Chapter 1

INTRODUCTION

Innovations in the production, deployment, and application of military power are crucial to international politics. Unfortunately, most assessments of the international security environment fail to incorporate either the relevance of military innovations or the importance of their spread. For example, in a thirty-year period, from 1850–80, the French Navy became the first to develop shell guns, and the first to deploy a steam-powered warship, an ironclad warship, a mechanically powered submarine, and a steel-hulled warship. These developments should have helped the French Navy gain superiority over its bitter rival, the British Royal Navy, but they did not. Moreover, barely a decade after the introduction of the steel-hulled warship in the 1870s, a new innovative school of naval theorists in the French Navy argued that the future of naval power lay with emerging technologies like torpedo boats and submarines, not the battleship. France was going to jump ahead once again. Yet despite this foresight and demonstrated initiative, most people generally do not consider France a great naval innovator of the period. Why is this? What advantages did it get from its introduction of a series of useful technologies into naval warfare?

The real answer is that the French Navy received no advantage. Unlike the U.S. Navy, whose mastery of the technology *and* organizational practices associated with carrier warfare provided it with a sustainable edge in naval power in the second half of the twentieth century, the French could not institutionalize their advantage. While the French excelled at inventing new technologies, crippling organizational debates prevented the integration of those technologies into French naval strategy. In each case, the French were the first to introduce a new naval warfare capability, while the British Admiralty appeared, in public, disinterested in French developments. Yet in each case the British, who had been carefully studying French advances in private, quickly adopted the new capabilities, improved on them, and used Great Britain's superior industrial production capabilities to eliminate France's ability to gain a relative power advantage from its inventions.

A prescient analysis in 1902 of submarine warfare by Herbert C. Fyfe, the "Sometime Librarian of the Royal Institution, London," includes an appendix on the French Navy that expresses French feelings on the matter:

> "We have seriously believed," says a writer in the *Journal de la Marine*, "that in all the great modifications that have been brought about in the

> construction of submarines is the result of the important changes which the last fifty years of the century have produced in the art of naval warfare. All these changes have been sought out, experimented upon, studied, and finally realized by France, who has also been the first to apply them. These results have established in a brilliant and incontestable manner the skill of our engineers; but our rivals have not only appropriated the results of our labours, but they have not been slow to place themselves on equal terms with us, and finally to excel us in the application of these discoveries. . . . We have been only the humble artisans working for them to establish their superiority." (Fyfe 1902, 281)

While France was the technological first mover in several cases, it failed to harness its advances into an actual war-fighting innovation in a way that increased France's relative naval power.[1] Instead, it was the British Royal Navy that came to exemplify naval power in the mid- to late nineteenth century as it entered an era of naval superiority.

The failure of the nineteenth-century French Navy to exploit its technological inventions in sea power yields two important lessons for a general understanding of military power and international relations. First, inventing technologies or even being the first to use them does not guarantee advantages in international politics. There is a big difference between the introduction of a technology on to the battlefield and the full integration of that technology into national strategy, including warfare and coercive diplomacy. It is the difference between the two, in fact, that often determines success or failure in international politics. It is the employment of technologies by organizations, rather than the technologies themselves, that most often makes the difference.

Second, in contrast to most prior work on military innovation, which has tended to focus on who innovates and why, it is the diffusion of a military innovation throughout the international system that most determines its influence on international politics. The study of military power is incomplete at best without a theoretically coherent understanding of how states respond to major military innovations, and how the pattern of their responses helps drive the rise and decline of nations as well as the patterns of warfare frequently analyzed by other scholars. By developing a theoretical framework that can bring together empirical topics like suicide bombing and carrier warfare that scholars have tended to study separately, this book presents a new, more efficient, way to think about approaching the diffusion of military power.

The introduction and spread of new means of generating military power, sometimes called major military innovations (MMIs), have played a critical role throughout history in determining the global balance of power along with

[1] This introductory section is based on both Fyfe's and Theodore Ropp's work on the French Navy (Fyfe 1902; Ropp 1987, 8–11, 42).

the timing and intensity of wars.[2] The infamous Mongol armies, with their mastery of the composite bow and a new form of cavalry strikes, toppled nations from China to those in the eastern part of Europe because of their leaps in technology and strategy. Hundreds of years later, the German debut of blitzkrieg warfare at the outbreak of World War II helped them rout French forces and consolidate control over Western Europe. But despite their significance in terms of driving change in international politics, the processes that govern the spread of innovations and their effects are little understood in the field of international relations. Several questions about military power remain unanswered: Is it best to be the first mover, to borrow a term from economics, and the first to figure out how to effectively employ new types of military power, like the Germans with blitzkrieg?[3] Or is it better to be a follower, learning from the leader, and trying to extend and improve the original ideas, like the Germans with all-big-gun battleships responding to British innovations? How do nonstate actors fit into this story? Insurgent and terrorist groups have to make decisions about military strategy just like nation-states. How do they decide whether or not to adopt new innovations in how they use force like suicide bombing?

This book addresses the broad puzzle of why some military innovations spread and influence international politics while others do not, or do so in very different ways. These patterns are explained with a theory of the spread of military power called adoption-capacity theory.

Nation-states have a number of possible strategic choices in the face of military innovations. These include adoption, offsetting or countering, forming alliances, and shifting toward neutrality, as noted in the preface. Adoption-capacity theory posits that for any given innovation, it is the interaction of the resource mobilization challenges and organizational changes required to adopt the new innovation, and the capacity of states to absorb these demands, that explains both the system-level distribution of responses and the choices of individual states.

As the cost per unit of the technological components of a military innovation increases and fewer commercial applications exist, the level of *financial intensity* required to adopt the innovation increases. The rate of adoption decreases and alternatives like forming alliances become more attractive. Similarly, if an innovation involves large-scale organizational changes in recruitment, training, and war-fighting doctrine, the innovation requires a high level of *organizational capital* for adoption, and fewer actors are likely to adopt it. Some states will have the necessary capacity and interests, while politics will prevent adoption by others. If capacity and interest are lacking, no matter how

[2] Chapter 2 discusses defining and operationalizing military innovations.

[3] As chapter 2 describes, in the blitzkrieg case, while the British were the first movers with regard to the technology, the Germans debuted the mature innovation.

intrinsically compelling a new innovation may seem, it will not diffuse throughout the system. Accurately measuring these variations in diffusion also more effectively explains shifts in the balance of power and warfare than traditional theories alone can do. While higher financial requirements generally mean that the adoption patterns will benefit preexisting wealthy and powerful states, higher organizational change requirements can handicap the wealthiest states and upset the balance of power toward newer and more nimble actors.

The question of how states deal with periods of uncertainty about military power is of special interest today. Significant global economic turmoil now accompanies ongoing debates about the future of warfare in the information age. International relations scholars have demonstrated that uncertainty about the current and future security environment can be a primary cause of conflict (Fearon 1994a; Powell 1999; Smith and Stam 2004). Sharp debates exist between those who believe that the United States should optimize its military for future counterinsurgency campaigns like Afghanistan and Iraq, and those who believe that the United States should focus instead on its conventional capabilities (Gentile 2008; Mazarr 2008; Nagl 2009). An important wild card for both perspectives is the role of the information age in international conflict.

The information age is popularly described as the application of information technology to enhance the productivity of businesses and government, increasing the ability of societies to rapidly create and disseminate large amounts of information anywhere around the globe in real time. The information age, like the Industrial Revolution before it, will eventually have a large-scale impact on warfare.

While some degree of change is likely inevitable, the details of that change and the consequences are still very much in the air. In particular, the United States currently appears to lead the globe in developing and integrating information age advances into its military forces. But software-heavy developments may come to dominate the information age, rather than expensive physical hardware. The declining cost of computing technology, Internet access, and devices like personal GPS units, along with the dual-use nature of many information age military technologies like precision-guided munitions, mean new capabilities may become available to an increasing number of countries over time. While the United States has led the way in utilizing information technology in its military operations, its lead is far from assured. Peter Singer (2009) has described the way that the robotics revolution will impact the future of warfare, contending that there are risks for the United States as well as potential benefits.

In that hypothetical case, the U.S. government's devotion to its tanks, bombers, and carriers could become an albatross that drags down the U.S. military, which might face organizational challenges in transforming itself, in favor of states that figure out new and better ways to organize their forces to take advantage of information age technologies. Countries like China and India could

end up leapfrogging a U.S. military that is increasingly focusing on irregular forms of warfare like those in Afghanistan and Iraq. Such an outcome is not on the immediate horizon and is far from inevitable, but it is a mistake to think that the United States is guaranteed to have the strongest conventional military forces in the world. These changes will also potentially empower nonstate actors attempting to find new ways to mobilize and fight against nation-states. Terrorist groups are already shifting the locus of their education, recruitment, and training operations to the "virtual" world of the Internet (Cronin 2006, 83–84; Hammes 2004, 198–99). The empowerment of nonstate actors means that a world of information warfare could substantially increase the capacity of terrorist groups and insurgents to deliver disruptive strikes on the major powers. Potential examples include taking down electricity grids or reprogramming satellites, which would further increase security challenges. While adoption-capacity theory cannot purport to provide exact answers, it can help us predict future trends and know the right questions to ask.

In sum, different military innovations spread throughout the international system differently, and the way they spread has a large effect on key issues in international politics like the balance of power and the probability, intensity, and length of wars. Understanding the spread of military power is therefore important not just for international relations theory but also for policy analysts interested in the future of global power and U.S. strategy as well.

Why the Spread of Military Power Matters

Military power is the measure of how states use organized violence on the battlefield or to coerce enemies. It represents the combination of the technology used to fight—"hardware" such as rifles, artillery, and bombers—and the organizational processes used to actually employ the hardware—"software" like recruiting and training. It is tempting, however, to view the spread of military power as simply the spread of military technology, the tools and devices used to prepare for or fight armed conflicts (Zarzecki 2002, 74).[4]

In contrast, in this book I am concerned with the spread and impact of changes in the character and conduct of warfare. While technological change often accompanies the innovations we remember in history, technology alone is rarely enough. Instead, building on work by Emily O. Goldman and others, it is the way militaries take raw technologies and use them that creates military force and influences diffusion patterns (Goldman and Eliason 2003a).

[4] This is also the starting point for most studies of arms races as well as arms imports and exports. The focus on quantitative measures of technology perhaps initially occurred simply because tanks and rifles are easier to count than methods of recruiting and training (Farrell 2005). For more on other theories of diffusion, see chapter 2.

My approach draws on evidence from the business world that shows studying technology alone is not enough to capture the essence of how innovations matter and what makes successful change more likely. For example, in the 1990s, Dell Computers pioneered a model of production that relied on made-to-order computers based on customer specifications, leading to lower inventories and overhead costs than its major competitors. This innovation in its organizational structure improved Dell's ability to integrate exogenous, or external, changes in personal computer technologies. When a technological change occurred, like the release of a new microprocessor from Intel, Dell could integrate it into its consumer production lines within a matter of days and without significant outdated warehouse stock; it generally took weeks for its competitors to do the same. This gave Dell an enormous advantage in its ability to deliver top-notch products to its customers, leading to more sales (Brynjolfsson and Hitt 2000, 29–30). While the technology mattered, since new microprocessors produced changes in computers in ways that altered costs and orders from customers, every computer company received the same chips from Intel. It was Dell's ability to integrate the new technology more efficiently than its competitors that produced its market advantage.

Another example of why both technological and organizational resources matter comes from survey data on business productivity. In 2001, the McKinsey Corporation and the London School of Economics surveyed over one hundred businesses that implemented technological changes, changes in managerial practices, or changes in both areas. The results showed the discontinuous impact of combining organizational and technological change. Businesses that implemented exclusively technological changes experienced a 2 percent increase in productivity, which paled in comparison to the 9 percent increase generated by exclusively managerial changes. Yet businesses that adopted both managerial and technological changes experienced 20 percent productivity increases, almost double the total from adding together technological and managerial change (Dorgan and Dowdy 2004, 13–15).[5] These results explain why companies like Dell succeeded in the 1990s and Apple has done so over the last decade.

Many international security researchers rely on measures of national power like iron and steel production, the numbers of troops or the defense budget of leading states, and their populations. The National Material Capabilities data gathered by the Correlates of War (COW) Project includes information on the military, industrial, and demographic capabilities of each state, which is summed into the Composite Index of National Capability (CINC).[6] CINC-based

[5] Despite many differences, military organizations share some key facets with firms, including the need to compete with other actors, the threat to survival from competitive failures, the development of bureaucracies to regulate and manage their operations, and the need to make strategic choices in response to changes in the external environment (Cronin and Crawford 1999; Waltz 1979).

[6] For more on CINC data and the COW Project, see Correlates of War 2 Project 2006; Singer 1987; Singer, Bremer, and Stuckey 1972.

research has become the standard way to measure power in international relations scholarship. The use of CINC data has produced a number of important insights into international politics, including evidence that materially stronger and wealthier states are more likely to win wars, all other things being equal, and that system power concentration is significantly related to militarized disputes (Bennett and Stam 2004).[7]

A growing body of literature in international relations, however, suggests that measuring military power and predicting military outcomes involve more than simply assessing the material resources states can bring to bear on the battlefield. Studies in recent years using more sophisticated quantitative models have built on some of the early research and shown that simpler models only relying on material power indicators do not reveal the full picture. For example, work by Dan Reiter and Allan Stam (2002) focuses on the political regimes of states, and how they influence battlefield outcomes.

Additionally, research by Stephen Biddle (2004, 21; 2007a, 218–20) demonstrates that material measures of international power are not in and of themselves enough to predict the outcomes of military campaigns. Biddle argues that force employment, or what militaries do with the equipment they have—the decisions they make about how to organize and deploy their resources—plays an important role in determining the military power of states (see also Stam 1996).

Materially strong states with weak force employment concepts sometimes lose, while materially weak states with strong force employment concepts sometimes win. For instance, despite having more ships, guns, and people, the Russian military lost badly to imperial Japan in the Russo-Japanese War. Another example of a sure loser according to conventional measures of military power is Israel, which confounded material indicators in a series of wars against numerically and materially superior Arab foes attacking from multiple sides. These cases show that core issues of international security cannot be explained without reference to much more than the number of people and specific technologies involved (Brooks 2007, 228).

Still, understanding the importance of both organizations and technology in producing military power is only the first step in appreciating the way military innovations influence international politics. The second part of the puzzle is the differences in the capacity of militaries to successfully adapt to changes produced by those innovations. New military innovations are not created equal when it comes to the ease of adoption. For example, the technological

[7] These systematic tests often navigated competing claims in the qualitative literature to help move intractable debates forward. The military dimension of both the Organski-Davies total output model and the Singer-Bremer-Stuckey national power model, for example, rely on military expenditures and personnel as the most important measures of military capabilities (Organski and Kugler 1980, 31; Singer, Bremer, and Stuckey 1972).

components of some innovations, like nuclear weapons, are extraordinarily expensive, especially for first movers and early adopters. In contrast, the unit costs of the technological components of some other innovations, like the rifle or machine gun, are relatively inexpensive. The organizational change requirements of innovations can also vary widely. Utilizing chemical weapons in World War I involved adding them into existing operational plans, not fundamentally changing the way militaries organized themselves. In contrast, adopting Napoleonic mass mobilization required an enormous shift in how militaries recruited and trained as well as the use of the division structure and the creation of skirmishers. It is these shifts in the financial and organizational requirements for adopting innovations—given the different capacities of military organizations—that produce varying implications for the international security environment (Gilpin 1981, 63).

Diffusion begins when a major military innovation reaches a critical "debut" or "demonstration" point. These terms, drawn from studies of business strategy, refer to the point when the relevant community has sufficient information to reasonably understand the significance of an innovation. While much of the time innovations debut through a demonstration during warfare, sometimes the revelation of a new capability during peacetime is enough to trigger a response, as when the British Navy introduced the *Dreadnought*.[8] This can vary depending on a variety of factors. The most critical of these is the extent and success of efforts by the first mover to shield knowledge of how the innovation works from potential adversaries or other states once it recognizes it has developed new military capabilities. Sometimes militaries do try to hide crucial elements of advances from the international community, as the Royal Navy did when it introduced the *Dreadnought* or the United States did with the Manhattan Project even after dropping two atomic bombs. At other times, an innovation debuts in a relatively transparent fashion, as it did when the United States and Japan both placed the aircraft carrier at the center of their fleets in the midst of World War II.[9] The debut point where diffusion starts varies from innovation to innovation.

Explaining the Spread of Military Power

Adoption-capacity theory combines research on the way both militaries and businesses change with new insights into the relative costs of new military

[8] The differences between introducing innovations in wartime or peacetime may be relevant as well.

[9] The question of shielding new military capabilities is related to Robert Axelrod's discussion (1979, 231–32) of when to debut new weapons in the first place. Whether or not the first mover can keep the innovation secret may be more or less possible depending on the domestic and international political environments.

systems to explain how military innovations spread once they have been introduced into the international system.[10] The basis of the theory is recognizing the adoption-capacity requirements of an innovation and how the capacities of individual states measure up.

Approaching the spread of military power from this perspective sidesteps the traditional debate about whether strategic competition, cultural factors, or norms best explains emulation and allows for the construction of a more powerful new theory. There are many reasons why states are interested in adopting innovations: strategic necessity, international norms, cultural openness, the need for interoperability with allies, and many others. Threats are a vital part of the matrix of factors that motivate nation-states. It is even possible that for the states that initiate military innovations, threats play an important role in their drive and capacity to innovate.[11] Prior research, though, has often presumed that for potential adopters, where there is a will to adopt, there will be a way (Elman 1999; Resende-Santos 2007). In the real world, states are sometimes overmatched no matter how well they optimize, and sometimes states do not adopt innovations even when they face large threats. Rather than viewing capabilities as totally fungible depending on state strategy, at least in the short- to medium-term it might be financial and organizational constraints that shape possible strategies as well as the probability of success.

Adoption-capacity theory argues that, once states have the necessary exposure to an innovation, the diffusion of military power is mostly governed by two factors: the level of financial intensity required to adopt a military innovation, and the amount of organizational capital required to adopt an innovation. As briefly introduced above, financial intensity refers to the investments required to purchase the physical hardware associated with an innovation, along with the relative ability of states to make those investments. Key to determining the level of financial intensity required for adoption is whether the relevant technology is exclusively military or has commercial applications, and the cost per unit of the physical hardware associated with the innovation, like a battleship or an aircraft carrier, in comparison with previous procurement. The more military oriented the technology and the higher the unit cost, the higher the financial intensity required for adoption.[12]

[10] The notion of relative costs here is complementary to measurements of military balances that incorporate the way new military advances can influence the relative cost of war (Anderton 1992; Powell 1999, 110–12, 197–98). James Fearon (1995a, 6–8) in particular explicitly recognizes the way that assumptions about rapid emulation have influenced offense-defense debates. Instead, in his view, what matters is the relative pacing of adoption.

[11] Barry Posen (1984, 1993) argues that threats drive the innovation process by determining whether civilian intervention occurs.

[12] This is related to research on capital intensity, but rather than focusing on the trade-offs between labor and capital, financial intensity is more about the way that capital is invested (Gartzke 2001).

The other half of the new theory is organizational capital, the intangible change assets needed by organizations to transform in the face of major military innovations. The study of organizations in general and military organizations in particular is hamstrung by the idiosyncrasies of individual militaries and the difficulties involved in parsing out exactly what determines their propensity to change. Though this will always be an issue, there are a variety of different ways to measure and evaluate the capacity of military organizations to change. Organizational capital is an imperfect but powerful way to conceptualize the potential change capacity of a military organization. Three factors in particular, measurable in military organizations prior to the demonstration of a given innovation, appear to best predict whether or not the organization will have the necessary capacity to adopt. First, the amount of resources devoted to experimentation is an indicator of the willingness and ability of organizations to consider major innovations. Second, as Mancur Olson (1982) contends in economics, older organizations often become bureaucratically ossified as subgroups of control proliferate, generating an increasing number of veto points that prevent innovations from being adopted. Therefore, the longer military organizations last without experiencing serious upheavals such as regime changes from within or defeats in interstate wars, the worse they should be at integrating innovations.[13]

Finally, the way that military organizations define their critical tasks plays a vital role in defining the range of the possible for those organizations (Wilson, 1989). The broader the definition of the organization and its purpose, the better it will be at adopting innovations. Al Qaeda's willingness to consider any and all operational methods for attacking the United States and its allies made it nimble enough to adopt suicide terrorism. Al Qaeda defined the means it would use to achieve its goals very broadly. In contrast, when an organization narrowly defines the optimal means to pursue its goals, the chances get higher that pushback from elites within the organization will prevent the adoption of innovations. A textbook case of how a limited view of the means to success can negatively influence an organization is the U.S. Army during the Vietnam War. The Vietnam era U.S. Army viewed using superior firepower as not just a means to an end but rather an end in itself; its ability to employ that firepower bled into how it measured success and failure. In 1965, the army even defined success based on the generation of enemy casualties.[14] This made it difficult for the army to master counterinsurgency operations requiring a lower emphasis on lethality (Krepinevich 1986, 5). The army instead preferred search-and-destroy

[13] There is no necessary correlation between organizational age and size. Nevertheless, older organizations are more likely to produce special types of bloated bureaucratic structures that make change difficult.

[14] It is even possible, based on Scott Gartner's work (1997), to argue that the focus on overwhelming firepower might have influenced the army's choice of body counts as its dominant indicator, or metric for success, during the Vietnam War.

missions where it could apply maximum firepower and generate the largest number of casualties (Gartner 1997, 130–31).

The speed and extent of an innovation's spread therefore depends on the relative financial and organizational requirements. Those requiring less to adopt will spread faster than those that require more. Adoption-capacity theory shows, however, that the levels of financial intensity and organizational capital required to adopt an innovation not only significantly influence the rate and extent of its spread throughout the international system but also drive its affect on international politics. Since it is generally easier to adopt the physical technologies associated with an innovation than the overall system of fighting, innovations featuring especially high levels of financial intensity are likely to spread, albeit slowly. In particular, financially intense innovations requiring organizational changes that sustain, rather than disrupt, previous critical tasks are likely to spread gradually but consistently, benefiting the preexisting strongest and wealthiest states in the international system. While preinnovation major powers lacking the financial capacity to adopt are likely to slip and become second-rate powers, the innovation is unlikely to reorient systemwide power balances. In contrast, innovations requiring disruptive organizational transformations but relatively reasonable financial investments, like blitzkrieg, the German combination of the radio, airplane, tank, and other motorized vehicles, will spread haltingly, with only a few states adopting the full innovation, and most acquiring some of its technical components but not adopting the new system of warfare. Innovations requiring large degrees of disruptive organizational change most clearly create strategic openings for power transitions and generate larger first-mover advantages. New powers that master the necessary organizational changes can gain an advantage over their potentially bigger though less nimble major power opponents.

Essentially, new major military innovations can create discontinuities in international politics, ushering in the risky situations described by Robert Powell (1999, 85, 199) where the actual balance of power sharply diverges from the distribution of benefits in the international system, because the system has not yet caught up to the new power realities. If a rising power develops a new innovation, it may gain an enormous edge in its drive to the top. In response, status quo powers that can quickly mimic and adapt to new military innovations or respond with their own new innovations have the best chance of limiting the disruptive impact of the innovation as well as maintaining their relative power level in the face of a challenge (Gilpin 1981, 60–61, 161–62). Sometimes, however, new major military innovations confront major powers, but for financial or organizational reasons they cannot adopt in the short- to medium-term. This presents a major power with a fundamental choice: continue posturing as if it is a major power, or recognize the writing on the wall and seek an alternative strategy that may involve making its interests subsidiary to those of another likely adopter. When states choose the former path, like the Austro-Hungarian

Empire did before World War I, it can destabilize the international system by accentuating informational gaps in national analyses of likely war outcomes. The resulting gap between beliefs and reality are a common cause of war because they make miscalculation and escalation more likely on all sides.[15]

Adoption-capacity theory is also useful for explaining the behavior of nonstate actors, as chapter 6 highlights. Like conventional militaries, insurgent and terrorist groups must make decisions about resource allocations and the organization of their forces. Financial intensity and organizational capital are useful metrics for understanding the strategic choices of terrorist groups in the suicide terrorism era. Those groups with critical tasks based in particular operational methods and that existed long before the beginning of the modern age of suicide terror faced substantial hurdles to adopting the innovation. The PIRA and ETA never adopted, for example, while it took Fatah, a key part of the Palestinian Liberation Organization (PLO), nearly twenty years to adopt. In contrast, groups with younger organizational ages and less defined critical tasks, from the broad tactical setup of the Tamil Tigers to the cell-based network of Al Qaeda, were more easily able to take advantage of suicide tactics, providing them with a new weapon.

Just as the tacit knowledge required to effectively operate aircraft carriers creates significant organizational obstacles for countries interested in adopting carrier warfare, the availability of instruction in suicide methods or direct geographic proximity to suicide terrorists has constituted a tacit barrier to entry for some terrorist groups. This is not to say that variables like national liberation movements, religion, and/or fighting for popular influence are not motivating factors for the adoption of suicide terrorism. Rather, adoption-capacity theory can explain both the groups that have adopted and why other groups do *not* adopt suicide terrorism—something prior work has rarely addressed. Prior theorizing on terrorist strategy, like that on military innovation, has tended to focus on what drives the interest of terrorist groups in suicide bombing, implicitly assuming that the desire to adopt suicide terrorism is enough to make it happen (Pape 2005). Applying adoption-capacity theory to the case of suicide bombing shows the web of interconnections between groups and the flaws in trying to predict terrorist group behavior without an understanding of the broader linkages between groups.

It is important not to overstate the scope of the theory. There are a variety of reasons why states are interested in innovations, why states adopt innovations, and why states become more or less powerful. Hopefully this book can make a contribution to ongoing debates in the academic and policy worlds about what types of changes are more or less likely to occur in periods of uncertainty about military power.

[15] This argument builds from work on bargaining, information, and war. In particular, see Fearon 1995b.

Importance for the Future of Warfare

While this book is mostly focused on the military innovations of the past, looking forward to the future is useful both as a demonstration of the theory and to show its relevance to ongoing policy debates. Adoption-capacity theory can help explain the way different types of warfare in the future will provoke different types of reactions on the part of responding actors, and benefit or disadvantage different states. This can help provide a framework for discussion by showing how the likely implications for the security environment depend on particular assumptions about the future.

At present, there is a spirited debate occurring around the world about the types of wars most likely in the future. In the United States, the debate about the utility of "network-centric warfare" has given way to one about whether the United States should focus its limited resources on institutionalizing the hard-earned counterinsurgency lessons of Afghanistan and Iraq, or refocus the U.S. military back toward conventional warfare (Boot 2006, 8–9; McMaster 2008, 25–28). Biddle maintains that there is not enough evidence to overturn the prominence of the "modern system" of warfare—the use of firepower, cover, and concealment to take and hold territory in conventional land engagements. Focusing on the dangers of allowing technology to dictate force structure, he states that the modern system is the "orthodox" approach to war, and that scholars and policymakers should be careful before embracing "heterodox" approaches (Biddle 2007b, 463–64). He also notes that many instances viewed as counterinsurgency campaigns, like Lebanon, have actually revolved around the application of conventional modern system principles (Biddle and Friedman 2008).

Thinking that the information age will make a difference in future warfare does not mean excluding the human element or skill on the battlefield. Nor should believing in the human element along with the importance of tactical proficiency or skill mean ignoring the way that the information revolution may shape the realm of the possible in warfare (Gray 2006). One popular and persuasive perspective, promoted most clearly by Frank Hoffman (2007), argues that the future of warfare will be "hybrid," demonstrating facets of both regular and irregular wars, but in an operating environment characterized by the information age.

If the information age, like the Industrial Revolution before it, is likely to have wide-reaching and complicated effects on society, determining its impact on the security environment matters whether the most probable future combat scenarios are potential U.S.-China scenarios in East Asia, land-heavy wars in the Middle East, or quasi–peace enforcement operations around the globe. It is possible that the most likely wars of the future are irregular campaigns featuring land forces, but that there are also significant possible contingencies involving the heavy use of naval and air forces. The impact of the information

age on each of these might be different, just as it might be different for states and nonstate actors.[16]

The U.S. military struggled during the early part of the last decade learning how to fight against insurgents in Afghanistan and Iraq. Yet many who think about the future of military power argue that at the very least, the U.S. military will indefinitely maintain and deepen its conventional military superiority (Brooks and Wohlforth 2008, 27–35; O'Hanlon 2000, 168–69). Acclamatory statements that the U.S. military has already mastered the information age are surely overstated; the United States leads the world in the application of information technology to its military operations, but U.S. military operations over the last decade suggest that the United States has far from mastered the information age. There are several areas where disruptive changes could influence the trajectory of warfare.

At present, the U.S. military has made great strides in precision warfare—the use of new communications and guidance technologies to hit targets more accurately as well as at greater distances than ever before. These capabilities are cited by both counterinsurgency and conventional war advocates as important for the future, although there are disagreements about their relative effectiveness at present. Whether or not these advances are properly categorized as an MMI is a matter of debate. But the initial demonstration of U.S. precision-guided munitions in the Gulf War may have represented the starting point of the ticking innovation clock, like the debut of aircraft carriers by the Royal Navy and/or the introduction of the tank by the Royal Army in World War I, rather than representing a completed, fully functional MMI (Welch 1999, 122). Linear advances in precision warfare up to this point have extended the edge of the U.S. military at conventional operations. Utilizing the innovation requires expensive platforms like bombers and ships, meaning there is a high level of financial intensity required to adopt. Conducting counterinsurgency operations has proven challenging for the U.S. military, however, due to the large-scale organizational challenge of shifting the armed services away from focusing on overwhelming firepower.

Precision warfare, under most foreseeable circumstances, will initially remain costly even as the reliance on major weapons platforms like bombers decreases. The financial intensity required to implement anything like what the U.S. military does today is so high that even a small decrease in unit costs will not allow many more states to actively seek military dominance. Moreover, as long as the

[16] While critics of network-centric warfare, like Frederick Kagan (2006, 389–90), and scholars studying warfare in the information age, such as Peter Dombrowski and Eugene Gholz (2006, 4–6), are certainly right that the information revolution will not necessarily lead to one particular optimal force structure outcome, that doesn't mean the changes wrought by the information age are irrelevant or that the information age is unlikely to matter at all.

core platforms for using precision warfare are linked to the platforms of today, recruiting, training, and organizing modern militaries will look similar.

Advances in areas like robotics and information technologies such as computing could shift the military power status quo, though. If advances in munitions and especially unmanned vehicles begin to make the expensive launching platforms that sit at the core of the U.S. military irrelevant, it could risk large-scale changes in military power balances. If a cargo ship or cargo plane is suddenly just as good for launching a missile at a target as an F-15, the financial intensity requirements for implementation will drop and the organizational capital requirements will increase.[17] In such a situation, militaries may also have to recruit differently—recruiting unmanned aerial vehicle (UAV) pilots who excel at video games instead of "fighter jocks," for example—and train people to conduct different tasks, since they will be operating mostly with joysticks rather than in actual battle spaces with the enemy.

If rising U.S. military capabilities illustrate a path away from the financially intense platforms that currently help ensure U.S. dominance, while also requiring militaries to organize themselves differently to best take advantage of available capabilities, countries such as China and India could find it increasingly possible and attractive to militarily compete with the United States. This low level of financial intensity and high level of organizational capital required to take advantage of the information age in the area of conventional war would then lower the barriers to entry for potential competitors to the U.S. military. Other states in the international system could then acquire the necessary capabilities to begin effectively reducing the military edge of the United States unless the country continues innovating to stay ahead. Possible areas for development include not only robotics, with UAVs as the most obvious manifestation, but cyberwarfare as well. The resulting situation could cause major shifts in the global balance of power as some states benefit and others, unable to implement, are increasingly left behind. Adoption-capacity theory principles help explain the microfoundations underlying the concern by authors like Max Boot (2006) and Singer (2009) about the way the information age could boomerang, allowing other countries to catch up to the United States in the long run.[18]

Just as it will influence warfare between states, the information age is likely to influence the trajectory of actions by nonstate actors. The commercial spread

[17] This could occur because of increases in range and the miniaturization of tasks currently conducted by support planes like the Airborne Early Warning and Control System into next-generation missiles.

[18] This is true whether one wishes to call this sort of development the second stage of precision warfare or something as yet undetermined but related to the combination of materials, information technology, and communications (Kagan 2006, 395).

of Internet access around the world along with the low unit cost of basic computers and laptops mean that any nonstate group with a minimal level of financial support can establish a Web presence that is useful for coordination, communications, and planning (Arquilla and Ronfeldt 2001).

Given that information age innovations are likely to feature low required levels of financial intensity for adoption, it may open the door to the acquisition of key components by nonstate actors as well. Cheaper and more widely available information age technologies could lower the barriers for groups seeking to challenge state authority, meaning it will become increasingly easy for new groups to spring up in virtual environments and to exchange information across borders (Hammes 2004, 207–9, 218). A proliferation of potential target points could foreshadow more dangerous cyberattacks against everything from the control systems at a power plant to the Department of Defense mainframe to Google. Groups will probably form faster, conduct operations, and potentially disappear, only to pop up again in another guise in another "virtual" place—or even another real place.

Again, these predictions are tentative. The information age may end up mattering quite a bit for some types of warfare, but much less for others. The point is that the debate should be about exploring the multiplicity of ways that periods like the information age may shape many different dimensions of warfare. Adoption-capacity theory is a useful tool to help explain the different outcomes likely in different security environments.

Moving Forward

Chapter 2, which follows, lays out what "counts" as a major military innovation and the theory of diffusion briefly explained above. This theoretical argument concludes with a discussion of the cases selected for analysis: British naval innovations in the late nineteenth and early twentieth century, carrier warfare, the advent of nuclear weapons, and suicide bombing. Chapters on each case follow the theoretical chapter. Two of the chapters—the ones on nuclear weapons (chapter 4) and suicide terrorism (chapter 6)—feature quantitative tests, while two—ones on carrier (chapter 3) and battlefleet (chapter 5) warfare—include more qualitative analysis featuring the use of both primary and secondary sources. Each empirical chapter concludes with an examination of the way that the given major military innovation under examination influenced the international security environment, focusing in particular on power balances, the probability/duration of wars, and alliance patterns. The importance of the variables identified by the new theory are compared with explanatory mechanisms from alternatives described in chapter 2.

I test adoption-capacity theory through a multimethod approach to make the overall results more reliable. Additionally, by using rigorous social scientific

methods to study a topic of substantive interest to both academics and policymakers, this study attempts to cross disciplinary lines, and integrate theory and practice (George 1993; Goldman and Eliason 2003b, 22–23).

The conclusion (chapter 7) discusses the implications for scholarly analyses of international relations, and then evaluates claims about the onset of the information age and the ways it may influence the future of warfare. The conclusion describes some crucial issues that are often absent in debates about the future of American defense strategy, and how adoption-capacity theory suggests that the information age may portend a much greater level of risk for U.S. conventional military superiority than some previous authors have envisioned.