrollment and attainment rates would suggest lesser exposure to the instruments of rationalization, while higher rates would suggest just the opposite.

Besides the enrollment and attainment rates at the secondary level, more specific indicators are required. These consist primarily of three variables: **teaching methodology, curriculum time, and nature of national examinations**. The indicators relating to teaching methodology should focus on assessing whether the mode of instruction emphasizes the acquisition of received wisdom in the form of "facts" or focuses on inculcating problem-solving techniques and encouraging creativity in general. The indicators relating to curriculum time should focus on assessing the time spent on science and mathematics relative to other subjects in the curriculum, on the premise that science and mathematics represent the problem-solving disciplines par excellence. The indicators relating to the national examination system should focus on assessing whether the national examinations place a premium on regurgitating facts or whether they

[11]The phrase is Mary Dietz's and comes from her article, "The Slow Boring of Hard Boards: Methodical Thinking and the Work of Politics," *American Political Science Review,* Vol. 88, No. 4 (December 1994), pp. 873–886.

emphasize analysis and creativity. It is possible that little international data exists on these variables. If so, such assessments will have to rely mainly on expert appraisal or reputational evaluations.

Substantive rationality. The second dimension of ideational resources is substantive rationality. Understanding the extent of substantive rationality within a country requires an assessment of how closely national organizations comport to the ideal of power-and-progress-oriented rationality and how effectively they embody a "conscious human effort to enlarge material power."[12] The objective here is to discern whether countries have institutions and structures that allow them to pursue processes relevant to the production of national power. The keys to developing substantively rational policies and norms with respect to the state's pursuit of wealth and power are to be found in the state's bureaucratic-administrative apparatus and legal system. The first indicator of substantive rationality, therefore, would be **state ideology** or evidence of a deliberate, public commitment to the production of wealth and power, particularly in the form of acquiring modern science and technology. The second indicator of substantive rationality is the existence of a **state structure oriented to the production of wealth and power**: this would be manifested by the existence of expert bureaucracies that identify the desired capabilities sought by the state; the routine use of public finance instruments, especially the national budget, to procure, subsidize, or provide incentives for the production of desired capabilities; and the existence of public-sector undertakings aimed at directly producing capabilities otherwise beyond the capabilities of civil society. The third indicator of substantive rationality would appear in **private organizations**, more specifically the existence of a **competitive socioeconomic system** and the prevalence of **cultural norms that emphasize achievement**.

MILITARY CAPABILITY

The ultimate yardstick of national power is military capability. Because countries subsist in an environment where internal and external threats to security are both common and ever-present, the

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[12]Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 1958), p. 52.

effectiveness of their coercive arms becomes the ultimate measure of power. Military capabilities enable countries to defend themselves, while simultaneously enabling their state managers to pursue whatever interests they wish, if necessary over and against the preferences of other competing entities. The ultimate "output" of national power should be—ideally—the ability of a military force to successfully prosecute a variety of operations against its adversaries. Whether a force is in fact capable of overwhelming these adversaries requires a detailed analysis of the balance of power, which will not be undertaken here, because the objective is not to assess power as an "outcome" but only as a "resource." Measuring military capability here will focus on understanding which ingredients are necessary for the creation of an effective force, and how the effectiveness of this force can be conceptualized in an intellectual sense.

The notion of military capability as the output level of national power is premised on the understanding that a country's military organizations receive national resources and transform them into specific warfighting capabilities. The warfighting capabilities thus generated are effective to the degree that they enable a country's leaders to impose their will on enemies. Thus, the larger logical framework developed for examining national power can be applied to examining how national military establishments generate effective military forces. Put simply, the question is, "What resources does the military get, and how successfully can they be transformed into effective military power?"

Military effectiveness thus becomes the result of the resources provided to the military and its capability to transform them into effective warfighting capability. The three major components of the military capability level are strategic resources, conversion capability, and combat proficiency.

Strategic Resources

Any consideration of a country's military capabilities or its military effectiveness must begin with an examination of the resources—financial, human, physical, and technological—that the national leadership makes available to its military organizations. These resources are clearly a function of the larger national-level assets of a country (examined earlier under the rubric of "national resources")

as well as the imperatives emerging from the "national performance" level, that is, the pressures levied by external threats, the power of the state vis-à-vis its society, and the ideational acuity with which both state managers and society as a whole can perceive problems and develop satisfactory solutions. These two dimensions, operating interactively, then define the kinds of resources transferred to the military, and any analysis that seeks to measure national power in military terms, especially in the context of a country's ability to undertake the "information-dominant" operations that will revolutionize warfare, must gather and assess information pertaining to the variables displayed in Figure 11.

Defense budgets. These have three components of interest: **total size, percent of GDP, and distribution by service**. The size of the defense budget is the most general single measure of the resources provided to a military by its political masters. It provides a sense of the relative importance of the coercive arm in comparison to other organs of state, and it conveys a general sense of the size of the military establishment in absolute terms. Toward that end, data that reveal the size of the defense budget as a percentage of both overall

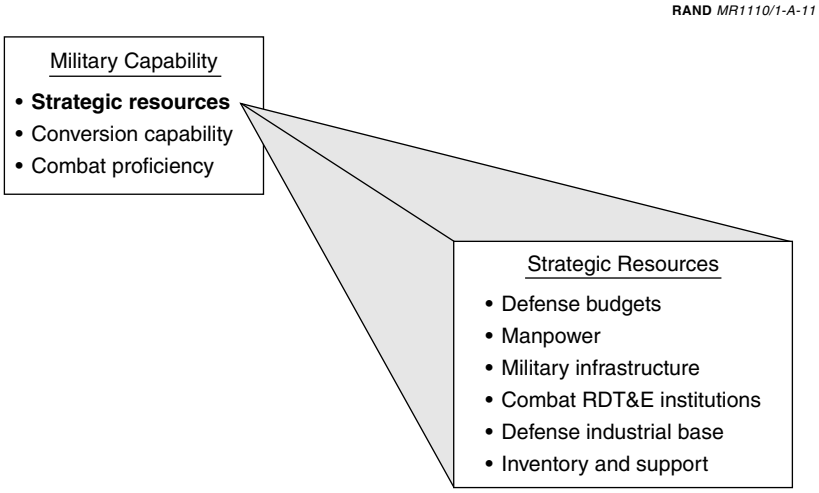

Figure 11—Components of Strategic Resources

public spending and of GDP/GNP are essential. These macro-indices should be refined by an analysis of the distribution of resources among the various services, which provides a preliminary view of a country's understanding of the salience of relative threats, its desired structure of combat proficiency, as well as the relative power of various military bureaucracies.

Manpower. The size and quality of military manpower is the second kind of resource that yields insight into a country's national power. Measures of military strength that focus on the absolute **size of the total force**, the division between active and reserve components, and the distribution of numbers across the services yield useful information. However, in an era increasingly defined by information-intensive means of war, the most useful information about military manpower consists of data relating to qualitative variables; in particular, the **educational levels of both the officer corps and the enlisted ranks** and the **levels of technical proficiency** demanded of the recruiting base provide critical information about the ability of a given military force to integrate and exploit the sophisticated military technologies.

Military infrastructure. The extent and quality of military infrastructure is the third kind of resource that affects quality of military capability. This category subsumes the **physical infrastructure** possessed by a military force, normally labeled "bases and installations." In addition to the facilities normally used to house military personnel and their equipment, this category should also comprise the number and quality of test and training ranges, medical facilities, military construction projects, and the like. **Distribution by category and service** also require consideration. Quality assessments are part of the analysis; for example, when examining air warfare capabilities, analysis pertaining to the number of bases relative to the size of the air force will also incorporate more detailed examination about the kind of protection offered to aircraft, the mix between active and passive protection, the degree of hardness embodied by the shelters, and the survivability of crucial assets like command, control, and communications (C^3), petroleum, oil, and lubricants (POL), and munitions. Two questions become particularly pertinent in this regard: Does the country have the necessary number and range of facilities and installations to adequately train its military personnel in the combat and combat support tasks facing the force? Is the

quality of these facilities comparable to those in the country's peer competitors or the United States?

Combat RDT&E institutions. The **number and quality of combat research institutions** is the fourth kind of resource that affects military capability. Rapid transformations in both technology and the military arts have resulted in a need for increasingly specialized institutions that focus on research, development, test, and evaluation (RDT&E) activities relating to combat. These institutions could be academic institutions, which specialize in training soldiers in the history of war or the higher requirements of command; specialized establishments, which focus on honing certain specific warfighting skills; technical centers, which either develop, test, and evaluate new equipment for various combat elements or advance new concepts of operations for military technologies developed by other institutions; or research organizations, which focus particularly on studying foreign military forces, their organization, equipment, patterns of training, and doctrine. As with the issue of military infrastructure considered earlier, the value of the combat RDT&E institutions from the perspective of measuring national power derives from the intelligence community's ability to discern, first, whether the target country has the **necessary number and range** of institutions to adequately support its military force in its operational tasks, and second, whether **the quality of these institutions is comparable** to those in the country's peer competitors or the United States.

Defense industrial base. The **structure, extent, and quality of a country's defense industrial base** constitutes the fifth kind of resource affecting military effectiveness. The defense industrial base essentially consists of firms or industries that depend on a country's defense spending for survival and upon which the country itself depends for the production of military technologies and instruments. **Sufficiency relative to the needs of each service** also needs to be considered.

Warfighting inventory and support. The character of a country's military inventory and its combat support capabilities is the last important category of military capability and effectiveness. Important capabilities include the following:

- **RSTA capabilities**, which refer to reconnaissance, surveillance, and target acquisition technologies required for a "God's-eye view" at all levels—tactical, operational, and strategic—of the battlefield.
- **Integrated battle management systems**, which involve technologies that "net" together "sensors-to-shooters" in a seamless way.
- **Precision strike weaponry**, which refers to guided and smart munitions that enable order-of-magnitude increases in accuracy, lethality, and effectiveness, again at all levels, tactical, operational, and strategic.
- **Weapons of mass destruction**, which refer to nuclear, biological, and chemical weapons that, together with their associated delivery and command-and-control systems, can cause high destruction and mass casualties among both military forces and civilian populations in relatively compressed timeframes.
- **Agile, integrated, and protected logistics systems**, which allow combat forces to sustain their military operations at high levels of intensity without either running out of crucial war materials or sustaining losses of such materials at possibly crucial moments of battle.

Conversion Capability

The availability of strategic resources is but part of the story. An effective military can take these resources and "convert" them to create a modern force capable of conducting operations against a wide range of adversaries. This conversion process is critical because it determines whether the resources garnered from the country as a whole will finally produce a military force with operational competencies that make a strategic difference on the battlefield. The components of conversion capability appear in Figure 12.

Of the many factors that affect a military's ability to convert resources into operational capability, the following are the most important: (1) the threats facing a country, which change in a reactive fashion, and the strategy developed to cope with those threats;

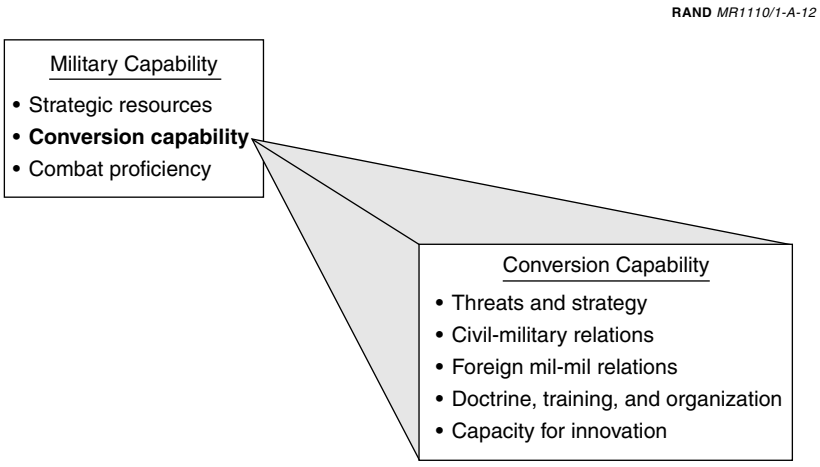

Figure 12—Components of Conversion Capacity

(2) the structure of civil-military relations, including the military's access to national leadership, which enables it to understand changing national goals, make its case for additional resources, and obtain the freedom to operate as required; (3) the density of foreign military-to-military relations, which determines access to other military forces and possible opportunities for learning, emulation, and analysis; (4) the nature of doctrine, training, and organization within a force, which functions as the glue that allows raw military resources to bind themselves into operationally effective social forms and combat practices; and (5) the potential and capacity for innovation, which determines whether a military force can cope with changing strategic and operational problems while continuously improvising solutions that keep it a step ahead of potential competitors.

Threats and strategy. At its broadest level, **military strategy** is the process by which a force matches its means (the resources provided to it) to its external problems. Military strategy is impossible to quantify; however, some generic signposts can help. These would be the country's prior military strategy; doctrinal writings; equipment inventories; pattern of force deployments; and past training exer-

cises.[13] When such information is integrated with geopolitical analysis assessing the country's

- geographic position, including critical geophysical features defining possible opportunities and vulnerabilities;
- most likely adversaries and allies in the event of conflict;
- historical roots, and continuity, of external policy and goals; and
- declaratory policy with respect to its strategic aims,

it is possible to discern whether a country's present military capability is adequate to the strategic tasks facing it and, if not, whether it is likely to respond by changing its present military size, structure, inventory, or warfighting strategy. The **threats** facing a country and the strategy developed to cope with those threats thus become the first important conversion factor that allows resources to be transformed into effective warfighting competencies.

Structure of civil-military relations. The structure of civil-military relations influences the conversion process, because the relationship between the holders of political and military power affects both the creation and the effective use of military forces. There are several models of civil-military relations. The most familiar are:

- The liberal model, characterized by integrated boundaries between the civil and the military, strong civilian control, and a military force oriented to coping with external threats;
- The authoritarian model, characterized by permeated boundaries between the civil and the military, strong civilian control, and a military oriented to coping with both external and internal threats; and
- The praetorian model, characterized by fragmented boundaries between civil and military, civil-military competition accompanied by occasional but tenuous civilian control, and a military oriented to coping with external threats and internal challenges to both the state and its own existence simultaneously.

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[13]These generic signposts are adapted from Jeffrey A. Isaacson, Christopher Layne, and John Arquilla, *Predicting Military Innovation* (Santa Monica, CA: RAND, DB-242-A, 1999), p. 56.

There is relatively little to suggest which of these models might be better from the perspective of a country's ability to increase its military capability or effectiveness. The utility of these models derives from their being ideal flowcharts that help to identify various patterns of power and authority relations: irrespective of which model applies to a given country, intelligence analysts will still have to identify the **personalities involved**, the **relative power of these individuals**, and the **general patterns of interaction** between them, with an eye to uncovering answers to those critical issues identified earlier: What is the nature and level of access enjoyed by the military to the national leadership (if the two are in fact different)? What is the bureaucratic power of the military with respect to securing funding, controlling procurement, and directing its internal organization? What is the institutional structure that regulates the development of military strategy and tests its coherence with other national goals?

Foreign military-to-military relations. The nature and extent of the relationships enjoyed by a country's military forces with their counterparts abroad can become an important ingredient that enables more effective conversion of national resources into usable military power. Military-to-military relations come in various forms: defense attachés in embassies, participation in military education programs abroad and observation of various foreign military exercises, combined exercises, combined training programs, and combined deployments for military missions.

Assessing the nature and extent of a military force's participation in such activities becomes a useful indicator of a country's desire to increase its conversion efficiency. The best test of whether military-to-military relationships are having any effect on the conversion capability of a country's military would be to look for **new developments in force structure, doctrine, training, organization, or equipment** that could be derived from its intercourse with other foreign military organizations.

Doctrine, training, and organization. Having resources in the form of raw equipment inventory and manpower is inadequate if these two assets are not structured and trained to solve operational tasks. Possessing sophisticated military technologies and a large mass of soldiers is one thing. Being able to use them effectively is something else. Today, more than ever before, the ability to *integrate* technol-

ogy and manpower through doctrine, training, and organization becomes the crucial determinant of a military's ability to use its power effectively and thereby increase its battlefield capabilities.[14]

Doctrine is the first vital integrative threshold. Doctrine refers to the body of principles that specifies how a military uses its assets on the battlefield. **Training** represents a second key integrative threshold. Military forces that are inadequately trained will fail to make effective use of the equipment at their disposal, no matter how sophisticated it is. **Organization** is a third crucial integrative threshold because suboptimal command and coordinating structures can inhibit military effectiveness. The crucial issue may be one of "appropriateness": is the doctrine, training, and organizational structure of a force **optimal for the missions it is tasked with executing?**

For the intelligence community, evaluating the doctrine, training, and organization of a foreign military force therefore becomes all the more important if credible assessments are to be made of a given military's conversion capabilities. A nested analysis becomes necessary. First, what is the country's **military strategy?** Second, what **operational tasks** are predicated by that strategy? Third, does the country possess the **equipment and manpower** to undertake those operational tasks? Fourth, is the **doctrine, technology, and organization** in each warfighting domain appropriate and adequate for the tasks sought to be attained?

Capacity for innovation. The final dimension of conversion capability is a military force's potential and capacity for innovation. This variable generally determines whether a force can cope with the ever-changing strategic and operational problems facing it, while simultaneously being able to develop solutions that keep them one step ahead of their potential adversaries. Innovation is a multidimensional phenomenon: At one level, it may refer to the ability to develop new warfighting concepts. At another level, it may refer to the ability to develop new integrative capacities: reorganized com-

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[14]See James F. Dunnigan, *Digital Soldiers: The Evolution of High-Tech Weaponry and Tomorrow's Brave New Battlefield* (New York: St. Martin's Press, 1996); Stephen Biddle, "Victory Misunderstood: What the Gulf War Tells Us About the Future of Conflict," *International Security,* Vol. 21, No. 2 (Fall 1996), pp. 139–179.

mand structures, better doctrine and tactics, improved logistics, new training techniques, and the like. The analytical challenge from the perspective of measuring national power consists of identifying factors that might facilitate a high capacity for innovation.

From the extensive literature on military innovation, it is possible to identify three dominant perspectives that explain the possibility of military innovation: neorealist, societal, and organizational theory. Each offers distinctive but complementary views on what produces a capacity for military innovation.

The neorealist perspective on innovation is simple and straightforward: military forces having a high capacity to innovate are the ones that face a hostile security environment or are committed to supporting expansive foreign and strategic national policies.

Societal perspectives draw attention to internal factors that are necessary to facilitate innovation, and in particular they argue that the ability of military organizations to innovate is affected crucially by the relationship between the military and its host society.[15] The most effective and innovative militaries are those subsisting in a cohesive society. That a military is set in a divisive society does not necessarily mean that it will not or cannot innovate, but rather that this innovative capacity cannot be sustained over the long term.

In contrast to the neorealist and the societal perspectives, the organizational perspective identifies states with organizational characteristics that can facilitate innovation. It is difficult for military organizations to innovate for a variety of reasons. These impediments to innovation are likely to be overcome only when specific conditions are fulfilled. First, organizations that have recently experienced major failure are likely to be stimulated into innovation. Second, organizations with "slack" (that is, substantial uncommitted resources) are more likely to engage in innovation. Third, innovation will occur when the civilian leadership intervenes to force military organizations to innovate. This intervention is held to be necessary

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[15]See Stephen Peter Rosen, *Societies and Military Power: India and its Armies* (Ithaca: Cornell University Press, 1996); Stephen Peter Rosen, "Military Effectiveness: Why Society Matters," *International Security,* Vol. 19, No. 4 (Spring 1995), pp. 5–31.

to overcome the status quo bias that is imputed to military organizations.

In another view, the requisites for successful innovation are: existence of senior officers with a new vision of future warfare ("product champions"); reform-minded junior officers; and the creation of new career paths within the organizations that allow the reform-minded younger officers to be promoted. Innovation is stimulated by competition and debate either within a branch of the military or between branches.

From the perspective of assessing the prospects for innovation within a military force, these theoretical perspectives suggest that the intelligence community ought to be directing its gaze along the following lines.

- Does the country in question face a high threat environment?
- Does the country in question seek to pursue revisionist aims?
- Does the country in question face high resource constraints?
- Does the country in question exhibit high societal cohesion, and how is this cohesion (or lack thereof) reflected in the military?
- Has the country/military force in question experienced conspicuous failures in the past?
- Are there identifiable "product champions" within the military?
- Are there plausible paths for career enhancement as a result of resolving existing technological, organizational, or doctrinal problems facing the military?

Combat Proficiency

Assessing the combat proficiency is by no means simple. Fortunately, the task here does not require assessing the combat proficiency of any given force, but rather simply explicating a methodology that identifies how such an assessment can be done in a way that accommodates a wide variety of military operations, ranging from simple to difficult, while simultaneously allowing for some meaningful comparisons among a small, select group of countries.

The methodology used here is drawn entirely from work undertaken at RAND by Jeffrey A. Isaacson et al. in recent years. This "capability-based methodology" is not intended to predict combat outcomes. It is based upon the simple hypothesis that military capabilities (or warfighting competencies) may be arrayed along a spectrum of increasing complexity, with each realm of military operations—ground, naval, and air—possessing internal "domains" separated by "thresholds" of technology and integrative capacity. The methodology suggests that increasing military capability (or extending warfighting competencies) requires a force not only to acquire new hardware, but also to develop the integrative dimensions it needs to utilize its technology, manpower, and other supporting resources effectively. This simple idea is then applied to ground, naval, and air operations. The analyst's task is to determine the point along the spectrum where a given country's forces fall, taking into account both the technology and the ability to integrate it.

Ground warfare capabilities. As Figure 13 shows, ground force competencies are arrayed along a spectrum ranging from irregular infantry operations at the simplest end to knowledge-based warfare at the complex end. **Irregular operations** consist mainly of ambushes, hit-and-run operations, and sniping activity, which can be prosecuted most efficiently in urban areas with limited equipment, mostly small arms, and small forces usually organized around the company level.

The next level of proficiency involves **coordinated infantry and artillery operations** that include the ability to mount static urban defense, including building robust fortifications, backed up by artillery. Offensive capabilities at this level of proficiency usually are not manifested above battalion level and involve some vehicular assets, packets of armor, and portable ATGMs usually employed against vulnerable soft targets or fixed installations.

Elementary combined arms represents a qualitative leap from the previous levels of proficiency. With the capability for coordinated armor/mechanized mobile defensive operations at the brigade level, a military force can now carry out basic flanking and envelopment operations against attacking armor with mobile forces using both infantry and armored elements.

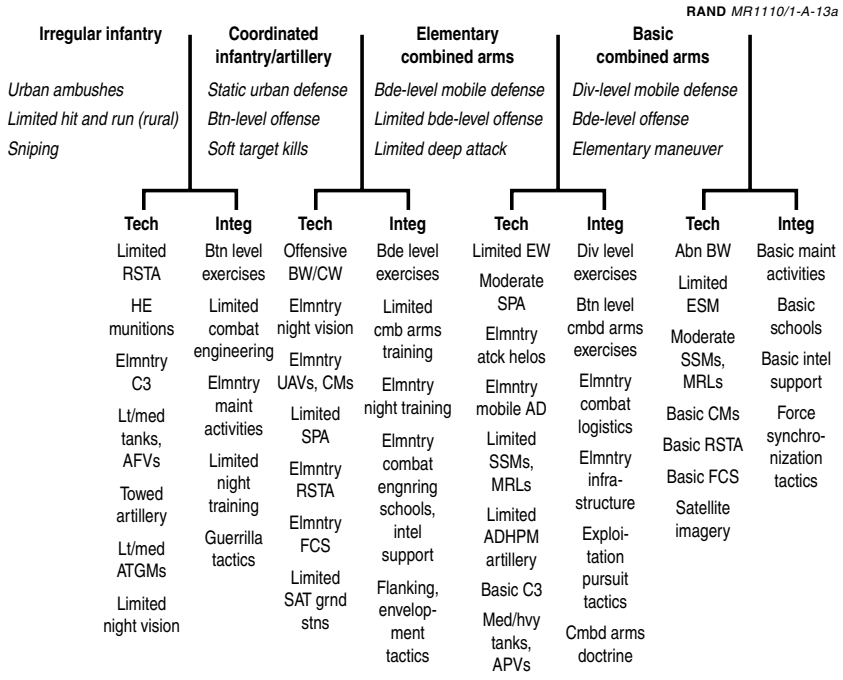

Figure 13—Assessing Ground Warfare Capabilities

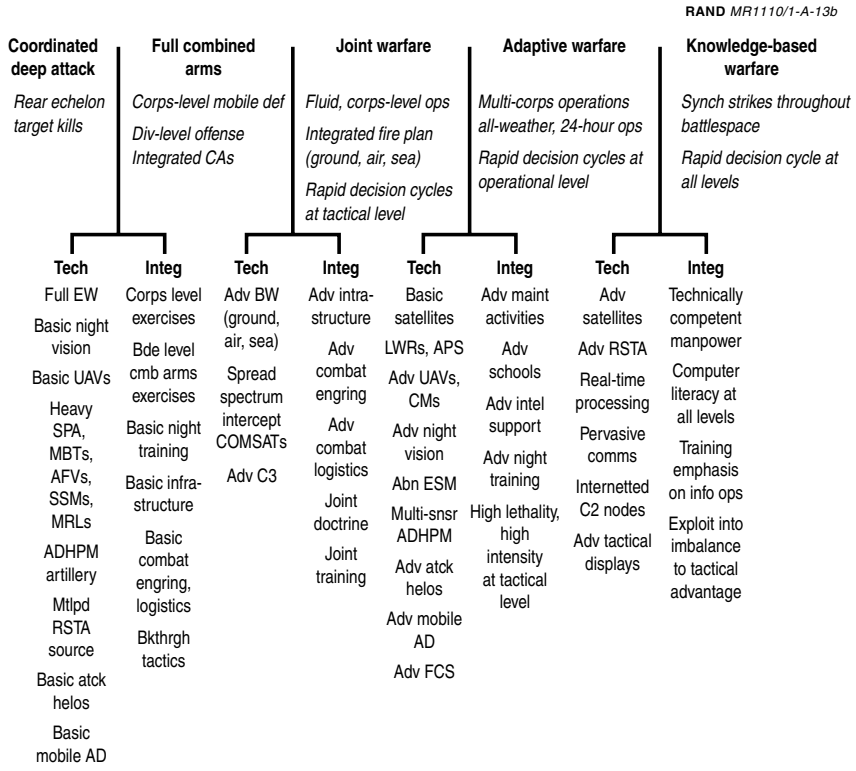

Figure 13—Assessing Ground Warfare Capabilities—extended

Basic combined arms forces represent a greatly expanded version of the maneuver skills manifested at the previous level of competency. Such forces can execute reasonably sophisticated division-level mobile defensive operations, featuring complete combined-arms operations: their defensive operations would include echeloned concentrations of armor, pinning attacks and feints, fire traps, and rapid shifts of forces from one sector to another; their deep offensive operations, mostly restricted to the brigade level, could include armored attacks that employ creative turning movements and open the door to exploitation/pursuit operations. They can coordinate deep attacks with operations at the front and use special operations forces to target critical installations like radars, SAM sites, and communications bunkers with cruise and ballistic missiles.

Coordinated deep attack competencies differ from basic combined arms primarily with respect to the capacity to mount deep operations that emphasize rear-echelon target kills. In particular, these forces can more accurately target corps-level rear echelon targets, such as assembly areas, truck parks, fuel dumps, and switching stations than can forces competent only in basic combined arms. In addition, these deep attacks can take place simultaneously with either offensive or defensive mobile operations at the front.

Full combined arms competencies represent an ability to conduct sophisticated mobile defensive operations at the corps level, including a mix of maneuver and firepower through the use of full combined-arms task forces. Defensive operations here can feature counterattacks of varying size as well as basic levels of joint operations, mainly air-ground cooperation in the form of integrated helicopter or fixed-wing close air support (CAS). Offensive operations would include division-level mobile capabilities that employ envelopment, turning, flanking, and bypassing operations, as well as full exploitation and pursuit. The ability to closely coordinate the deep and close battle in sequence implies that deep strikes with missiles and tactical aircraft against enemy rear echelons can be mounted just before or just after the critical close combat phase begins, and the acquisition of modest-quality night-vision equipment heralds the prospect of round-the-clock operations.

Joint warfare competency represents an entry into the realm of nonlinear warfare, wherein force-on-force annihilation no longer depicts

the battle accurately. Forces capable of such operations can overwhelm an adversary by quickly paralyzing his command nodes with deep armored thrusts, missile attacks, and massive jamming/intercept operations, and they can execute fluid armored operations at the corps level on both offense and defense.

Adaptive warfare competencies yield a force with the ability to conduct nonlinear operations at the multicorps level in both offense and defense. Such forces can launch deep attacks based on near-real-time intelligence data, operate at night and in adverse weather, and strike throughout the entire depth of the battlespace simultaneously. Under many circumstances, such forces can defeat more primitive opponents even when facing highly disadvantageous force-on-force ratios, and they can wrest the initiative from opponents through cognitive dominance at the operational level.

Knowledge-based warfare represents a competency that allows a force to achieve cognitive dominance over its opponents at all levels—strategic, operational, and tactical. Because such forces possess a near-perfect, dynamic picture of all unit positions in real time, these armies can get inside the adversary's decision cycle (the so-called "OODA loop") so rapidly that the latter's command structure will always be making decisions based on obsolete information. No army in existence today has mastered knowledge-based warfare, but the U.S. Army's Force XXI vision represents a step toward this ideal.

Naval force capabilities. The spectrum of naval force competencies has been structured in a manner analogous to that of ground forces (see Figure 14). **Coastal defense and mining** represent the most primitive naval warfighting competency in the capabilities-based methodology. Such operations are the provenance of navies composed of small craft (under 70 feet), armed with small-caliber weapons, and used primarily to patrol coastal waters or lay mines for defensive operations. Personnel engaged in such operations acquire ship-operating skills primarily from the fishing industry, and their limited weapons proficiency may require soldiers on board to handle weapons.

Coastal anti-surface warfare represents a marginal improvement in competency deriving from increased offensive capability, with converted Army weapons such as rocket-propelled grenades, .50 caliber

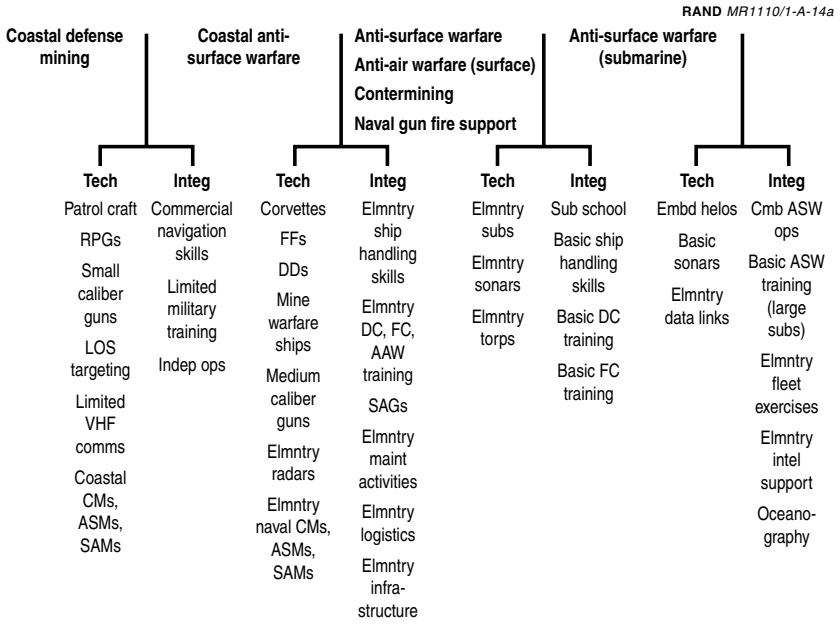

Figure 14—Assessing Naval Warfare Capabilities

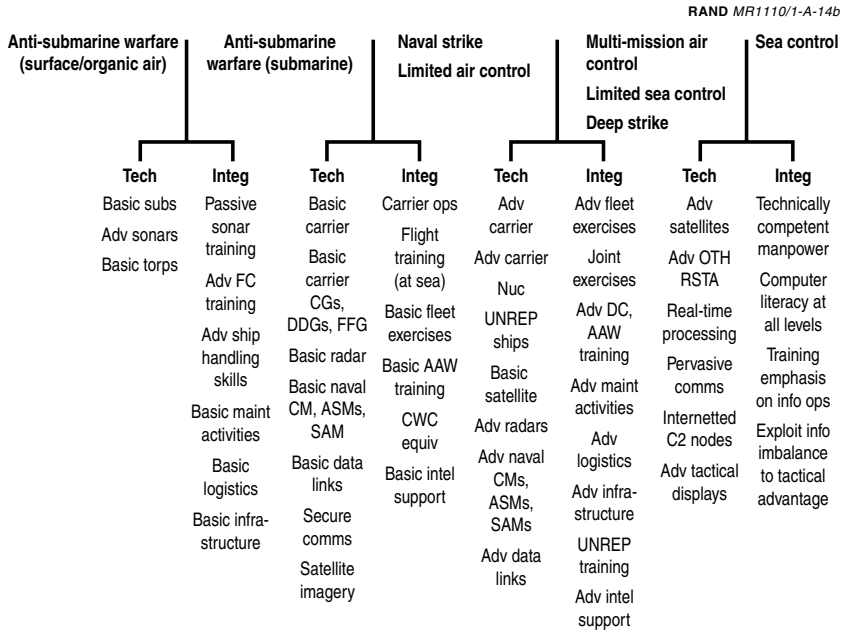

Figure 14—Assessing Naval Warfare Capabilities—extended

machine guns, and shoulder-launched rockets as the normal armament. In some cases, land-based missile batteries may be part of the weapons inventory. Forces at this level of competency typically operate ships as independent units, remain relatively close to shore, generally utilize line-of-sight targeting of surface vessels, and possess limited VHF communications. For the most part, personnel acquire ship-handling skills from the commercial sector, but limited naval training may provide the skills required for weapons proficiency.

Anti-surface and anti-air warfare (AAW) with surface ships, including countermining and naval gun fire support, represent further improvements in competency but nonetheless remain within the ambit of the simplest form of naval warfare: ship versus ship. Such forces cannot operate at long distances from the coast for extended periods, and ships generally sail independently. With increased experience and operating time at sea, several ships can perform as a small surface action group, with capabilities for limited air/surface search, line-of-sight targeting of low-tech missiles, and naval gun fire support. The technology pertinent here includes corvettes, older frigates, destroyers, and minesweepers, but the larger size of these vessels and the more complicated weapon systems aboard them usually make for greater integrative demands. Ship-handling skills, more advanced than in the commercial sector, usually require formal training for their proper development (usually accomplished at a naval school or training base). In addition, damage control, fire control, and AAW create new training requirements. Finally, keeping large ships under sail—even to a limited degree—requires elementary logistics (e.g., supply) and maintenance activities (e.g., shipyards with skilled laborers).

Anti-surface warfare with submarines represents a higher level of competency relative to operations conducted with surface ships alone because of the complexity of submarine operations and the challenges of operating effectively under water. These operations usually take the form of small diesel submarines targeting military and civilian shipping traffic. Such vessels usually operate at moderate distances and require resupply and refueling, usually accomplished at a naval base. Typically, diesel submarines act independently and station themselves at geographic choke points. Although they involve high initial investment and operating costs, small diesel boats can provide a relatively potent stealth weapon under the right

circumstances even if they are equipped with older-generation sonars and torpedoes. Training for submarine operations usually requires a dedicated submarine school, with a curriculum that includes improved weapons and sensor training to locate and destroy a target.

Anti-submarine warfare (ASW) with surface ships represents another step up in the spectrum of competency because it requires dedicated surface combatants with capable sonars, and usually an organic helicopter capability. Because ships and helicopters must now operate with each other to perform ASW, this competency imposes substantial demands on integration. Ship manning and aviation skills combine with greater maintenance requirements. Moreover, such operations require tactical coordination, including the capability to pass tactical information between units, either by voice or through tactical data links. Target submarines are also required for ASW training, so that elementary fleet exercises become important for realizing such competencies.

ASW with submarines represents an even higher level of competency in comparison to surface ASW because of technological requirements, relating to submarine quietness (through hull and propulsion design) and the possession of advanced passive sonar and fire control systems, as well as the high integrative demands owing to the inherent difficulty of subsurface ASW targeting. In this context, passive sonar operations and advanced fire control training are as important as the advanced ship-handling skills necessary to operate submarines effectively in an ASW environment. While nuclear submarines are excellent platforms for ASW, late-model diesels like the German Type 209 and Russian Type 636 Kilo can perform equally well in some missions. An advanced submarine fleet requires high levels of skilled maintenance and effective logistics support.

Naval strike and limited air control represents an important transition point in naval warfare competency because it signals the ability to project power ashore. Forces capable of such operations typically operate some type of aircraft carrier (perhaps a V/STOL carrier) with embarked aircraft capable of light attack. To support these operations, either satellite imagery or land-based long-range maritime patrol aircraft, together with intelligence support (for mission planning), are necessary for successful scouting and targeting. Because

carrier operations are extremely demanding, an extremely high level of integrative efficiency is required. In addition to the carrier and its aircraft, the force structure required by this competency usually includes guided missile frigates, destroyers, and cruisers to protect the high-value assets against attack and to support the limited air control mission. These battlegroups usually perform basic fleet exercises, are capable of sharing moderate amounts of tactical data, and normally operate under some kind of component warfare commander (CWC) concept, whereby various commanders are assigned responsibility for defined mission areas so that coordinated defensive and offensive operations can be carried out simultaneously.

Multimission air control, limited sea control, and deep strike proficiencies come closest to realizing true "blue water" capability. Forces capable of such operations field advanced aircraft carriers capable of launching a variety of specialized CTOL aircraft, host advanced high-speed data transfer and communications systems, and possess sophisticated multidimensional offensive and defensive systems. Advanced cruise missiles with robust intelligence support provide a deep strike capability against both land and sea targets. In addition, under way replenishment makes forward presence possible, although a system of forward supply bases with ports can suffice in many instances. Such capabilities require advanced training and support, large-scale fleet exercises, and substantial joint operations. Moreover, an advanced shore establishment ensures that adequate maintenance and supply capabilities are available.

Comprehensive sea control is the naval equivalent of knowledge-based warfare in the realm of ground operations. In this case, over-the-horizon (OTH) reconnaissance, surveillance, and target acquisition (RSTA) systems, real-time processing, and pervasive communications create true network-centric forms of warfare that enable a force to successfully interdict an adversary's assets in any operating medium. Such capabilities promise an as-yet unseen multiplication of naval force effectiveness and remain an ideal that even the U.S. Navy can only aspire to today.

Air forces. Air forces have a warfare capabilities spectrum as well (see Figure 15). **Airspace sovereignty defense** remains the most primitive form of air warfare capabilities, and a force whose competencies are exhausted by this mission is usually equipped with

lightly-armed air assets operating in tandem with ground-based radars. These forces can detect intrusions into their air space and defend it against unarmed adversaries. Little else is within the grasp of such a rudimentary force.

Elementary defensive counterair (DCA) represents an improved ability to defend one's air space against armed intrusion. While it may not suffice to conduct a sustained DCA campaign against a more advanced air force, it does allow for an ability to inflict some losses against a more advanced aggressor and to prevent a potential foe from conducting unlimited overhead reconnaissance. A force capable of such operations usually fields obsolete air defense fighters, which prosecute air-to-air engagements solely within visual range with cannon and early generation missiles and do not operate outside of fixed air defense corridors. Command and control procedures for such air forces are rigid and consist mainly of GCI operations, with pilot training being light and restricted to simple combat maneuvers.

Basic DCA and elementary strategic strike are in many ways similar to the previous level of competency except that such forces often field improved air defense fighters and better AAMs and GCI radars, and they operate out of hardened shelters that provide enhanced passive defense to the force as a whole. Pilot training also improves marginally to enable handling more sophisticated aircraft, but elementary logistics usually make for low operational tempos. In addition, this force can use simple unmanned aerial vehicles (UAVs) or other forms of elementary aerial reconnaissance for a nascent strategic strike capability, mostly useful for attacks against large, soft targets like cities and industrial plants.

Advanced DCA coupled with maritime defense (coastal) competencies represent a leap in capability over the previous level of proficiency. These forces possess some current-generation air defense aircraft armed with modern air-to-air missiles and possibly supported by airborne early warning (AEW) aircraft. They also exhibit an improved strike capability, utilize long-range, high-altitude aerial reconnaissance in the form of specially configured platforms, and have the capability to deliver anti-ship missiles effectively within their coastal waters. Realizing such increased capabilities requires integrative investments, including advanced maintenance facilities,

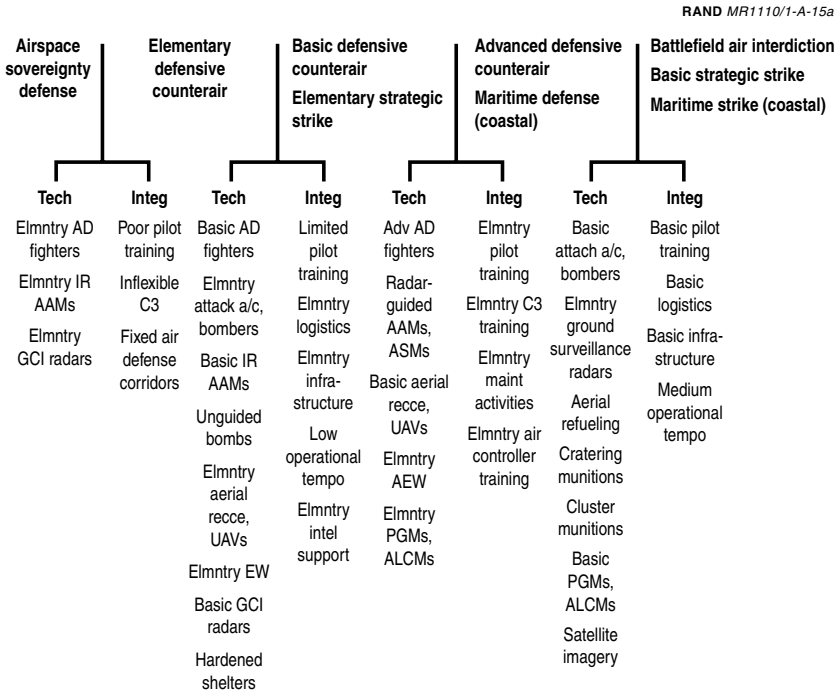

Figure 15—Assessing Air Warfare Capabilities

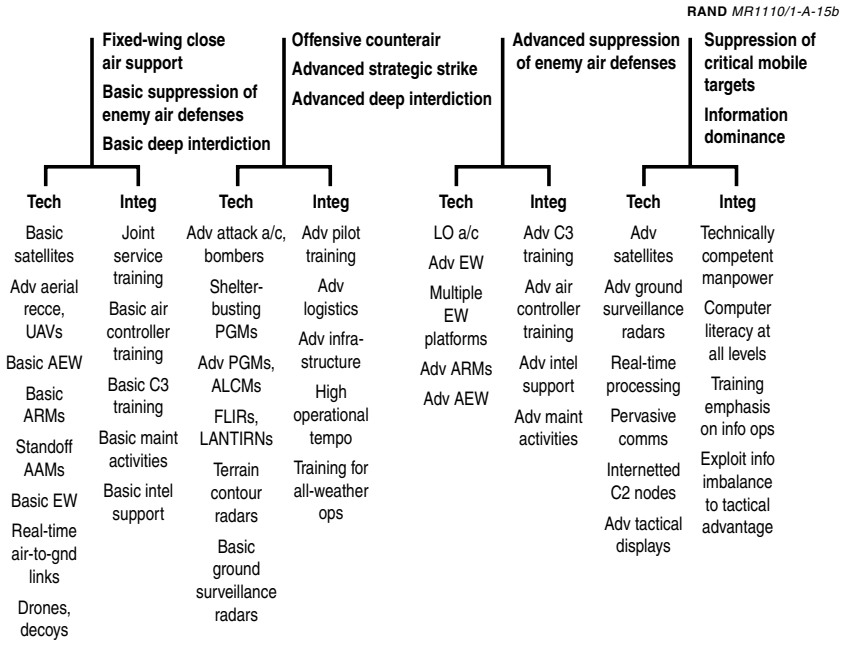

Figure 15—Assessing Air Warfare Capabilities—extended

dedicated support, relatively high levels of training, and sophisticated command, control, and communications (C^3). The importance of integrative factors sharply increases in this domain, and air forces focusing on technological improvements alone are not likely to realize the full capabilities possible in this regime.

Battlefield air interdiction (BAI), basic strategic strike, and maritime strike competencies enable a force to influence ground combat in a manner impossible for forces with lower levels of capability. Utilizing basic attack aircraft, ground surveillance radars, cluster munitions, and basic anti-armor precision-guided missiles (PGMs), such forces can influence the tactical battlefield while also reaching out to targets in the strategic realm. Here, such forces usually rely on their own air-breathing reconnaissance platforms or on foreign-supplied satellite data for targeting; they may also possess aerial refueling technology and ALCMs to strike an array of deep (i.e., greater than 300 km) targets like large surface-to-air missile (SAM) sites or surface vessels operating outside of their coastal waters. Pilot training in such forces is usually extensive, and a well-organized logistics system is usually available for combat support.

Fixed-wing close air support, basic suppression of enemy air defenses (SEAD), and basic deep interdiction remain competencies associated with highly advanced and capable regional air forces. Such forces use real-time communications with mobile ground units and can provide direct air support to ground elements engaged in close combat. They also possess an established SEAD capability that includes moderate jamming, the use of decoy and reconnaissance drones, and basic anti-radiation missiles (ARMs). In the air-to-air realm, they often possess active radar missiles, improved AEW systems, and highly integrated air defense ground environments (ADGES), potentially making them formidable air-to-air adversaries for most air forces of the world. Finally, using small, independent satellites and advanced aerial reconnaissance they can execute deep interdiction missions against mobile and hard stationary targets. Creating such a force involves significant integration requirements, including joint service training with an emphasis on C^3, well-trained forward air controllers (FACs), effective intelligence support, and basic facilities and manpower for maintaining advanced systems.

Offensive counterair (OCA), advanced strategic strike, and advanced deep interdiction capabilities allow an air force to conduct a decisive offensive counterair campaign that includes airbase suppression through a day/night/all-weather deep interdiction campaign. Such a force possesses advanced attack aircraft, sophisticated navigation and targeting sensors, and highly capable ground surveillance radars. Its weapons include shelter-busting munitions, advanced air-launched cruise missiles utilizing GPS guidance, and advanced precision-guided munitions that can be used in high-intensity operations conducted at high tempos. Thanks to intensive and sophisticated training regimes, advanced logistics, and sizable ordnance stockpiles, this type of air force can seal off the ground battlefield from enemy reinforcements for substantial portions of time.

Advanced SEAD competencies allow a force to rapidly paralyze even the most advanced air defense systems. Using low-observable (LO) aircraft and munitions, sophisticated jamming from multiple platforms, spoofing, intelligent anti-radiation missiles, and advanced AEW, this force can achieve theater-level air supremacy more rapidly and at less cost than a force at the previous level of competency. This force invests heavily in C^3 training, air controller training, intelligence support, and maintenance activities to allow for high levels of sortie generation and effectiveness that are "second to none." Only the U.S. Air Force has this level of air power competency.

Suppression of critical mobile targets (CMTs) and information dominance represents a capability whereby a force relies on information imbalances to paralyze its adversaries and dominate its battlespace. Using real-time data processing and pervasive communications, it can destroy critical mobile targets (e.g., mobile missile launchers, mobile command posts) with a high level of confidence. This force can typically sustain a fleet of advanced ground surveillance aircraft in theater, a robust theater missile defense (TMD) capability, and a fully rounded out indigenous satellite capability that produces photo, infrared, and radar imagery in real time. Its tracking radars and air-based targeting sensors are more advanced than any fielded currently, and its well-trained, technically competent manpower can fully exploit them to perform CMT spotting and to attack adversaries effectively even in forested or mountainous terrain. This type of force remains an ideal for now.

The purpose of such a methodology is to locate a country's military competencies on a schematic map that enables the analyst to depict its relative capabilities. The advantage of this framework is that it allows military capabilities to be perceived not simply in terms of what countries have but rather in terms of what they can do—their operational competency—as a consequence of what they have. It allows for the integration of both their strategic resources and their conversion capabilities, but ultimately it assesses their military power in terms of operational proficiencies that can be attained as a result of these interacting variables.